The Law of the Rio Chama

San Juan Chama Project, New Mexico
Lower Colorado Basin Region

by The Utton Transboundary Resources Center

Utton Transboundary Resources Center

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Acronyms and Abbreviations

ABCWUA	Albuquerque Bernalillo County Water Utility
AWRM	Active Water Resources Management
BIA	Bureau of Indian Affairs
BiOp	Biological Opinion
CADSWES	Center for Advanced Decision Support for Water and Environmental Systems
Cfs	cubic feet per second
Collaborative Program	Middle Rio Grande Endangered Species Collaborative Program
Compact	Rio Grande Compact of 1938
CRSPA	Colorado River Storage Project Act of 1956
CWA	Conservation Water Agreement
DWP	Drinking Water Project
EDWA	Emergency Drought Water Agreement
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
LFCC	Low Flow Conveyance Channel
MRG	Middle Rio Grande
MRGCD	Middle Rio Grande Conservancy District
msl	mean sea level
NEPA	National Environmental Policy Act
NMISC	New Mexico Interstate Stream Commission
NWSRA	National Wild and Scenic Rivers Act
O&M	operations and maintenance
OSE	Office of State Engineer
P.L.	Public Law
POD	points of diversion
RCFP	Rio Chama Flow Project
PMF	probable maximum flood
Reclamation	Bureau of Reclamation
URGWOM	Upper Rio Grande Water Operations Model
URGWOPS	Upper Rio Grande Water Operations Review
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WCM	Water Control Manual
WEG	WildEarth Guardians
WRDA	Water Resources Development Act

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I. INTRODUCTION

Global climate change-type drought is driving water management innovation in New Mexico. In the winter of 2017–2018, snowpack in the Rio Grande Basin was at a historic low; the Rio Grande at Albuquerque dried in parts as early as April.[1] As of September 20, 2017, Elephant Butte Reservoir storage was roughly three percent of total capacity, approximately 60,000 acre-feet.[2] Spurred by these ongoing exceptional conditions, a historic partnership comprised of the Audubon Society, Pueblos, and municipalities collaborated the following summer to release nearly 1,000 acre-feet of water to keep a stretch of the Middle Rio Grande (MRG) from drying.[3] Later in the summer irrigation season, the Bureau of Reclamation (Reclamation) leased roughly 20,000 acre-feet of water from the Albuquerque Bernalillo County Water Utility (ABCWUA, or Authority) to maintain Rio Grande flows—at a cost of about $2 million.[4] Guiding and constraining such innovative responses to the exigent hydrologic circumstances is the "Law of the River," the legal and policy infrastructure that governs water operations.

This report summarizes the findings of an investigation by the Utton Center to explore the constraints of, and flexibilities inherent within, the Law of the River.[5] Through this investigation,[6] we have attempted to identify and characterize the most salient constraints and flexibilities. The context for this effort is the Rio Grande Basin, a complex, interconnected system. The core of our analysis focuses on the Rio Chama, a principal tributary to the Rio Grande, where three reservoirs (Heron, El Vado, and Abiquiu) of system-wide import are located. In order to analyze reservoir operations in a simplified system, the Rio Chama Flow [Optimization] Project has focused solely on the stretch of Rio Chama between El Vado and Abiquiu Reservoir. Of course, neither the Rio Chama nor this legal analysis of reservoir operations optimization exist in a vacuum. In compiling the Law of the River for Rio Chama, we drew from interconnected elements of the laws of the Rio Grande and the Colorado River.

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[1] *See also* Laura Paskus, It's Only April and a Stretch of the Rio Grande Has Already Dried, N.M. Political Rep't (Apr. 8, 2018), http://nmpoliticalreport.com/822352/its-only-april-and-a-stretch-of-the-rio-grande-has-already-dried-en/; Henry Fountain, In a Warming West, The Rio Grande is Drying Up, N.Y. Times (May 24, 2018), https://www.nytimes.com/interactive/2018/05/24/climate/dry-rio-grande.html.

[2] Laura Paskus, WATER DEEPLY, *As New Mexico Reservoirs Hit Bottom, Worries Grow Over the Future* (Sept. 25, 2018), https://www.newsdeeply.com/water/articles/2018/09/25/as-new-mexico-Reservoirs-hit-bottom-worries-grow-over-the-future.

[3] *See* Press Release, Audubon New Mexico, In Historic Partnership Audubon and New Mexico Municipalities Release Water to Recharge Vital Habitat Along the Rio Grande (July 17, 2018), http://nm.audubon.org/press-release/historic-partnership-audubon-and-new-mexico-municipalities-release-water-recharge; *see also* Press Release, Audubon New Mexico, Audubon Announces Historic Water Release to the Middle Rio Grande (Sept. 7, 2016), http://nm.audubon.org/press-release/audubon-announces-historic-water-release-middle-rio-grande.

[4] Press Release, Reclamation, *Water Managers Partner to Preserve Middle Rio Grande Flows* (Aug. 22, 2018), https://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=63104.

[5] RIO CHAMA FLOW PROJECT, *Draft Proposal* (Nov. 13, 2015), at 1 [hereinafter RCFP Proposal]; *see also id*. at 4 (scope of legal analysis).

[6] The investigation comprised scoping and mapping exercises to determine relevant law as well as evaluation of both the "hard law" (i.e., law on the books) and "soft-law" (i.e., law-in-action).

Our case study of the Rio Chama offers insights into the operations of a "novel [eco]system" as well as man's attempts to optimize it.[7] Rio Chama mirrors many features of the Rio Grande. For example, in its short course, the Rio Chama is dammed twice and receives water from an off-channel reservoir that equalizes imported supplies from the Colorado River Basin. This infrastructure provides water and flood control for the Albuquerque metro area, including the Middle Rio Grande Conservancy District (MRGCD), one of the largest suppliers of irrigation water in the state. Rio Chama also conveys water imported across the Continental Divide from the Colorado River Basin, as part of Reclamation's San Juan-Chama Project; this Project water is destined primarily for the ABCWUA and the MRGCD. Rio Chama thus regularly flows at greater-than-historical levels by a large margin. This is a unique occurrence in the arid West. The San Juan-Chama Project's annual "firm-yield" of nearly 100,000 acre-feet flows from Reclamation's Heron Reservoir, through MRGCD's El Vado Reservoir, and then through a U.S. Army Corps of Engineers (USACE) flood management reservoir (Abiquiu Reservoir), before finally being released for use in the Rio Grande's middle valley near Albuquerque.

Like the Rio Grande Basin of which it is a part, Rio Chama is a complex[8] socio-ecological[9] system where geography, hydrology, law, economics, and policy and management decisions control the flow and allocation of water. Modeling the larger, encapsulating Rio Grande system requires 180 discrete policy rules.[10] The legal, policy, and management framework of the Rio Grande Basin's New Mexico reservoirs (three of the five reservoirs are located on Rio Chama) was laid out in a special issue of the University of New Mexico's *Natural Resources Journal*. Not surprisingly, uncertainty also abounds in this complex

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[7] Mike Harvey, RIO CHAMA FLOW [OPTIMIZATION] PROJECT, *2016 Pulse Flow: "Resolution Hydrograph"* (Oct. 12, 2016) (PowerPoint presentation, given at *Rio Chama Flow Project Advisory Council Meeting*) (on file with author) (characterizing the Rio Chama as a "novel system" that has been triply dammed, but receives an influx of "new" San Juan-Chama Project water diverted from the Colorado River Basin).

[8] *See, e.g.*, G. Emlen Hall, *The Middle Rio Grande—Short on Water, Long on Legal Uncertainties*, in N.M. BUREAU OF GEOLOGY AND MINERAL RESOURCES, *Decision-Makers Guide: Water Resources of the Middle Rio Grande: San Acacia to Elephant Butte*, Chap. 2, at 54, 54-62. (L. Greer Price, Peggy S. Johnson, and Douglas Bland eds., 2007) [hereinafter Hall (2007)] (providing an overview of the "many basic facts about legal claims to the Middle Rio Grande [that] we [don't] know"); *see generally* William K. Jaeger, et al., *Water—Finding Water Scarcity Amid Abundance Using Human-Natural Models*, in PROCEEDINGS OF THE NAT'L ACAD. OF SCIENCES EARLY EDITION (accepted Sept. 20, 2017), at 2, fig. 1 [hereinafter Jaeger, *Finding Water Scarcity*] (diagram components and linkages for model of Willamette River hydrological/economic/legal system, which contains multiple Reservoirs and water uses).

[9] *See, e.g.*, Melinda Harm Benson, et al., *Water Governance Challenges in New Mexico's Middle Rio Grande Valley: A Resilience Assessment*, 51 IDAHO L. REV. 195, 205–18 (2014) (analyzing elements as well as key interactions as thresholds of social and ecological elements of the Middle Rio Grande, including their associated "drivers and disturbances") [hereinafter M.H. Benson (2014)].

[10] Craig Boroughs, *Upper Rio Grande Water Operations Model (URGWOM): RiverWare Ruleset Documentation, Version 5.0.2* (Sept. 12, 2013), at 4–5 [hereinafter URGWOM Ruleset] (noting policy for operating water storage and diversion facilities along the Rio Grande and Rio Chama represented in URGWOM in 46 different policy groups and 180 specifically coded rules).

system, as in any system of water rights or uses.[11] Within this complex system, reservoir operations[12] may be ripe for more flexible, optimized configurations.[13] In the face of water-short conditions, such configurations should offer both resiliency and adaptive capacity.

Despite the importation of water from the Colorado River Basin, the middle valley of the Rio Grande remains perennially water short and water management collaboration has progressed haltingly. The sum of various individual legal uncertainties, such as the nature and extent of Pueblo and MRGCD water rights, has superimposed a "legal scarcity" on top of natural water scarcity.[14] Despite a narrative of collaboration gaining traction,[15] in the years following commencement of the Rio Grande silvery minnow litigation and issuance of the 2003 Biological Opinion (BiOp), major stakeholders could not even agree on which *scenarios* of reservoir operations to model to optimize water management (e.g., URGWOM).[16] In contrast to the lack of consensus regarding the desirability, feasibility, and legal underpinnings of alternative water and reservoir operations in the Middle and Upper Rio Grande, there is scientific consensus on the need to manage this surface water system for keystone ecological processes.[17] Aquatic biology and riparian ecology, as it turns out, cannot be separated from the *human* ecology of the river.

According to author and conservationist William DeBuys, the biggest challenge in effectively managing the Rio Grande is political.[18] Notwithstanding the tremendous technical work done on the Rio Grande, there likely will never be full agreement regarding operational models of this system, due to some non-

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[11] *See, e.g.*, William De Buys, *Navigating the River of our Future: The Rio Poco-Grande*, 41 NAT. RESOURCES J. 265, 277 (2001), https://digitalrepository.unm.edu/nrj/vol41/iss2/2/ [hereinafter De Buys (2001)] ("uncertainty abounds" in "any cluster or water rights and uses").

[12] *See generally* Susan Kelly and Diego Urbina, *New Mexico Major Reservoirs: An Overview* (2011), in UTTON CTR., *WATER MATTERS!*, at 20-1–20-18 [hereinafter Kelly & Urbina, *Reservoirs Overview*].

[13] *See, e.g.*, Adell L. Amos, *Developing the Law of the River: The Integration of Law and Policy into Hydrologic and Socio-economic Modeling Efforts in the Willamette River Basin*, 62 Kan. L. Rev. 1091, 1132 ("Once these flexibilities are represented, they will facilitate the investigation of the resiliency and adaptive capacity inherent within the current legal system and identify where changes to law and policy might be most effective."); De Buys, *supra* note 11, at 277 (". . . there is flex in the system").

[14] Hall, *supra* note 8, at 57 ("The sum of all of these uncertainties—the nature and extent of pueblo and MRGCD rights, the source of rights for increasing municipal demand, the unintended consequences of changes to policies—is even greater uncertainty"); De Buys, *supra* note 11, at 277 ("Every system leaks. Most systems operate as much on assumptions as hard data, and only rarely are those assumptions entirely correct.").

[15] *See generally* JOHN FLECK, WATER IS FOR FIGHTING OVER: AND OTHER MYTHS ABOUT WATER IN THE WEST (2016).

[16] Susan Kelly, *Modeling Reservoir Storage Scenarios by Consensus*, 47 NATURAL RES. J. 651, 663–71 (2007) [hereinafter Kelly (2007(b), *Modeling Reservoir Storage*].

[17] De Buys, *supra* note 11, at 268, 270–71, 274 (describing "keystone processes" and their ecological significance and arguing that environmental river management should manage for keystone processes by, *inter alia*, providing flows which mimic the natural hydrograph); *see also* Ryan Morrison, *Managing Complex Water Resource Systems for Ecological Integrity: Evaluating Tradeoffs and Uncertainty*, Ph.D. Diss. (Univ. of N.M., May 2014), at App. A (environmental flows background).

[18] I.e., the Middle Rio Grande's "most daunting problem[.]" De Buys, *supra* note 11, at 277–78.

quantifiable aspects of decision-making.[19] These models, such as the Upper Rio Grande Water Operations Model (URGWOM) used by agencies such as Reclamation and USACE, represent powerful and sophisticated planning, predictive, and accounting capabilities. They are based on current knowledge—scientific and otherwise. One major underpinning of such models is the legal infrastructure that dictates many operational rules. But while many legal mandates, such as provisions of the Rio Grande Compact or reservoirs' authorizing legislation, translate neatly into operational requirements and water accounting schemes, assumptions may be built into the model's representation of other legal authorities. Further, water management and reservoir operations take place within a decision-making continuum ranging from professional judgment to multi-stakeholder negotiation and collaboration. Within this discretionary space, where water managers and regulators may differ in the particulars, taking different approaches may not violate the Law of the Rio Chama.

Water resources management, as well as concomitant efforts in agriculture, conservation, and climate adaptation, is neutrally governed by our inherited geography. Under this view, the Rio Grande silvery minnow that has spawned prodigious litigation efforts, but also collaborative efforts, is a blessing, not a curse.[20] The minnow's existence is a function of its unique, arid geography. It has been a disruptive force incentivizing needed climate adaptation, efforts to increase water management resilience, and cooperation. The premise of this work is that optimized reservoir operations, like actions taken to support the life cycle of the minnow, need not be a zero-sum game.

This report represents an attempt to integrate law and policy into collaborative efforts[21] of stakeholders to manage flows of the Rio Chama for multiple purposes.[22] First, it is intended to be a "fresh look" at the well-trodden components of the law of the rivers—such as the legislative underpinnings of water storage in and release from Heron, El Vado, Abiquiu Reservoirs.[23] Second, it is intended to be an innovative mapping exercise, incorporating those "soft law" components of the law of the river which have largely escaped detailed analysis, i.e., policy, management, and operations. We intend that the most salient of our conclusions be incorporated into the Rio Chama Flow Project's analyses and considerations. Such modeling efforts would go beyond those of the Upper Rio Grande Water Operations Review and Environmental Impact Statement in 2007 (URGWOPS EIS), which, for example, did not consider water ownership in modeling reservoir operations flexibility on the Rio Chama.[24]

[19] *Id*. at 279 (arguing this situation "effectively throws decision making into the political and economic sphere").

[20] *Id*. at 280.

[21] For an example of similar work in Oregon, *see generally* Amos, *supra* note 13. *See also* Jaeger, *Finding Water Scarcity*, *supra* note 8.

[22] Ranging from, for example, acequia interests downstream of Abiquiu Reservoir to the USACE, whose flood control management decisions could affect the integrity of acequia diversion structures.

[23] For another example of such an approach, *see generally* Victor Flatt & Jeremy Tarr, *Adaptation, Legal Resiliency, and the U.S. Army Corps of Engineers: Managing Water Supply in a Climate-Altered World*, 89 N.C. L. REV. 1499, Pt. III (2011) (taking a "fresh look" at legal authority for USACE' dam management).

[24] *See* Boroughs at 10.

This work is also intended to be used as a tool for adaptive management of a complex system.[25] First, it aims to prevent institutional and operational constraints to modifying flows and storage from becoming fixed and inflexible.[26] Next, it attempts to contribute to a portfolio of flexible water management strategies. Finally, it memorializes—that is, documents, analyzes, and highlights—actual examples of reservoir operations flexibility. Throughout, we characterize the historical basis for many operational constraints in order to show how related assumptions may not be invalid.[27] We also show how discretion is regularly exercised by water managers, recognizing this flexibility paradigm occurs within existing legal authority and options for its extension.

II. BACKGROUND

A. Objective and Methodology

Broadly speaking, the Rio Chama Flow Project's (RCFP, or Project) seeks to achieve environmental and recreational improvement on the roughly 35-mile-long stretch of Rio Chama between El Vado and Abiquiu Reservoirs. To do so, the Project set out to identify feasible changes in the operations of Heron and El Vado Reservoirs that do not affect downstream water users. This complex operational setting provides a unique opportunity to develop optimized hydrographs ("multi-objective flow optimizations schedules") depending on water availability, the most critical among many constraints. Ultimately, the Project intends to foster a collaborative determination of water operations based on multi-disciplinary science and sustainable policy. Building on baseline studies (e.g., hydrology, geomorphology, system dynamics modeling), the Project is currently undertaking modeling efforts to incorporate an enhanced understanding of the operational, legal, and institutional constraints on optimization reservoir operations.[28]

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[25] *See generally* Kathleen Moore, *Optimizing Reservoir Operations to Adapt to 21st Century Expectations of Climate and Social Change in the Willamette River Basin, Oregon*, Ph.D. Diss. (Oregon St. Univ., June 2015); Mary Tchamkina, *Evaluating the Need for Adaptation for U.S. Army Corps of Engineers Wilmington District Reservoirs*, Masters Thesis (Duke Univ., April 2016); *see also* RCFP Proposal, *supra* note 5, at 1 (intended outcomes); *id*. at 4 (noting goal of legal analysis to "prevent...institutional and operational constraints to modifying flows and storage" from becoming "fixed and inflexible") (noting previous work: Melinda Harm Benson, Ryan Morrison, and Mark Stone, *A Classification Framework for Running Adaptive Management Rapids*, 18 ECOLOGY & SOC'Y, No. 3, Art. 30, at [PDF] pp. 3-8, esp. tbls. 2, 3 (2013) (presenting a conceptual model for adaptive management and river restoration in the context of the Rio Chama) [hereinafter M.H. Benson (2013)].

[26] *See, e.g.*, Flatt & Tarr, *supra* note 23, at Pts. IV, V (analyzing legal authority for USACE's Reservoir operations with eye to (a) "preserving flexibility by exercising discretionary authority in inherent in common Corps' decisions" and "recognizing the flexibility paradigm and making it operational").

[27] M.H. Benson (2014), *supra* note 9, at 218–21 (suggesting avenues for "more flexible and adaptive strategies for water storage and delivery," highlighting institutional constraints (including operations restrictions at Heron and El Vado but noting that "changes are possible," giving the example of ca. 2007–10 Cochiti Deviation(s) and historical basis of many constraints, including "many...assumptions...[which] are now known to be invalid");

[28] RCFP Proposal, *supra* note 5, at 1 (intended outcomes); *id*. at 4 (noting goal of legal analysis to "prevent...institutional and operational constraints to modifying flows and storage" from becoming "fixed and inflexible").

Following the work of Benson, et. al. (2013),[29] and many others,[30] this report analyzes the legal constraints and opportunities for flexibility in reservoir operations on Rio Chama. In doing so, it does not focus on individual conflicts but instead attempts to treat the system as a whole. To that end, we map and evaluate both real and perceived limitations. (These include prevailing Federal reservoir authorizing legislation and state water law, along with regulation, management, policy, and operations).

We intend this work to facilitate transparency, to clarify decision-making and accurately inform water users, managers, and citizens; our compilation of "Law of the River" for Rio Chama, which underlies our legal analysis, will be available through the Utton Center's website.[31] This law of the river is a collection of treaties, interstate compacts, statutes, court decisions, regulations, and contracts generated over more than 100 years of conflict regarding the allocation of the Rio Grande and its tributaries. While there is not necessarily a definitive version of the Law of the River for the Rio Grande or the Rio Chama, the Utton Center's compilation may be the first Law of the Rio Chama to be compiled in database form, complete with explanatory annotations and relevant "gray" literature that assists in understanding the law.

The literature review phase began with a broad orientation to interstate compact law, including an overview of the Rio Grande Compact's provisions accounting for debits and credits, as well as the "relinquishment" of accrued credits in certain situations that allows storage in reservoirs such as El Vado despite standing restrictions.[32] Our review next canvassed the literature on reservoir operations, using the *Natural Resources Journal*'s 2007 symposium on New Mexico reservoirs as a starting point. That symposium resulted in articles covering a range of reservoir operations issues, including: the legal framework, legislative and litigation history, conservation storage at Abiquiu, modeling reservoir storage, Rio Grande silvery minnow litigation, carryover storage and Indian pueblo water rights, and "Prior and Paramount" water rights.

As the literature review progressed, orienting progressively to primary authorities—e.g., congressional authorizations of the reservoirs[33]—a database of the resulting Law of the River and gray literature took

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[29] M.H. Benson (2013), *supra* note 25.

[30] The source of international and interstate conflict going back at least 120 years, the Rio Grande Basin is well characterized. *See* DOUGLAS LITTLEFIELD, CONFLICT ON THE RIO GRANDE: WATER AND THE LAW, 1879-1939 (Univ. of Okla. Press, 2008).

[31] uttoncenter.unm.edu

[32] Colin McKenzie, UTTON CTR., *Interstate Compact Law* (June 29, 2015) [hereinafter McKenzie (2015a); Colin McKenzie, UTTON CTR., *Relinquishment Credit Water Allocation* (Sept. 1, 2015) [hereinafter McKenzie (2015b)].

[33] A broad view of these legal authorities would include, *inter alia*: project authorizing statutes, programmatic statutes, applicable Federal environmental law, and regulatory authority such as USACE's water control manuals and water control plans; Reclamation's water supply contracts, as well as state water law. *See* Amos, *supra* note 13, at 1137–38 (noting that an approach to investigating Reservoir operations flexibility would [1] "build a description of the statutory and regulatory authorities that govern the operation of the Federal Reservoirs managed on the Willamette River and the non-Reservoir statutory and regulatory frameworks that impact the Reservoir operations"; [2] "catalog and describe the relevant Federal court decisions that impact the exercise of discretionary legal authority on the part of the relevant Federal agencies on the Willamette River"'; and [3] involve "interviews to better understand the process used by the relevant agencies to determine how and when to exercise available discretionary authority."); *see also generally* Reed Benson, *Reviewing Reservoir Operations: Can Federal Water Projects Adapt to Change?*, 42 COLUMBIA J. ENVT'L L. 353, 368–84 (2017) (providing an overview of legal factors affecting dam operations in the West) [hereinafter R. Benson (2017)].

shape. In its current form, this information is housed in: one hierarchical database containing sources, an annotated outline, and compilation of primary provisions of the Law of the River, and an annotated bibliography that serves as a "guide" to the Law of the River.[34] The primary provisions of the Law of the River captured by this database encompass legal regimes that correspond to multiple sovereigns: the United States and Mexico; Colorado, New Mexico, and Texas and at least six Middle Rio Grande Pueblos. The Law of the River thus captures elements of international law and U.S. Federal law, as well as contracts—Federal, State, and private—between these various government and other private entities. Substantively, the Law of River encompasses, *inter alia*, water law, environmental law, and Indian law. Primary provisions of the Law of the River are summarized in Attachment A. Table 1.[35]

In addition to these primary authorities, sundry regulations, agreements, and other provisions drive the storage and release of water from reservoirs on the Rio Chama and Rio Grande. This physical water storage and delivery infrastructure is primarily managed by Reclamation and the USACE, along with MRGCD. These water management agencies, therefore, figure prominently into the operational aspects of the Law of the River. Accordingly, the Law of the River database, as our analysis, can be conceptually divided into two parts: (1) "Hard law," i.e., treaties, statutes, and case law;[36] and (2) "soft law," i.e., regulation, policy, management, and operations.[37] A summary of these "soft law" provisions is presented in Attachment A. Table 2 which contains excerpts of key water management decisions from 2000 to present, an extended drought and legal conditions in the Rio Grande Basin, including a legal scarcity driven by Endangered Species Act (ESA) compliance. Attachment A. Table 3 presents excerpts from Engineer Advisers' Report in Rio Grande Compact Commission Annual Reports, 2000 to 2019.

The legal analysis contained in this report represents both a synthesis of the Law of the River and a response to the first order question: What authorities, statutory and regulatory, govern reservoir operations—i.e., storage and release of water? Our review of operations over the past 20 years allowed us to form a conceptual understanding of the system, comprising mainly "hard law" along with policy and operations. Thus situated, the RCFP project team was able to contextualize key regulatory, water management, and reservoir operations decisions—such as Rio Grande Compact Commission Resolutions, which have authorized deviations from the congressionally mandated "Reservoir Regulation Plan" for the Middle Rio Grande Project Reservoir. This sort of operational and historical contextualization also extended to the technical realm. We were, for example, able to identify precisely the priority with which

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[34] *See* UTTON CTR., *Law of the River Database: Sources* (last updated Sept. 7, 2018) (on file with Utton Center); UTTON CTR., *Law of the River: Annotated Bibliography* (Sept. 10, 2018) (selected grey literature) (on file with Utton Center).

[35] [*Internal note:* styled after ENCOURAGE CAPITAL & SQUIRE PATTON BOGGS, *Liquid Assets* 60-61]

[36] McKenzie, UTTON CTR., *Law of the River: Outline and Compilation* (July 4, 2018) ("hard law").

[37] UTTON CTR., *Law of the River: Policy and Operations* (May 23, 2018) ("soft law" comprising tabular presentation of experts from (1) Engineer Advisors' Reports from the Rio Grande Compact Commission's Annual Report, 2000–16, and (2) Bureau of Reclamation's Annual Reports to the Rio Grande Compact Commission) [hereinafter UTTON CTR. (2018a)]; UTTON CTR., *Law of the River*: *URGWOM Annotated Ruleset* (Sept. 2018) (on file with Utton Center) (summary presentation of operative policy rules from 2013 Riverware ruleset documentation, including explanatory annotations and citations to relevant legal authority) [hereinafter *URGWOM Annotated Ruleset*]

[*Internal note:* Utton Ctr., Law of the River: Policy and Operations (May 23, 2018) (tabular presentation of experts from (1) Engineer Advisors' Reports from the Rio Grande Compact Commission's Annual Report, 2000–16, and (2) Bureau of Reclamation's Annual Reports to the Rio Grande Compact Commission]

Reclamation treats key "policy rules" in their modeling efforts using URGWOM. These policy rules are grounded in legal authority, but their application takes place in a discretionary technical space. Transparency regarding this sort of "law in action," through a process of "unpacking" and memorializing, was a key component in our analysis process.

By unpacking the different layers of reservoir operations and related law, policy, and management decisions, we were able to identify key threshold interactions[38] that define the behavior of complex socio-ecological systems such as Rio Chama. Having identified these "boundary conditions,"[39] we focused our investigation on key relationships and agreements, which we term "work-arounds." It has become apparent that water allocation in the West is as much determined by these work-arounds as it is by the Law of the Rivers' "black letter" law.[40] This focus permits evaluation of where operational flexibility lies within the existing legal infrastructure.

The premise of this analytical approach is that there is inherent flexibility within the water management system. This type of flexibility, however, is non-linear, involves multiple "colors" of water, tends to be transactional, and often occurs "off balance sheet." Sometimes this flexibility is the result of private negotiations and thus not a binding precedent; other times it is the result of "horse trading." Regularly, it occurs as a function of ground-level water managers diligent and daily operations coordination, which involves multiple water users and government agencies. This sort of flexibility has not lent itself to description and exploration—and the results of individual laws and conflicts which dominate water law;[41] nonetheless, it embodies the most important and dynamic boundary conditions which govern the Rio Chama as a system.

Having considered some of the key liminal relationships, agreements, and legal parameters which govern the importation, flow, storage, release, and subsequent diversion of water on the Rio Chama, we generated specific research questions. These questions guided, as well as narrowed, our legal analysis. For example:

- What is the nature and extent of discretionary authorities given to water managers in this system?
- What processes govern agency application of discretionary authority to manage flow?
- To what extent is discretion controlled by legal requirements as opposed to professional judgment?

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[38] *See* M.H. Benson (2014), *supra* note 9, at 215-18 (characterizing "key interaction and thresholds" in Middle Rio Grande socio-ecological system such as river channelization and changes in the natural hydrograph, including an earlier peak runoff).

[39] *See* Barbara Cosens, Panel Comments, CANADIAN COUNCIL ON INT'L LAW CONFERENCE, *Crisis, Resilience, and the Reformation of the International Law on Sustainable Development* (Nov. 2012), http://lawprofessors.typepad.com/environmental_law/2013/02/perspectives-on-crisis-resilience-and-the-reformation-of-the-international-law-on-sustainable-develo.html (noting importance of boundary conditions—i.e., how the behavior of interconnected systems is defined by how they interact—in analyzing complex systems, from geochemistry to geomorphology); *see also* Roberto Mangabeira Unger, *Legal Analysis as Institutional Imagination*, in LAW, SOC'Y, AND ECONOMY: CENTENARY ESSAYS FOR THE LONDON SCH. OF ECON., at 184–5 (noting impact of reforms in the "institutional and ideological context of political and economic life" —e.g., social democracy in Europe; the New Deal in America; and Keynesianism—on setting the "boundary conditions" within which society organizes and "understands and defends their interests.")

[40] *See generally* Fleck, *supra* note 15.

[41] *Id*.; Amos, *supra* note 13, at 1095–96.

- Finally, what is the magnitude of variability in flows derived from existing (or past) discretionary authority.[42]

Water law and policy scholars have consistently argued that reservoir operations are ripe for taking a "fresh look" with the goal of identifying management flexibility and discretionary operations. For example, Benson (2007) contends that Reclamation's operation of water projects is an "[i]nherently [d]iscretionary [a]ctivity."[43] Flatt and Tarr claim (2011), similarly, that there is discretionary authority inherent in the USACE's decisions.[44] And Amos (2014) proposes that "there is inherent discretionary authority in the existing structure of water law" that "has not been fully explored or implemented" and that "may provide the adaptive capacity to address changed future circumstances."[45] This report furthers those arguments, presenting operational examples of this flexibility paradigm. We map the operational aspects and legal underpinnings of such water management and reservoir operations innovations as:

1) drought agreements for "conservation storage" of water;
2) voluntary water transfers and complex water management actions; and,
3) temporary re-operation of flood-control reservoirs for spring "pulse flows" on the Rio Chama and Rio Grande.

In these case studies, we see that changes to the ostensibly ossified law of reservoir operations are possible. We note where there is a historical basis for certain assumptions; we also note where assumptions are either known to be, or may be, invalid. Finally, with an eye to coupling law and modeling efforts, we identify areas ripe for future investigation in terms of the physical, infrastructural, institutional, and climatological variables at play in existing and prospective sources of discretionary authority.

This work clearly reveals a complex multi-jurisdictional space, a case study in polycentric governance. Western water law—even without the overlay of, for example, environmental law and the sovereignty, livelihood, and economic development needs of Native American Tribes and Pueblos—is a fragmented jurisdictional space.[46] Combined with the new exigency of ESA requirements amidst prolonged drought, the resulting political and economic risk is significant. This risk has manifested recently in the protracted litigation over the endangered Rio Grande silvery minnow and a pending U.S. Supreme Court suit

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[42] For a treatment of these questions in the context of the Willamette Basin in Oregon, *see* Amos, *supra* note 13, at 1137.

[43] Reed Benson, *Dams, Duties, and Discretion: Bureau of Reclamation Water Project Operations and the Endangered Species Act*, 33 COLUMBIA J. ENVT'L L. 1, 40-43 (2007).

[44] Flatt & Tarr, *supra* note 23, at Pts. IV, V.

[45] Amos, *supra* note 13, at n.18 and accompanying text (citing J.B. Ruhl, *General Design Principles for Resilience and Adaptive Capacity in Legal Systems—with Applications to Climate Change Adaptation*, 89 N.C. L. REV. 1373, 1388–93 (2011); Barbara Cosens, *Transboundary River Governance in the Face of Uncertainty: Resilience Theory and the Columbia River Treaty*, 30 J. LAND RES. & ENVTL. L. 229 (2010).

[46] *See, e.g.,* Kundis Craig, *Climate Change, Regulatory Fragmentation, and Water Triage*, 79 U. COLO. L. REV. 825 (2008); Robert Adler & Michele Straube, *Watersheds and the Integration of U.S. Water Law and Policy: Bridging the Great Divides*, 25 WM. & MARY ENVTL. L. & POL'Y REV. 1 (2000) (cited in Amos, *supra* note 13, at n.6).

between Texas and New Mexico over interstate allocation of river.[47] The Rio Grande Basin in New Mexico is, therefore, an important venue for this type of research.

B. Geographic and Institutional Setting

1. Geographical and Historical Overview[48]

This article focuses on the Rio Grande's principal tributary, the Rio Chama, but also necessarily involves a treatment of the Rio Grande from Española, in northern New Mexico at its confluence with Rio Chama, through the middle Rio Grande valley, from Cochiti Reservoir to Elephant Butte. The geology, history, geography, and ecology of the Rio Grande Basin yield an appropriate—and unique—setting for studying reservoir operations, their legal framework, and the potential adaptive capacity of each in the face of global changes. Diversity produces resilience,[49] and the Rio Grande Basin has a rich history that is characterized by geographic and cultural diversity.[50] Geographically, the headwaters of the Rio Grande lie above the treeline in the southern reaches of the Rocky Mountains. From there, the river gains as it flows through the parched Colorado Plateau of northern New Mexico and feeds the Pueblo civilizations, as well as newer Anglo developments in the Middle Rio Grande from Albuquerque to Socorro, roughly. Prior to forming the international boundary between Mexico and the United States, the Rio Grande provides for extensive irrigated agriculture in the northern reaches of the Chihuahuan Desert; from source to sea, the Rio Grande flows 1,896 miles.[51]

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[47] Perhaps a tacit acknowledgment of this reality, New Mexicans have in recent years often been tapped as Commissioner for Reclamation, the agency's top position. *See* BUREAU OF RECLAMATION, *Commissioners of Reclamation* (March 1, 2018), https://www.usbr.gov/history/commiss.html (listing all Reclamation Commissioners, including New Mexicans Eluid Martinez, Michael Connor, and Estevan López—three of the last six, since 1995).

[48] SQUIRE PATTON BOGGS AND ENCOURAGE CAPITAL, *Liquid Assets: Investing for Impact in the Colorado River Basin* (2015) [hereinafter SPB, *Liquid Assets* (2015)].

[49] In other words, diversity—of ecology, landscapes, cultures, politics, for example—demands and thus produces resilience. *See, e.g.,* Thomas Friedman, Interview, LIVING ON EARTH (Dec. 16, 2016), http://www.loe.org/shows/segments.html?programID=16-P13-00051&segmentID=6. *Cf.* M.H. Benson (2014), *supra* note 9, at 198 (noting the contrast, in explaining how under resilience theory, regime shift causes transformation—both ecologically and politically).

[50] *See generally* FRED M. PHILLIPS, G. EMLEN HALL, AND MARY E. BLACK, REINING IN THE RIO GRANDE: PEOPLE, LAND, AND WATER (paperback, 2015) [hereinafter REINING IN THE RIO GRANDE]; PAUL HORGAN, GREAT RIVER: THE RIO GRANDE IN NORTH AMERICAN HISTORY (1991); IRA G. CLARK, WATER IN NEW MEXICO: A HISTORY OF ITS MANAGEMENT AND USE (1st ed., 2nd printing, 2002) [hereinafter WATER IN NEW MEXICO]. *See also* Steve Harris, *Long River, Short Water: The Rio Grande Water Development Story*, in N.M. BUREAU OF GEOLOGY AND MINERAL RESOURCES, *Decision-Makers Guide: Water Resources of the Middle Rio Grande: San Acacia to Elephant Butte*, Chap. 1, at 7, 7-14 (L. Greer Price, Peggy S. Johnson, and Douglas Bland, eds., 2007) [hereinafter Harris (2007)]; Hall (2007), *supra* note 8, at 54–57; M.H. Benson (2014), *supra* note 9, at 199–200 (providing an overview of historical background); RECLAMATION, WEST-WIDE CLIMATE RISK ASSESSMENT: UPPER RIO GRANDE IMPACT ASSESSMENT (Dec. 2013), at App. A, A-1–A-3 [hereinafter CLIMATE RISK ASSESSMENT] (summarizing basin history).

[51] Texas Parks and Wildlife, *Rio Grande Basin*, available at http://tpwd.texas.gov/business/grants/wildlife/cwcs/media/docs/rivers/riogrande1.doc.

The Rio Grande follows the eponymous, roughly 30 million-years-old, three-mile deep Rift Valley from Colorado to Chihuahua, Mexico. Three sub-basins mark the Upper and Middle Rio Grande reaches, from north to south: the San Luis (in southern Colorado), the Española, and the Albuquerque basins, the latter of which exhibits a thickness of up to 1,500 feet of partially consolidated sediments. Precambrian rock forms the basement of the Middle Rio Grande, the surface exposure of which can be seen, for example, in the Sandia Mountains overlooking Albuquerque. For comparison, the modern Rio Grande Valley dates from approximately 1 million years ago, while the Albuquerque volcanoes erupted about 150,000 years ago, and the area was first settled 12,000 years ago, with permanent settlement occurring roughly 1,500 years ago.[52]

The path of the Rio Grande Basin is through varied landscapes, ecosystems, and cultures. The river's ecological diversity mirrors the social diversity along its banks. New Mexico is home to 23 Native American Tribes, including 19 Pueblos, nearly all of which are situated alongside the Rio Grande. These Tribes have inhabited their lands from time immemorial, through cycles of drought, colonization, and development. With the river's annual spring flooding, the historical floodplain comprised a similarly rich riparian ecosystem, characterized by cottonwood, migratory birds, waterfowl, and a variety of fish. Natural temporal variation in the river's flow has historically complemented its biological and geographical diversity: the Rio Grande is known as a "feast or famine" river. A changing climate amplifies these variations, as drought and flood magnitudes increase and snowmelt runoff occurs earlier in the year. This new exigency, along with the effects of human-induced alteration of the river's ecosystem and hydrograph, demands a new form of ecological resilience.

Humans have modified the natural hydrologic regime of the Rio Grande throughout historical and colonial times, but modern efforts altered the river on a vast scale. The river has a high sediment load and historically had a dynamic, braided river channel. Its main water course could reach a half-mile wide, and regular flooding would inundate the floodplain and reorient the channel's margins and sand bars.[53]

A still larger effect on the river's hydrograph in the Middle Rio Grande was occasioned within the past hundred years. In the nineteenth century, large-scale water storage and flood control projects were constructed (from Heron, El Vado, and Abiquiu Reservoirs on Rio Chama to Cochiti and Elephant Butte Reservoirs on the main-stem of the Rio Grande). The big dams of this area drastically affect the river's flow regime. In general, peak flows were dampened as flows began to be stored by dams and released over time. This process also traps large quantities of sediment in each reservoir, which in turn causes river aggradation upstream of each dam and degradation downstream. Today, the Middle Rio Grande reach has largely been channelized through flood management structures such as levees, and Kellner jacks ("jetty jacks"), resulting in a more homogenous, deeper, and swifter river with less—if any—hydraulic connection to its historical floodplain.

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[52] Adrian Oglesby, *The Colors of Water: Compact, Irrigations, M&A, Ecological, and Recreation* (n.d. 2010) (notes for talk given on Rio Chama rafting trip); *see also* PHILLIPS, *supra* note 50, at 11–23. This paragraph is adapted from Colin McKenzie, Seminar Paper, *Reservoir Operations as Conservation Measures? Discretion and Collaboration in the El Vado Reservoir Deviations and New Rio Grande Biological Opinion* (Dec. 16, 2016), at 5 [hereinafter McKenzie (2016)]

[53] *See, e.g.*, Teresa Rice, *The Middle Rio Grande Basin*, in NAT. RES. LAW CENTER, *Restoring the West's Waters: Opportunities for the Bureau of Reclamation, Vol. 2* (1996), at Ch. 6, pp. 6-1 – 6-7 (narrating water supply development, geographic setting, as well as customary water management regimes).

Human settlement along the river is indeed a foundational aspect of current governance structure on the Rio Grande. It is not widely known that the Rio Grande Basin is home to one of the oldest, most developed hydraulic societies in the world. Native American Pueblo water use and governance date back at least a thousand years. As historian Roxanne Dunbar-Ortiz points out,[54] indigenous peoples in the Western Hemisphere had economies and institutions that supported populations on the same level as those of Europe at the time. New Mexico was one of the most successful of these indigenous societies, and its complex irrigation systems date from pre-colonial times.[55] Because the past is often a prologue, this vast history may contain clues for this new ecological resilience.

During the basin's most recent 500-year history, the waters of the Rio Grande have been governed by six sovereigns: Native American Tribes and pueblos; the Spanish crown; Mexico; the territory and then state of New Mexico; and the United States. Spanish influence on water management in these areas dates to the beginnings of European colonialism in the mid-1500s, including Spanish royal "granting" of tracts of lands, concomitant agricultural development, and the community-oriented governance of surface-water irrigation known as acequias. In 1848, these Pueblo and Hispanic lands formally passed from Mexico to the United States through the Treaty of Guadalupe Hidalgo. Complex, competing claims among these groups —and other, more recently arrived groups such as Anglo settlers—persisted, and would multiply and continue to the present.[56]

After initial settlement by the ancestors of the modern day Indian Pueblos, and the first wave of colonization by Hispanic citizens of Spain and Mexico, widespread human intervention in and development of the Rio Grande began in the mid-nineteenth century in the San Luis Valley of southern Colorado.[57] At this time, agriculture expanded significantly, facilitated by the construction of large-scale irrigation works and levees. The resultant increase in sediment load, along with river dewatering, channelization and narrowing, contributed to a newly aggrading river, one whose increasingly frequent flooding and elevated water tables were growing more divorced from the historical, natural rhythms of the river.[58]

The United States' Federal presence on the Rio Grande dates to the end of the nineteenth century, as the national government became involved as a water developer, owing to the repeated failure of private irrigation enterprises. Initially, the Federal government imposed an embargo on non-Federal—i.e., both state and private—development on the Upper Rio Grande from 1895 to 1925, as it investigated and then

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[54] Roxanne Dunbar-Ortiz, Lecture, *An Indigenous Economic Model*, ALTERNATIVE RADIO (Feb. 2, 2017) (transcript on file with Utton Center).

[55] *Id*.

[56] See Phillips, supra note 50, at 24–33; see also Richard Hughes, Pueblo Indian Water Rights: Charting the Unknown, 57 Nat. Res. J. 219, 222, n.7 (2017) (providing an overview of the nature of Pueblo land holdings in New Mexico, including by Spanish "grant"), https://digitalrepository.unm.edu/cgi/viewcontent.cgi?article=1327&context=nrj; id. at 253-54 (noting impact of Spanish and Mexican law on Pueblo water rights); *see generally* Malcolm Ebright, Rick Hendricks, and Richard Hughes, *Four Square Leagues: Pueblo Indian Land in New Mexico* (UNM Press 2014).

[57] Burke Griggs, *The Political Cultures of Irrigation and the Proxy Battles of Interstate Water Litigation*, 57 NAT. RESOURCES. J. 1, 12, n. 58 and accompanying text.

[58] Oglesby, *supra* note 52; *see also* Andrew Gulliford, *Aldo Leopold, Estella Bergere, Mia Casita and Sheepherding in New Mexico and Colorado*, 57 NAT. RESOURCES J. 395, 401–403 (2017); PHILLIPS, *supra* note 50, at 70-72.

built the roughly 1 million acre-foot impoundment of water at Elephant Butte Dam and Reservoir. In the mid-1920s, the Middle Rio Grande Conservancy District was founded to drain the swamplands that had developed along the newly aggrading Rio Grande.[59] While the MRGCD would come to be the core water supplier in the Middle Rio Grande—having consolidated dozens of individual acequias, including those of what came to be known as the six Middle Rio Grande Pueblos—it was originally so unsuccessful at its original drainage project as to re-acquire a bailout by the Federal government. As Reclamation bolstered its water development and supply presence in the West, Reclamation cemented itself in the Middle Rio Grande. The bailed-out MRGCD, and its existing acequia infrastructure, became the cornerstone of the Reclamation Middle Rio Grande Project.

2. Middle Rio Grande: Water Governance

This history and geography shapes water management and allocation decisions to the present. Various forms of governance have attached to different forms of advanced agriculture in the Rio Grande Basin. Today, the major legal regimes reflect these historical water governance institutions, and add new ones.[60] They focus on *inter alia*: aboriginal rights (Pueblo water rights); community governance (*acequias*); public lands reclamation, flood control, environmental law (Federal claims); and municipal and irrigation needs (imported transbasin water). At the highest level, three institutions are woven throughout nearly all water law, policy, management decisions in the Rio Grande Basin: international treaties, interstate compacts, and Federal regulation and agency mandates.

Federal intervention on the Rio Grande was catalyzed by the international as well as interstate nature of the river, which is allocated (legally) between four sovereigns—three states, Colorado, New Mexico and Texas, and a country, Mexico—facilitated by a fifth, the United States. In the 1890s, a dispute arose between Mexico and the United States over excessive upstream American diversions of the river. This dispute and resultant diplomatic pressure caused a Federal embargo on the use of public lands for diversion and storage of water in both Colorado and New Mexico that would last until 1925. The 1906 convention between Mexico and the United States resolved the conflict with a provision that gave Mexico a legal entitlement to 60,000 acre-feet per year of Rio Grande water. To help in part with the resulting obligation to deliver water to Mexico and also to facilitate effective, large scale surface-water irrigation, the Federal Rio Grande Project commenced in 1907.[61]

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[59] Middle Rio Grande Conservancy Dist., Senate Memorial 21 Task Force Studying the Electoral Process of the Middle Rio Grande Conservancy District: Findings and Recommendation 1-2 (n.d.),

[60] *See* M.H. Benson (2014), *supra* note 9, at 199-205 (providing a useful overview of governance structure and key actors); *see also* Susan Kery, et al., *Overview of Water Law Applicable to the Middle Rio Grande Water Planning Region* (Jan. 2003), in STATE OF N.M., INTERSTATE STREAM COMM'N & OFFICE OF THE STATE ENG'R, MIDDLE RIO GRANDE REGIONAL WATER PLAN (2004), Supporting Document H-6 [hereinafter Kery (2003), *Overview*] (providing an overview of, *inter alia*, New Mexico water law; pueblo water rights; relevant Endangered Species Act considerations; the San Juan-Chama project; and interstate compacts); CLIMATE RISK ASSESSMENT, *supra* note 50, at App. A (providing comprehensive overview of Upper Rio Grande Water Operations).

[61] *See* Littlefield *supra* note 30 at 146.

In a further bid to avoid transboundary conflict on the river, now between Colorado, New Mexico and Texas, the United States implemented another embargo on water development to pressure a binding, interstate agreement to share the river in 1935.[62]

An interstate compact, the Rio Grande Compact of 1938 (Compact), is the cornerstone of the Rio Grande's Law of the River.[63] The Compact intended to protect contemporaneous water uses and newer, upstream uses—i.e., development facilitated by the construction of new reservoirs. For example, Article VII dictates that no water may be stored in upstream, "post-1929" reservoirs when "usable project water" in storage at Elephant Butte Reservoir falls below 400,000 acre-feet.[64] Accordingly, new uses upstream of Elephant Butte must occur through either imported water from the Colorado River Basin or as a function of water stored above the volumes that Rio Grande Project users are entitled to divert.

Under the Rio Grande Compact, water delivery requirements are indexed based on current flows, and New Mexico makes delivery to Texas, not at the political boundary of the two states, but at Elephant Butte Dam. Despite these annual, indexed delivery obligations, the Compact allows for a certain degree of management flexibility. Compact Article VI provides the upstream states an accounting system of credits and debits with regards to annual interstate delivery obligations. The accrued debits and credits, however, are limited to 200,000 acre-feet "at any time," with no more than 150,000 charged in any given year.[65] Credits and debits are cancelled entirely in those years when Elephant Butte Reservoir is full, or "spills."[66] Article VII, in turn, provides that New Mexico or Colorado "may relinquish accrued credits at any time, and Texas may accept such relinquished water." In that case, the upstream state is entitled to store the amount relinquished.[67] New Mexico would accordingly store in such post-1929 reservoirs as El Vado.[68]

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62 Susan Kelly, et. al., *History of the Rio Grande Reservoirs in New Mexico: Legislation and Litigation*, 47 NAT. RES. J. 525 (2007) (containing an excellent history of interstate water litigation on the Rio Grande, building on previous work by Al Utton) [hereinafter Kelly (2007a), *Rio Grande Reservoirs*].

63 While *the* "law of the river" usually refers to the Colorado River, "laws of the rivers" exist around the West. *See* COLORADO RIVER COMM'N OF NEVADA, "LAWS OF THE RIVERS": THE LEGAL REGIMES OF MAJOR INTERSTATE SYSTEMS OF THE UNITED STATES (OCT. 2006).

64 Rio Grande Compact, N.M. STAT. § 72-15-23 (1978), at Art. VII.

65 *Id*. at Art. VI.

66 *Id*.

67 *Id*. at Art. VII.

68 *See generally* Luke Piermont, Comment, *Muddying the Waters: The Fight Over Relinquishment Credit*, Vista (New Mexico Bar Natural Resources, Energy and Environmental Law Section newsletter) (Winter 2012) (providing an overview of Article VII credit relinquishment water and related legal issues, including ownership of this water). Piermont notes that while Compact Art. VII provisions on relinquishment credits allow New Mexico to store water in post-1929 Reservoirs, New Mexico's Interstate Stream Commission (ISC) has undertaken to convert "paper" relinquishment credits to "wet" relinquishment water by contracting with MRGCD and the U.S. Bureau of Reclamation for such storage in El Vado.

Just as the Rio Grande Compact influences the timing and magnitude of water storage, so do the mandates of Federal agencies—primarily Reclamation, USACE, and USFWS.[69] Reclamation and USACE both manage the built infrastructure along the river, including dams and reservoirs, but their missions are different. Since the Reclamation Act of 1902, Reclamation—and its predecessor, the Reclamation Service—has been charged with "reclaiming" the arid lands of the West, that is west of the 100th meridian. The newest addition to Reclamation's portfolio of water supply projects in New Mexico is the San Juan-Chama Project, which diverts a firm yield of 96,200 acre-feet per year of water from the Colorado River Basin to be used primarily by the City of Albuquerque and the MRGCD, with smaller amount allocated to 14 other project contractors. The USACE, in contrast, was deputized in the 1930s and 40s to lead flood control efforts around the country. In the Middle Rio Grande, the City of Albuquerque and MRGCD irrigators have benefitted from the resulting infrastructure of dams (e.g., Abiquiu and Cochiti) and levees. USFWS, in turn, is charged with implementation of key aspects of the ESA. In its Biological Opinions, the USFWS determines whether Federal agency actions, such as by Reclamation or the USACE, will "jeopardize" listed endangered species. Because such an opinion may require such actions as maintaining minimum flows in a river to avoid jeopardy to an endangered species, these Biological Opinions operate as a key water management constraint in a water-short environment like New Mexico.

Two other Federal institutions affect water allocation in the Middle Rio Grande: The Middle Rio Grande Endangered Species Collaborative Program (Collaborative Program) and the Bureau of Indian Affairs (BIA). The Collaborative Program is a multi-stakeholder group that supports and coordinates efforts to achieve compliance with the ESA. To this end, the Federal funds it receives—which must be matched in part—are directed to research and other efforts to achieve ESA compliance.[70]

The Six Middle Rio Grande Pueblos are sovereign Native American nations whose water use dates from time immemorial. They hold the most senior water rights in the Middle Rio Grande to irrigate 8,847 acres of tribal land per year. Because they are superior to all other irrigation water rights in the region, they are referred to as "Prior & Paramount" water rights. The Bureau of Indian Affairs has the obligation to ensure the Pueblos receive this water, even when Compact Article VII restriction would otherwise prevent water from being stored at El Vado Reservoir (the only reservoir along the Rio Chama in which native Rio Grande Basin water can be stored).

3. Rio Chama: Institutional Framework[71]

The institutional framework of the reach of the Rio Chama on which this report focuses—the designed Wild and Scenic reach from El Vado Dam downstream to Abiquiu Reservoir—is dominated by contrasting elements. Flows are largely controlled by three dams, an inter-basin water transfer, and municipal and agricultural water allocations—yet the waters are remote and contain a blue-ribbon fishery

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[69] *See generally* M.H. Benson (2013), *supra* note 25, at Table 2 (summarizing key constituencies and managers).

[70] *See* Colin McKenzie, UTTON CTR., Federal Advisory Committee Act/Middle Rio Grande Endangered Species Collaborative Program 1–2, at nn. 2–4, 12–13 and accompanying text (Apr. 16, 2017).

[71] *See generally* N.M. OFFICE OF THE STATE ENG'R, REGIONAL WATER PLAN: RIO CHAMA WATERSHED, at Ch. 3, 1-10 (2006), http://www.ose.state.nm.us/Planning/RWP/Regions/14_RioChama/2006/3-Legal-Issues.pdf [hereinafter Rio Chama RWP (2006)]; N.M. OFFICE OF THE STATE ENG'R, RIO CHAMA REGIONAL WATER PLAN, at Pts. 3, 4.3 (2016), http://www.ose.state.nm.us/Planning/RWP/Regions/14_RioChama/2016/Reg%2014_Rio%20Chama%20Regional%20Water%20Plan%202016_July%202016_with%20appendices.pdf ("Description of the Planning Region" and "Legal Issues Unique to the Region and Local Conflicts Needing resolution," respectively).

dominated by brown trout. As explained above, its hydrologic regime has been fundamentally altered, owing to both El Vado Dam and Reservoir, which dates from the 1930s, and the importation of San Juan-Chama Project water from the Colorado River basin. This imported San Juan-Chama Project water represents an average annual increase of 40 percent over pre-Project, native Rio Grande Basin flows on the Rio Chama; nonetheless, operations at El Vado occasionally cause low flows in the river. Post-El Vado Dam construction, high flows have been recorded on the order of 6,000 cubic feet per second (cfs). Transbasin diversion flows are coupled with the unique absence of non-negligible diversions. This circumstance, coupled with the fact that flows from El Vado Reservoir may be stored in Abiquiu Reservoir, indicates a ripe possibility for reservoir operation and experimentation with the goal of improving flows for multiple purposes in this reach.[72]

This reach of Rio Chama from El Vado to Abiquiu has also been designated as a Wild and Scenic River. This Federal designation recognizes the unique natural, cultural, and recreational values of free-flowing rivers. While dams on this and other rivers confine flow, the Wild and Scenic Rivers Act aimed to "complement" existing dams with a policy of protecting other selected rivers and reaches "in their free-flowing condition to protect the water quality of such rivers and to fulfill other vital national conservation purposes." As a Wild and Scenic River, a portion of this reach of the Rio Chama is "wild" designated, which means that its shores and watershed are essentially primitive.[73]

Even as a Wild and Scenic River, downstream diversions control flows on the Rio Chama, since the MRGCD stores water at El Vado Reservoir. When MRGCD is not calling for irrigation water, flows on the Rio Chama are primarily comprised of the Water Utility's San Juan-Chama allocation. The Water Utility tends to "move" water when the MRGCD does not; for example, it has released water during the winter to support brown trout spawning. Indeed, the cold, tailwater releases below El Vado have also generated a world-class trout fishery. At the macro level, this institutional mix has resulted in dampening of spring peaks in the hydrograph, as the MRGCD stores native water at El Vado, and augmentation of summer flows as irrigation water is released.[74]

[72] *See* M.H. Benson (2013), *supra* note 25, at 3-7 (providing an overview of Rio Chama system, including: [1] the river's "Wild and Scenic" designation; [2] its altered hydrologic regime; [3] the San Juan-Chama Project; and [4] recent experimental flows); Morrison, *supra* note 17, at §§ 2.2.1, 2.2.2 (basin description and environmental flow study); *see also* M.H. Benson (2014), *supra* note 9, at 206–16 (detailing elements of social and ecological system(s) in Middle Rio Grande)

[73] Wild and Scenic Rivers Act, P.L. No. 90-542, 82 Stat. 906 (1968), codified at 16 U.S.C.A. § 1274 et. seq.

[74] *See, e.g.*, CLIMATE RISK ASSESSMENT, *supra* note 50, at App. A, A-12–A-14 (noting Reservoir storage and changes to the size and duration of peak flows).

C. Reservoir Operations: Key Institutional Capacity Issues

1. Overview[75]

The unique institutional nature and hydrologic regime of the Rio Chama between El Vado and Abiquiu Reservoirs has generated interest in experimental flows; it is a ripe venue. Specific interest in such flows—which would conceptually be released from El Vado Reservoir and later stored at Abiquiu Reservoir appears to date from 2009. That year unique runoff conditions required a controlled release of 5,600 cfs from El Vado. This release equaled a two-year return period flow event in the pre-El Vado Dam era—i.e., not terribly large. Still, it was the biggest release from El Vado since 1985. At this time, scientists observed that such flows could be passed safely through the El Vado to Abiquiu reach (towards Abiquiu, there are only U.S. Forest Service (USFS) roads and a Benedictine Monastery near the river). Of more immediate interest, however, were the geomorphologic changes of such a "pulse flow" event of this magnitude, in particular to reestablish some ecological function of the pre-dam version of the river.

In order to further investigate pulse flow-type events on Rio Chama, scholars have set out conceptual models for categorizing and analyzing the relevant constraints (and related opportunities for more flexible reservoir operations). For example, Benson et. al. (2013) proposed a classification system for thinking about the "institutional and physical capacity" issues relevant to more flexible operations, in an adaptive management framework.[76] Such flows are heavily influenced by a "complex set of legal requirements, physical constraints, and both social and ecological enhancement opportunities."[77] The classification framework is an attempt to navigate this complexity; to facilitate stakeholder involvement; to prevent ossification of perceived limitations; and to investigate capacity issues.[78]

Benson et. al. suggest that "legal and institutional uncertainties" might also be incorporated into such a framework. With physical, institutional, and capacity issues—and uncertainties—thus mapped, the RCFP is now attempting to incorporate a numerical modeling tool. Within this broader effort, this report contributes a nuanced perspective on the legal constraints and uncertainties, as well as capacity opportunities to such reservoir operations on Rio Chama.

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[75] Key issues include: the endangered silvery minnow; strategic water management and operations; collaborative efforts; and global change/drought. *See, e.g.*, CLIMATE RISK ASSESSMENT, *supra* note 50, at S-iv–S-v (summary of climate change impacts on water management); *id*. at App. A, A-15–A-20 (San Juan-Chama water operations), A-22–A-25 (El Vado Storage and Release Operations and Cochiti Deviations), A-32–A-38 (ABCWUA Drinking Water Project), A-41 (Endangered Species Act); Susan Kery, et al., *Legal Issues Specific to the Middle Rio Grande Water Planning Region* (Supporting Document H-5), in STATE OF N.M., INTERSTATE STREAM COMM'N & OFFICE OF THE STATE ENG'R, MIDDLE RIO GRANDE REGIONAL WATER PLAN (2004), at 11-18 (providing an overview of "new water users on the Rio Grande," including ESA-related in-stream flow right related to the endangered silvery minnow); *see also generally* Kevin Flanigan, *Surface Water Management: Working Within the Legal Framework*, 47 NATURAL RES. J. 515 (2007); Susan Kelly (2007a), *Rio Grande Reservoirs*, *supra* note 62; Kelly (2007(b), *Modeling Reservoir Storage*, *supra* note 16.

[76] M.H. Benson (2013), *supra* note 25, at tbl. 2, 3.

[77] *Id*. at 8.

[78] *Id*.

2. Agency Perspectives

Many legal constraints to reservoir operations on the main-stem Rio Grande also apply to the Rio Chama.[79] This is not surprising. Even though there are no endangered species at present and no significant water users on the river's Wild and Scenic reach, reservoir operation is a multijurisdictional, highly interconnected system.

Three major high-level constraints tend to dominate water managers on both Rio Chama and Rio Grande. First, a complex accounting of "native" Rio Grande Basin flows and "non-native" flows is required for New Mexico to achieve both legal—and physical—compliance with the Rio Grande Compact. Such accounting is carried out by complex numerical models. These models contain "rules" regarding the physical assumptions and legal requirements underlying how such accounting operates. Modification of reservoir operations would need to be represented in the accounting model, and the effects to components of the water balance provided to different stakeholders—i.e., Texas, New Mexico, MRGCD, the Water Utility, and the Pueblos. These effects are difficult to predict (or conceptualize by humans), given the complex, non-linear nature of the system as a whole.[80]

Second, Abiquiu Reservoir—through which native and non-native flows pass—is operated "primarily" for flood control purposes. Any deviation from these "normal operations" requires approval from the Rio Grande Compact Commission. The Texas Commissioner, at a minimum, will scrutinize such operation for implications to their allocation, as delivered to Elephant Butte.

Third, any perceived or actual shortage to their allocation through altered reservoir operations could injure the water rights of irrigators—a matter of livelihood, and for Pueblos, a matter of livelihood and sovereignty. In this way, the Wild and Scenic section of Rio Chama clearly does not exist in a vacuum. New Mexico's water managers, especially Federal dam and water project operators, are sensitive to these wide-ranging implications of modified reservoir operations on Rio Chama.

[79] *See, e.g.*, Jennifer Faler, *Reservoir Operation Constraints and Opportunities, from the Perspective of the Bureau of Reclamation*, Presentation at "Institutional Constraints to Water Management in New Mexico, Albuquerque, NM (May 20, 2016), at 9–10, 12–15 (comments and analysis from Reclamation's current area director regarding Reservoir operations discussing, *inter alia*, opportunities and examples of operations flexibility) (on file with Utton Center); John R. D'Antonio Jr., *Challenges and Opportunities for Federal Reservoir Management*, Presentation at "Institutional Constraints to Water Management in New Mexico, Albuquerque, NM (May 20, 2016) (presentation by former New Mexico State Engineer providing, *inter alia*, overview of law and management of Federal Reservoirs and discussing relevant authorities) (on file with Utton Center); *id*. at 19-20 (discussing "opportunities"); Rolf Schmidt-Petersen, *Managing the Surface Water of the Upper Rio Grande*, in N.M. BUREAU OF GEOLOGY AND MINERAL RESOURCES, *Decision-Makers Guide: Water Resources of the Middle Rio Grande: San Acacia to Elephant Butte*, Chap. 1, at 27, 30 (L. Greer Price, Peggy S. Johnson, and Douglas Bland eds., 2007) (detailing how water management decisions are made); *see also* Brad Hudgens, USACE Institute for Water Resources, *USACE Water Supply Storage 101* (2016).

[80] *See* Amos, *supra* note 13, at 1099, n.16 and accompanying text (describing sophisticated, agent-based simulations tools used to model complex, socio-ecological systems for purposes of optimizing water management); *id*. at 1131–32 (describing application of agent-based modeling to evaluate water scarcity outcome vis-a-vis the dynamics of legal flexibility, in a project that involves the "integration of biophysical parameters and social science data by legal research regarding the interaction of state and Federal water law, on issues like instream flow and water quality").

Reclamation's perspective on reservoir operations is informed by the water management responsibilities on the Rio Grande and Rio Chama from Colorado to Texas. Reclamation manages Heron Reservoir for imported San Juan-Chama Project water, and El Vado Reservoir primarily for MRGCD supplies, which include both water native to Rio Chama and some San Juan-Chama flows. Storage is sometimes restricted under the Rio Grande Compact. El Vado Reservoir may be used to store water pursuant to New Mexico's relinquishment of credit water under the Rio Grande Compact. Reclamation also manages the Rio Grande Project's Elephant Butte Reservoir, which is New Mexico's delivery point to Texas under the Rio Grande Compact. In addition to this matrix of legal requirements and management responsibilities, Reclamation must also meet flow requirements or hydrologic objectives on the main stem Rio Grande required under the ESA.

Reclamation views reservoir operations flexibility as a tool to meet these various obligations, including ESA requirements, while enhancing ecological resilience, including meeting—or "enhancing"—its water delivery capabilities during drought. To that end, Reclamation has noted that reservoir *storage* flexibility "may be needed" to address water scarcity, earlier peaks of spring snowmelt runoff, as well as more intense floods and more prolonged drought.[81] With these exigencies in mind, Reclamation's 2016 Biological Assessment, prepared in support of the new Rio Grande Biological Opinion, suggested ways to enhance water management flexibility. These suggestions included alternative El Vado Reservoir operations that Reclamation indicated were "*within current* [Reservoir] *authorizations*."[82] These "offsetting" and conservation measures for El Vado included:

1) "modific[ation] of operations to better meet species needs[;]
2) "adjustment to storage timing" during the spring peak [flows; and]
3) "facilitat[ing] exchanges of San Juan-Chama Project water from downstream to upstream to improvement water management flexibility."[83]

Beyond reservoir operations that Reclamation has been exploring for some time,[84] Reclamation has also suggested pursuing modification to reservoir operations that go beyond existing authorization. For example, adjusting the timing of storage and creating conservation pools in upstream reservoir has been suggested.[85]

Reclamation Area Office Manager, Jennifer Faler, highlighted in 2017 some of Reclamation's "outside the box" thinking—which probes the boundaries of current legal authority and existing authorizations. Focusing on reservoir operations, she cited four recent examples of collaboration with key water users, managers, and regulators. Ms. Faler highlighted, first, Reclamation's coordination with the Rio Grande Compact Commission to enact Commission Resolutions which permitted storage in El Vado Reservoir

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[81] Faler, *supra* note 79, at 9.

[82] *Id*. at 12.

[83] *Id*.

[84] U.S. ARMY CORPS OF ENGINEERS, U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION, AND NEW MEXICO INTERSTATE STREAM COMMISSION, UPPER RIO GRANDE WATER OPERATIONS REVIEW, Vol. II, at App. I (Water Operations), I-11 (Apr. 20, 2007) [hereinafter URG WATER OPERATIONS REVIEW] (citing Emmett Rice, Reclamation Field Solicitor Opinion (Nov. 3, 1983) (memorandum providing legal rationale for carryover storage where benefit "inures" to the Federal government, not any individual San Juan Chama Project water contractor).

[85] Faler, *supra* note 79, at 9.

during Compact Article VII restriction and subsequent releases to support peak pulse-flows on the Middle Rio Grande. Next, she pointed to altered timing for the release of unused Prior and Paramount water stored for the Six Middle Rio Grande Pueblos at El Vado Reservoir, which "facilitate[d] a more natural hydrograph *without affecting [downstream] water use[s] or deliveries under the Rio Grande Compact*." Ms. Faler also referenced two exchanges of San Juan-Chama Project water from Elephant Butte Reservoir to upstream storage—for the Water Utility in 2013 and for the City of Santa Fe in 2014. Finally, Ms. Faler cited Reclamation's ongoing "support [for] Albuquerque in its quest for storage of native waters in Abiquiu Reservoir" as another example of creative water management in the Middle Rio Grande.[86]

For its part, USACE has a naturally narrower view of reservoir operations flexibility, in large part due to safety and engineering considerations underlying its primary mission of flood control. While USACE often operates reservoirs within its purview for multiple authorized purposes (such as municipal water supply, fish and wildlife, and recreation), flood control is the "primary" authorized purpose in the case of Abiquiu and Cochiti Reservoirs, as part of the Middle Rio Grande Project. As a threshold matter, the Water Supply Act of 1958 requires congressional approval for any "major . . . operational changes" to Abiquiu or Cochiti Reservoirs, or for any "modification ...which would seriously affect the purposes for which the project was authorized. Within the primary—flood control—constraint to its operations, recent litigation highlights USACE's current dim view on at least one aspect of reservoir operations discretion. In *WildEarth Guardians v. U.S. Army Corps of Engineers, 2018*, the issue was whether the USACE has, as a matter of law, insufficient discretion in its operations of Abiquiu Reservoir to exempt it from the requirement that USACE consult with USFWS under the ESA.[87] USACE expressed the view that temporary, congressionally authorized deviations from normal operations at USACE-managed Cochiti Dam and Reservoir were an "unreliable tool for the purpose of silvery minnow spawning."[88] Further, USACE expressed that it currently has "no authority" for further Cochiti deviation, in part because USACE "does not own water or have water rights" and that USACE "does not own the land."[89] In more general terms, USACE similarly claimed it has "no discretion in [its] normal [daily] operations," which allow for the "free flow" of native Rio Grande and San Juan-Chama Project water through its dams to contractors.[90] In the same vein, USACE categorically indicated that it has "no authority to acquire or release any added volume of water" and "no real property interests required to store water."[91]

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[86] *Id*. at 14.

[87] *WildEarth Guardians vs. U.S. Army Corps of Eng'rs*, 314 F.Supp.3d 1178 (D.N.M., June 6, 2018, amended Aug. 8, 2014), WildEarth Guardians v. United States Army Corps of Eng'rs, 2018 U.S. Dist. LEXIS 137112 (Aug. 14, 2018) [hereinafter *WEG v. Corps*].

[88] D'Antonio, *supra* note 79, at 17.

[89] *Id*.

[90] *Id*.

[91] *Id*.

Congress has assisted USACE in overcoming its concerns about lacking authority to deviate from its primary mission to operate Cochiti Reservoir only for flood control. In the 2018 Water Resources and Development Act, Congress authorized USACE to reinitiate temporary deviations in its operations of both Cochiti and Jemez Reservoirs for a period of five years.[92] USACE must consult with the Pueblos of Cochiti and Santa Ana before restarting temporary deviations and will continue to evaluate the effectiveness of the deviations.

Lest USACE be attacked for its unyielding outlook, USACE indicated that, had the *WildEarth Guardians* litigation settled, it would have been "happy to facilitate stakeholder discussions to address:

- "sources of water
- permits to store water
- real property interest required to store water
- Rio Grande Compact Commission approval
- congressional authorization".[93]

That said, *WildEarth Guardians* did not settle as USACE prevailed in court. USACE personnel have recently expressed the view that the agency has been less solicitous in seeking reservoir operations flexibility due to of increased scrutiny of its water operations, presumably in terms of the threat of environmental litigation.[94]

The USACE also notes it has completed "comprehensive data collection" for Cochiti Dam and Reservoir, which "would serve as baseline information" for a new, system-wide study.[95] Such a study would presumably form the basis for operating USACE reservoirs on the foundation of up-to-date data. This process could have the effect of rendering previous assumptions invalid and result in an optimized system. If, as a result, USACE obtained a more accurate estimate for open-water evaporation,[96] project operations and policy could be altered to more efficiently store water without impairing USACE's acceptable margin of risk for its flood control operations.

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[92] America's Water Infrastructure Act of 2018, S. 3021 (Public Law No: 115-270), Sec. 1175.

[93] *Id*. at 19.

[94] Anjali Bean, *Opportunities to Enhance Environmental Flows on the Rio Chama*, Master of Water Resources Professional Project, 6–7 (Univ. of N.M., Aug. 2018) (contending, based on interviews with USACE personnel, that "[g]reater scrutiny of [USACE's] operations...has made the agency less able to find flexibility in their operations" and noting that the Federal district court's June 2018 decision in favor of the USACE in *WildEarth Guardians* owed, in large, to the USACE's strict adherence to black letter law of, *inter alia*, Middle Rio Grande Project authorizing legislation.).

[95] D'Antonio, *supra* note 79, at 19.

[96] Reservoir evaporation which currently comprises high percent of water use in the Middle Rio Grande. *See* Abiquiu Water Control Manual (WCM), *supra* note 282, at 4-5 (noting 80-inch estimate of average annual evaporation at Abiquiu Dam).

3. Key Issues

Achieving some measure of reservoir operations flexibility is a necessary but insufficient condition for adapting to climate change induced drought (which early-21st century Rio Grande Basin conditions have previewed).[97] Still, the process of studying reservoir operations may be as important as specific results. As a laboratory, the Wild and Scenic stretch of Rio Chama offers an opportunity to focus on the process of consensus and trust-building. Complicating factors such as the Endangered Species Act and impairment to water rights are not at issue—as noted above, there are no endangered fish or substantial diversions on this reach of Rio Chama.

In the case of Rio Chama experimental flows, the confidence interval as to their legality and practicability would benefit from answers to three significant outstanding questions:

- First, there is an outstanding legal question as to authority for carryover storage at Heron Reservoir. Such storage allows a flexible source of water for downstream release.

- Second, despite general consensus about the need for more flexible storage at Abiquiu, stakeholders are split on feasibility.[98] The MRGCD, for one, is concerned how such storage could affect their storage rights in El Vado Reservoir.[99]

- Third, as water moves downstream to Abiquiu, where it would be stored (if temporarily), evaporative losses increase, thus necessitating proper accounting for this consumptive use. Even so, one can imagine these three issues having technical solutions that would leave all water users—and the environment—whole.

Such technical solutions and the concomitant legal analysis are precisely the terrain of the Rio Chama Flow Project. The Project views these issues as significantly less intractable than those related to the maelstrom on the mainstem Rio Grande, i.e.: more complex water rights impairment analysis, high-priority Endangered Species Act requirements, and bottom line Compact delivery obligations.[100]

The Rio Chama Flow Project thus represents an attempt to simplify the Rio Grande Basin system as a whole in order to focus on evidence-based work that all actors can participate in. To this end, we have attempted to present our legal analysis in the most transparent way possible. This report, itself, is

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[97] *See, e.g.*, R. Benson (2017), *supra* note 33, at 356–57 ("[R]eservoirs operate in dramatically changing context […] Climate change has serious implications for dam operating plans.")

[98] *See, e.g.*, Bean, *supra* note 94, at 7 (noting conceptual agreement among Reclamation, USACE, MRGCD, and ABCWUA regarding the benefits likely to inure to the Flow Project's goals; highlighting generalized support of the concept from USACE and ABCWUA; but explain that the MRGCD is "not particularly interested in risking harm to their own rights").

[99] *Id*.

[100] Despite this conceptual simplification, one researcher has aptly noted the connection between experimental flows on Rio Chama and management of the Rio Grande for the needs of the endangered silvery minnow. Bean, supra note 94, at 8 (noting that "large portion of the water used [for]...Silvery Minnow endangered species compliance *is stored and released first* [on] the Chama"). Understanding this nuance, Chama/Flow Project stakeholders have powerful questions regarding "overlaps in the needs of the minnow and the [ecological] needs of Chama." *Id*. For example, "[c]ould released down the Chama for the minnow be organized in a way that they would benefit the upper channel as well." *Id*.

extensively cited. In an effort to make the Law of the River more transparent, we also offer multiple summaries of primary legal authority and regulatory decision-making, including explanatory annotations, as well as secondary academic and other "gray" literature. It is our hope these tools will foster discussion and collaboration, which we foresee will result in much more fruitful analysis and sourcing of many more solutions than the legal analysis has.

III. Legal Framework: Law of the River

A. Overview

Within this complex international, interstate, and intrastate scheme of water and environmental law, various "colors" of water are present and must be accounted for, physically and also legally. Such accounting forms the basis of the legal framework, the Law of the River—by which surface water is managed, and therefore also how reservoirs are operated.

Amidst protracted drought and the sometimes-zero-sum mentality of water stakeholders, Federal action—and therefore Federal law—in the Rio Grande Basin is one axis on which all water management turns. The three bases of Federal action in the basin, as have been mentioned, are (1) international treaties and interstate compacts, (2) Federal water projects, and (3) environmental law. All represent explicit Congressional authorizations, approvals, or mandates. The 1906 treaty with Mexico allocates a portion of the Rio Grande's flow to Mexico, while the Rio Grande Compact of 1938 represents Colorado, New Mexico, and Texas's attempt to divide these international and interstate waters among the three states. Next, the MRGCD attempted to harness the river but failed. The Federal government authorized its bailout as part of the Middle Rio Grande project, by which USACE was to provide flood control through a network of dams and levees on the Rio Grande and its tributaries. Subsequently, Congress authorized the San Juan-Chama [Diversion] Project, whereby Reclamation would import water from the Colorado River basin to supply, primarily, the City of Albuquerque and the MRGCD.

Pursuant to authorizing legislation, neither project could be operated so as to interfere with New Mexico's delivery obligations to Texas under the Rio Grande Compacts. Further, the Endangered Species Act has obligated water be delivered for endangered species.[101]

Uncertainty regarding the nature and extent of Pueblo water rights necessarily informs any discussion of water law and policy in the Rio Grande Basin,[102] which is further complicated by the federal-tribal relationship.[103] As scholar and water lawyer Em Hall has pointed out, although "[w]e are accustomed to

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[101] *See* M.H. Benson (2014), *supra* note 9, at 200–05 (providing an overview of interstate compacts, San Juan-Chama Project, tribal agreements, and Federal agencies); Oglesby, *supra* note 52 (discussing various "colors of water"); Flanigan, *supra* note 75 (setting out legal framework for surface water management); Kelly (2007a), *Rio Grande Reservoirs*, *supra* note 62; Kelly (2007b), *Modeling Reservoir Storage*, *supra* note 16; Kelly & Urbina (2011), *Reservoirs Overview*, *supra* note 12; Hall (2007), *supra* note 8, at 54 (Middle Rio Grande surface flows "subject to different legal claims"); Kara Gillon, *Watershed Down?: The Ups and Downs of Watershed Management in the Southwest*, 5 U. DENV. WATER L. REV. 395, 408–11 (2002) ("The Law of the Rio Grande") [hereinafter Gillon (2002)]; *see generally*, Amos, *supra* note 13, at Pt. III.

[102] *See*, *e.g.*, Kery (2003), *Overview*, *supra* note 60, at 36 ("Pueblos' [and Tribal] Reserved Water Rights"); *id*. at 37 ("Reserved Rights for Other Federal Purposes").

[103] *See, e.g.*, UTTON CTR., *American Indian Water Rights*, in *WATER MATTERS!* (2015), at 5-1 – 5-4, 5-6 – 5-7 (esp. 5-3, re: Reclamation projects vis-à-vis Indian water claims) (providing an overview of, basis for, quantification, and

say that the 1938 Rio Grande Compact limits New Mexico's access to [water] in the Rio Grande generally[,] the Pueblo claims come before the compact, which exempts them from its terms."[104]

Practically speaking, the priority and magnitude of these rights has the potential to replace nearly all non-native water users. Further, aboriginal or reserved rights—which are governed under Federal law—are not subject to state rules on beneficial use and abandonment or forfeiture. To add to this complexity, the nature and extent of Indian water rights is judicially evolving, and in New Mexico, contains a wrinkle. Here, the water rights of Pueblos do not fall squarely within the well-established *Winters* doctrine of Federal reserved rights for Tribes. Instead, Pueblos may have, in part, "aboriginal rights" that were, unlike Federal reserved rights that attached to Indian reservations—generally in the latter half of the nineteenth century—recognized by prior sovereigns, Spain and Mexico, and subsequently preserved by the United States in 1848 in the Treaty of Guadalupe Hidalgo.

On grant lands, Pueblo water rights have an "immemorial, aboriginal, or first priority" because those lands:

1) "have been occupied and the water used since before Europeans entered the territory;
2) "were recognized by prior sovereigns;
3) "came into the United States protected by the Treaty of Guadalupe Hidalgo; and
4) "were never relinquished to the Federal government."[105]

Quantification of Pueblo rights is an open legal question, although the "historically irrigated acreage" standard (as opposed to *Winters*' "practicably irrigated acreage" standard) was applied in the *Aamodt* adjudication. Because the *Aamodt* litigation was ultimately settled, that standard is not binding precedent. Federal water rights in New Mexico, however, were not developed with regard to the historical and practical realities of native water rights. As a result, watersheds were over-appropriated—including through the Federal reclamation program. Amidst this ongoing process of defining native claims—through adjudication and settlement—"the complexion of water resources, management, and the demands on the resource are changing."[106]

A final, judicial definition of the nature and extent of Pueblo rights may never occur. Instead, recent Indian water rights settlements in New Mexico, such as *Aamodt* and *Abeyta* (Taos), may provide the next-best "answer" as they highlight the magnitude of fiscal and multi-stakeholder collaboration required through the settlement process to resolve the "issue" of Indian water right. For example, the *Aamodt* and *Abeyta* settlements required Federal contributions of $174 and $124 million, respectively, and State contributions of $50 and $19 million, respectively—to say nothing of the process required to implement the Regional Water System, for example, in the *Aamodt* case.[107] For example, along the path to full implementation of the *Aamodt* settlement lie numerous milestones. The Pueblos of Jemez, Santa Ana, and Ana have returned to litigation in the *Abouselman* adjudication of the Rio Jemez, so a judicially defined method for quantifying Pueblo water rights question is still a possibility.

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priority of tribal and pueblo water rights, as well as notes on government-to-government relations); Hall (207), supra note 8, at 54-55; Kery (2003), *Overview*, *supra* note 60, at 31-36.

[104] Hall (207), supra note 8, at 54.

[105] Utton Ctr., *supra* note 103, at 5-2.

[106] *Id*. at 5-3.

[107] *Id*. at 5-4.

Other than the Pueblos' water rights, tribal rights most relevant to the Rio Chama Flow project are the rights of the Jicarilla Apache Nation, which owns riparian lands on Rio Chama. In March of 2013, the State of New Mexico and the Jicarilla Apache Nation successfully concluded years of negotiation and collaborative technical work in the *State of New Mexico v. Aragon* (Rio Chama) adjudication with the entry of a Consent Order recognizing the Nation's water rights on lands acquired since the entry of the 1998 Jicarilla Apache Nation decree,[108] including riparian land it subsequently purchased along Rio Chama.[109]

B. Federal Law[110]

1. Treaties

a) 1906 Treaty[111]

International diplomacy was one of the first drivers of water management on the Rio Grande. Concerns over water shortages in Mexico resulted in the 1906 Convention with Mexico, which established the United States' obligations for Rio Grande water deliveries to Mexico—an average of 60,000 acre-feet per year.[112] The International Boundary and Water Commission oversees these annual delivery obligations,[113] which toll at the International Dam at Ciudad Juarez.[114]

To help fulfill this delivery commitment and to make good on deliveries downstream to Texas, Elephant Butte Dam and Reservoir were constructed[115]—which also became the delivery point for New Mexico deliveries to Texas under the Rio Grande Compact.[116]

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[108] *Id*. at 5-5.

[109] *Id.* at 5-5.

[110] As an internal check, *see* Upper Rio Grande Water Operations Review, *supra* note 84, Vol. 1, at App. A, 1-10–1-12 ("applicable laws and regulations").
[111] For concise overviews*, see e.g.*, Gillon (2002), supra note 101, at 410; Rice, *supra* note 53, at Ch. 6, 6-17–6-20; UTTON CTR., *The Rio Grande as an International River*, in *WATER MATTERS!* (2015), at 26-1; *see also* Kelly (2007a), *Rio Grande Reservoirs*, supra note 62, at 536–40 (detailing history—legislative and otherwise—of Congressional authorization and construction of Elephant Butte Reservoir, including the interplay between the 1905 authorizing legislation and 1906 treaty with Mexico, vis-à-vis Mexican claims on water of the Rio Grande); *id.* at 538, n.56 (citing Art. I of 1906 treaty: 60,000 acre-feet).

[112] William A. Paddock, The Rio Grande Convention of 1906: A Brief History of an International and Interstate Apportionment of the Rio Grande, 77 Denv. U. L. Rev. 287 at 292 (1999).

[113] *Id.* at 296.

[114] *Id.* at 306.

[115] *Id.* at 312.

[116] Resolution Adopted by Rio Grande Compact Commission at the Annual Meeting Held at El Paso, Texas, February 22-24, 1948 (Changing Gaging Stations and Measurements of Deliveries by New Mexico).

2. *Interstate Compacts*[117]

As instruments of interstate cooperation, interstate compacts like the Rio Grande Compact are the preferred method of interstate allocation of water.[118] Under the compact clause of the U.S. Constitution, interstate compacts require Congressional consent,[119] which when conferred has the effect of transforming an interstate compact into Federal law. Compact law has also historically been coextensive with contract law,[120] yet compact meaning may not be defined unilaterally by one state for parochial concerns such as intrastate water allocation.[121] Correspondingly, "no court may order relief inconsistent with its express terms," absent a finding the compact is unconstitutional.[122] Nonetheless, intrastate allocation issues are potentially troublesome as a function of States' unwillingness to relinquish control of water resources in water-short years or basins.[123] The Supreme Court adjudicates compact disputes as a matter of course—and original jurisdiction—and may dictate remedies for their breach.[124] Finally, interstate compacts are also codified as State law.

a) Rio Grande Compact of 1938[125]

In 1929, Colorado, New Mexico, and Texas agreed to a temporary Rio Grande compact. Subsequently, a Federal Natural Resource Committee undertook an extensive evaluation of water supply and demand along the river that would form the basis for a definite apportionment of the river under the final 1938 Compact. In extensive negotiations, Colorado intended to "lock in" water uses from extensive development that occurred largely in the San Luis Valley. In turn, New Mexico desired a reservoir in its Middle Valley to smooth out late-season shortage which had become common. Finally, Lower Rio Grande users served by the Rio Grande Project, including some in Texas, demanded assurances that upstream uses would not leave them dry.[126]

A result of these tri-state negotiations, the Rio Grande Compact of 1938 became the primary legal constraint to water use in the state. The State's delivery obligations to Texas are based on indexed inflows (at the Otowi gage located at the confluence of the Rio Chama and Rio Grande near Española) and a

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[117] Portions of this section are adapted from McKenzie (2015a), *supra* note 32.

[118] *Id*.

[119] U.S. CONST. Art. I, §10, cl. 3.

[120] *See Green v. Biddle*, 21 U.S. 1 (1823) (interpreting an interstate compact, for the first time, as a contract). *See also Tarrant Regional Water Dist. v. Herrmann*, 133 S.Ct. 2120, 2130 (2013) ("[i]nterstate compacts are construed as contracts under the principles of contract law […] So, as with any contract, we begin by examining the express terms of the Compact as the best indication of the intent of the parties."); Petty v. Tenn.-Mo. Bridge Comm'n, 359 U.S. 275, 285 (1985) (Frankfurter , J., dissenting) ("[a] compact is, after all, a contract") and *Montana v. Wyoming*, 131 S.Ct. 1765 at n.4 ("As with all contracts, we interpret the Compact according to the intent of the parties […] We look primarily to the doctrine of appropriation in Wyoming and Montana, but…we also look to Western water law more generally."). *See also* U.S. CONST. art. I, §10, cl. 1 (precluding states' impairing obligation of contracts)

[121] *See, e.g.*, State *ex rel. Dyer v. Sims*, 341 U.S. 22, 28 (1951), *Nebraska v. Iow*a, 406 U.S. 117, 124 (1972).

[122] *Texas v. New Mexico* I, 462 U.S. 554, 564 (1983).

[123] Edella Schlager and T. Heikkila, Resolving Water Conflicts: A Comparative Analysis of Interstate River Compacts, 37 Pol'y Studies J., No. 3, at 371 (2009), (citing Jerome Muys, Comments at The Western States' Experience With Interstate Water Issues Panel: Lessons From the West, sponsored by American Bar Association Section of Environment, Energy, and Resources, at the conference Eastern Water Resources: Law, Policy and Technology, Hollywood, Florida (May 2004)).

schedule for outflows from Elephant Butte.[127] The obligations must be fulfilled regardless of rights under state law.[128] Pueblo water rights notwithstanding, this highest-level legal authority controls nearly every water law, policy, and management decision on the Rio Grande.

New Mexico's delivery obligations under the Compact are based on gaged (measured) inflows at Otowi, adjusted by the subtraction of releases of water from transmountain diversions made through the San Juan-Chama Project. This means that summer monsoon runoff within the Rio Grande Basin basins below Otowi and above Elephant Butte do not count towards New Mexico's obligations to Texas. Precipitation in the basin above Otowi does count in calculating New Mexico delivery obligations, since that precipitation tolls the Compact as it passes Otowi gage as surface runoff.

New Mexico's share of the Rio Grande is thus based on variable runoff, not set quantities as with other compacts.[129] But runoff is not the only factor in determining New Mexico's Compact compliance. Over the last half-century, increased municipal and environmental demands on the river have fundamentally altered the water budget of the basin.[130]

The bottom line is that, because the Compact sets the delivery obligation in terms of flows, it also only "sees" *net depletions*. Thus, New Mexico must control these depletions to meet its Compact delivery obligations as its own prerogative.[131]

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[124] *Id*. at (explaining that, as a function of their ratification of the U.S. Constitution, "the States gave this Court complete judicial power to adjudicate disputes among them...and this power includes the capacity to provide one state a remedy for the breach of another.") (citing *State of Rhode Island v. Com. of Massachusetts,* 37 U.S. 657 (1838)). *See also* U.S. CONST. art. 3, § 2, cl. 1 et seq. and *Kansas v. Nebraska*, 135 S. Ct. 1042, 1052 (2015) (noting more than one hundred years of the court's recognition of its "inherent authority, as part of the Constitution's grant of original jurisdiction, to equitably apportion interstate streams.") (citing *Kansas v. Colorado*, 185 U.S. 125, 145 (1902)).

[125] Rio Grande Compact, N.M. Stat. § 72-15-23 (1978). For a concise overview, *see* Hall (2007), *supra* note 8, at 55. For a brief history leading up to the Compact, *see* Harris (2007), supra note 50, at 10. *See also* Kevin Flanigan & Amy Haas, *The Impact of Full Beneficial Use of San Juan-Chama Project Water by the City of Albuquerque on New Mexico's Rio Grande Compact Obligations*, 48 NATURAL RES. J. 371, 377 (2007) ("The Compact"); U.S. BUREAU OF RECLAMATION, JOINT BIOLOGICAL ASSESSMENT, BUREAU OF RECLAMATION AND NON-FEDERAL WATER MANAGEMENT AND MAINTENANCE ACTIVITIES ON THE MIDDLE RIO GRANDE, NEW MEXICO, Pt. I-13 ("The Rio Grande Compact and Article VII Storage Restrictions") (2013), https://www.usbr.gov/uc/albuq/envdocs/ba/MRG/Part4/BA-Part-IV.pdf. [hereinafter JOINT BA]; Kery, *Overview* (2003), supra note 60, at 44–51. Also see June 2, 1959 amendments to the Rio Grande Compact.

[126] Harris (2007), *supra* note 50, at 10; *see also* WATER IN NEW MEXICO, *supra* note 50; REINING IN THE RIO GRANDE, *supra* note 50; G. EMLEN HALL, HIGH AND DRY: THE TEXAS–NEW MEXICO STRUGGLE FOR THE PECOS RIVER (Univ. of N.M. Press, 2002); DOUGLAS LITTLEFIELD, CONFLICT ON THE RIO GRANDE: WATER AND THE LAW, 1879-1939(Univ. of Okla. Press, 2008).

[127] *See* Resolution Adopted by Rio Grande Compact Commission *supra* note 116.

[128] *See* Hinderlider v. La Plata and Cherry Creek Ditch Co., 304 U.S. 92 (1938).

[129] *See generally* Sherk, G.W., Dividing the Waters: The Resolution of Interstate Water Conflicts in the United States (2000).

[130] *See, e.g*., Hall (2007), *supra* note 8, at 55–56.

[131] *Id*. at 55 (noting that New Mexico is on the hook for "shifts in net depletions created by rules of law" but arguing that "we don't know much . . . about" these rules).

b) Colorado River Compact[132] (1922)

The Colorado River Compact, negotiated among the seven states of the Colorado River Basin in 1922 and ratified by Congress in 1929, divided the basin into two subbasins, allocating water supplies among the "Upper Basin" (which New Mexico is a part) and the Lower Basin. It anticipated the possibility that water from within the Colorado's hydrologic basin would be exported to communities for use outside the hydrologic basin. The Compact's Article II(C) in fact defines "Colorado River Basin" as "all of the drainage area of the Colorado River System and *all other territory within the United States of America to which the waters of the Colorado River System shall be beneficially applied*." (emphasis added)

With flows declining as a result of climate change, Colorado River water users, including those in New Mexico, are already dealing with reduced supplies. In 2021, for example, San Juan-Chama users got just 60 percent of a normal supply, simply because the water wasn't there.

c) Upper Colorado River Basin Compact (1948)[133]

The 1922 Colorado River Compact left allocation of the waters within each subbasin ("Upper" and "Lower") for the states within each subbasin to work out. New Mexico joined with the other Upper Basin states in 1948 in negotiating the Upper Colorado River Compact. The Upper Basin Compact, which anticipated transmountain diversions, allocated 11.25 percent of the Upper Basin's Colorado River water to New Mexico.

Under the 1948 Upper Colorado River Basin Compact, the four states of the Upper Colorado River Basin – Utah, Wyoming, Colorado, and New Mexico – agreed to share in shortages on the river. The agreement calls for proportional sharing of shortages among the four states. But the legal definition of such shortages is unclear, as is the method that might be used to apportion those shortages and carry out any resulting cutbacks among each states' water users.

3. Authorizing Legislation

The backdrop of international treaty and interstate compact delivery obligations, along with Federal trust obligations with respect to Indian water rights, makes it clear that water management in New Mexico is a complex system. Along with these international and interstate delivery obligations, Federal claims to water also drive this system.

The largest water supplier in the West, Reclamation began building dams following the insufficiently capitalized efforts of private irrigation interests.[134] The Reclamation Act of 1902 first authorized the Interior Department—the Reclamation Service of the U.S. Geological Survey and its successor the Bureau of Reclamation—to carry out large irrigation water supply projects that would hasten development in the arid, public lands west of the 100th meridian.[135] Under this original mandate, Reclamation would build water supply infrastructure such as dams, diversions, irrigation ditches, and canals. Since 1902, Reclamation's dam-related mission has grown to incorporate such knock-on projects

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132 Colorado River Compact, 70 Cong. Rec. 324 (1928). For concise treatment, *see* Flanigan & Haas, *supra* note 125, at 377 (Colorado River Compact and Upper Colorado River Basin Compact); Gillon (2002), *supra* note 101, at 403–08 ("The Law of the Colorado River").

133 Upper Colorado River Basin Compact, ch. 48, 63 Stat. 31 (1949).

134 *See* Clark supra note 50 at 188-213.

135 Chris Bromley, A Political and Legal Analysis of the Rise and Fall of Western Dams and Reclamation Projects, 5 U. Denv. Water L. Rev. 204 at 204 (2001).

as hydropower generation, non-irrigation water supply, and recreation.[136] Regardless of the specific use, water that flows through Reclamation's project facilities is known as "project water."[137]

The USACE joined the dam building business in the 1930s, when Congress charged USACE with Federal flood-control activities. As with Reclamation's expanding mission, Congress would later authorize USACE' dam projects for multiple purposes beyond flood control, including hydropower, recreation, and both irrigation and municipal water supply.[138] Congress authorizes a particular Reclamation or USACE project with specific legislation that dictates the operational details of a particular project—usually in the form of specifying project purposes.[139]

The activities of both agencies are also governed by programmatic statutes that apply to all the respective agencies' projects, where Congress has not provided for exceptions.[140]

a) Selected Programmatic Statutes

(1) Reclamation[141]

The Reclamation Act of 1902 charged Reclamation with responsibility for the management and operation of its reservoirs—even after the termination of repayment obligations of individual project beneficiaries, such as irrigators.[142] Section 8 requires that the Interior Secretary "proceed in conformity with" state law "relating to the control, appropriation, use, or distribution of water used in irrigation, or any vested rights acquired thereunder…." This means that in the construction and operation of Reclamation projects, including the delivery of water, Reclamation must comply with state water law. Despite this limitation, states may not impose conditions on Reclamation projects that would frustrate congressional directives.[143]

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[136] R. Benson (2017), *supra* note 33, at 360–61, nn. 29–30, 32–35 and accompanying text; *see also* Reed Benson, *Dams, Duties, and Discretion: Bureau of Reclamation Water Project Operations and the Endangered Species Act*, 33 COLUMBIA J. ENVT'L L. 1, 8, nn.40–46 and accompanying text (2008) [hereinafter R. Benson (2008)]

[137] *See*, *e.g*., Reed Benson, *Whose Water Is It? Private Rights and Public Authority*, 17 VA. ENVT'L L.J. 363, 370–71 (1996–97) (containing an overview of Reclamation and "project water" legal and institutional regimes) [hereinafter R. Benson (1997)].

[138] *Id*. at 361–62, nn. 37–42 and accompanying text.

[139] *Id*. at 368–69, nn. 72-79 and accompanying text.

[140] *Id*. at 379.

[141] For excellent treatments of Reclamation law, including in the context of Reservoir operations, *see* R. Benson (2008), *supra* note 135, at 6–9 (overview of Federal Reclamation projects); R. Benson (2017), *supra* note 33, at 373–74. *See* also Rice, *supra* note 53, at 6–8. And for a great overview of Reclamation and "project water" legal and institutional regimes, *see* generally R. Benson (1997), *supra* note 136. *See* also general reclamation laws after 1902 which affect national policy for the Bureau: 43 U.S.C. § 521 (2012) (allowing, subject to certain requirements, sale of surplus project water); 43 U.S.C. § 374 (2007) (reiterating primacy of state water law); § 9 of the 1939 Reclamation Project Act, 43 Stat. 1194 (codified at 43 U.S.C. § 485h), and the 1982 Reclamation Reform Act, P. L. No. 97-295, 96 Stat. 1263 (codified as amended at 43 U.S.C. §§ 390aa–390zz-1), cited in R. Benson (2008), *supra* note 135, at 7, n.33; *see also* Gillon (2002), *supra* note 101, at nn.49–52 and accompanying text (providing an overview of Reclamation law and its effect on the environment of the West).

[142] Act of June 17, 1902, ch. 1093, 32 Stat. 388 (codified in scattered sections of 43 U.S.C. §§ 371–498) [hereinafter Reclamation Act of 1902]. *See*, *e.g*., *id*. § 8 (re: conformity with state laws).

[143] R. Benson (2008), *supra* note 135 (citing California v. United States, 438 U.S. 645, 675 (allowing states to condition Reclamation projects, not inconsistent with Congressional directives)).

(2) USACE[144]

(a) 1936 Flood Control Act

In the Flood Control Act of 1936, Congress granted USACE authority over flood control.[145] Specifically, the Flood Control Act of 1936 provided that "flood control on navigable rivers or their tributaries is a proper activity of the Federal Government in cooperation with States' and local governments."[146] Accordingly, the Act charged USACE with responsibility for "Federal investigations and improvements of rivers and other waterways for flood control and allied purposes. In carrying out such work, however, Congress directed USACE not to "interfere with" Reclamation's projects, including such incident "investigations" and related "river improvements".[147] As we explain below, Reclamation and USACE would indeed collaborate in water resources development in central New Mexico in the mid-twentieth century, as they prepared the "joint investigation" for the Middle Rio Grande Project.

(b) 1944 Flood Control Act[148]

The Flood Control Act of 1944, in turn, required USACE to develop regulations for the use of flood control storage—even at non-USACE reservoirs.[149] In doing so, the Act gave USACE jurisdiction over the Federal government's in-stream flood control activities,[150] thus giving USACE regulatory power over the flood control aspects of even existing Reclamation dams. Further, the Act contained important water supply provisions, which permitted the addition of domestic and irrigation water supply. Specifically, USACE was permitted to market "surplus" water for domestic—i.e., municipal and industrial—uses, provided that such water supply contracts did not harm "existing lawful uses of such water."[151] The Act also permitted Reclamation to develop irrigation water supplies at USACE projects, but only with the specific determination by USACE that such a project "may be utilized for irrigation purposes."[152]

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[144] *See* Brad Hudgens, U.S. Army Corps of Engineers Institute for Water Resources, *Corps Water Supply Storage 101* (2016) (providing summary of key "guideposts"); Flatt & Tarr, *supra* note 23, at Pts. IV, V (analyzing legal authority for USACE's reservoir operations); R. Benson (2017), *supra* note 33, at 371–72 (detailing "key elements" of USACE's legal regime w.r.t. projects operations, noting legal requirement and authorities for "range of project purposes").

[145] Act of June 22, 1936, ch. 688, 49 Stat. 1570.

[146] 33 U.S.C. § 701a (2012).

[147] *Id*. § 701b.

[148] *See* R. Benson (2017), *supra* note 33, at 371–72, nn. 84–87, 88, 92 and accompanying text (providing over of key provisions of legislation); Flatt & Tarr, *supra* note 23, at 1529, tbl. 1, nn. 187–89 and accompanying text ("Allows the addition of recreation as an authorized purpose. Permits USACE to allocate surplus water for domestic use.")

[149] P.L. No. 78-534, § 7, 58 Stat. 887, at 890-91 (codified at 33 U.S.C. § 709).

[150] *Id*. § 2, 58 Stat. at 889 (codified at 33 U.S.C. § 701a-1).

[151] *Id*. § 6, 58 Stat. at 890 (codified at 33 U.S.C. § 708)

[152] *Id*. § 8, 58 Stat. at 891 (codified at 43 U.S.C. § 390).

(3) Reclamation and USACE

(a) Water Supply Act of 1958[153]

As broad as Reclamation's and the USACE's water management mandates may be, the Water Supply Act of 1958 limits the degree to which both agencies can unilaterally re-purpose or re-operate water projects.[154] The Act required that Congress approve "[m]odifications of a reservoir project heretofore authorized, surveyed, planned, or constructed to include storage" if such modifications "would seriously affect the purposes for which the project was authorized, surveyed, planned, or constructed, or which would involve major structural or operational changes." It has been argued that while this provision limits agencies' ability to unilaterally alter project purposes, it implicitly permits *non*-"major" changes to project operations, thus affording Reclamation and USACE a degree of discretion in operating their projects.[155]

(b) Endangered Species Act[156]

Under Section 7(a)(2) of the Endangered Species Act (ESA), both Reclamation and USACE—and all Federal agencies—must also ensure that their actions do not "jeopardize the continued existence" of endangered species or harm their critical habitat.[157] To this end, Federal agencies must first determine whether their proposed action(s) "may" affect the endangered species or its habitat.[158] If the answer is yes, the agency is required to consult with the USFWS.[159] After this consultation process, USFWS issues a Biological Opinion by way of assessing the "likely effects" of the proposed agency action.[160] Should FWS determine that harm is "likely" to occur to the listed or endangered species or its habitat, the Biological Opinion must issue a "Reasonable and Prudent Alternative"—measures the agency may take to avoid affecting the species.[161] In other words, under a "jeopardy" determination," USFWS must identify alternative measures that permit the Federal "action agency" to proceed with the proposed activit[ies] in a manner that avoids jeopardy. "At that point, an agency must either terminate an action likely to harm an endangered species (according to FWS's Biological Opinion), seek an exemption, or follow the Reasonable and Prudent Alternative."[162]

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[153] *See generally* Flatt & Tarr, *supra* note 23, at 1522, nn. 133–34 and accompanying text ("The WSA of 1958 requires congressional approval for a major allocation change to a previously authorized project that stores water. Section 301 of the Act, which requires congressional approval of modifications to a Reservoir project that 'would seriously affect the purposes for which the project was authorized,' has not been the subject of much litigation."); *id*. at 1529, nn. 190–91 and accompanying text (Act "[r]equires congressional approval of a 'major structural or operational change' and modifications that 'seriously affect' authorized purposes.")

[154] P. L. No. 85-500, Stat. 297, § 301 ("major" changes).

[155] R. Benson (2017), *supra* note 33, at 370–71, nn.81-83.

[156] *See, e.g.*, *WEG v. Corps*, 314 F.Supp.3d at 1184–85 (summarizing relevant provisions).

[157] 16 U.S.C. § 1536.

[158] 50 C.F.R. § 402.14(a).

[159] *See* 50 C.F.R. §§ 402.13, 402.14

[160] *See* 16 U.S.C. § 1536(b)(3)(A); 50 C.F.R. § 402.14(g)—(h).

[161] 50 C.F.R. § 402.14(h).

[162] *Rio Grande Silvery Minnow*, 601 F.3d at 1106.

b) Project-Specific Authority[163]

In terms of magnitude, the largest basis for the non-treaty Federal claims to (and control of) water in New Mexico are Federal water projects, first developed—as discussed above—by Reclamation. On the Rio Grande, these include the Rio Grande Project, the Middle Rio Grande Project, and the San Juan-Chama [Diversion] Project (a component of the Colorado River Storage Project).

Between Heron and Elephant Butte (San Juan-Chama and Rio Grande Projects, respectively), the four reservoirs which comprise the Middle Rio Grande Project are operated as a system. Unlike Heron and Elephant Butte, however, flood control is the primary purpose of these Middle Rio Grande Project reservoirs: Abiquiu, on Rio Chama; Cochiti, on the mainstem Rio Grande; and Galisteo and Jemez Dams, which are minor tributary facilities. Some Middle Rio Grande facilities, however, also store and release water imported through the San Juan-Chama Project—meaning that an understanding of these facilities is a prerequisite to a robust understanding of reservoir operations as a whole.

(1) Middle Rio Grande Project[164]

Congressional authorizations of the Middle Rio Grande Project, which joined flood and sediment control purposes with re-development of agricultural lands in the Rio Grande's Middle Valley, occurred over a nearly 20-year period. In 1941, Congress authorized preliminary flood control studies[165] and not until 1960 was the "Reservoir Regulation Plan" for the Project's component reservoirs defined by statute.[166] In the intervening years, Congress would:

1) approve the USACE's and Reclamation's "Rio Grande Basin Comprehensive Plan" for water resources development;
2) require the Project be operated in strict compliance with the Rio Grande Compact;
3) define flood control as the sole purpose of the project's reservoirs;
4) provide for rehabilitation of MRGCD's existing dam and diversion facilities; and
5) authorize and define operations first at Abiquiu and then Cochiti Dam and Reservoir.

Subsequent to these legislative underpinnings for Abiquiu and Cochiti, Congress would later authorize a permanent recreational pool at Cochiti, as well as expanded storage at Abiquiu that would include both imported San Juan-Chama and native Rio Grande Basin water—beyond these facilities' original, solely flood control authorized purpose.[167]

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[163] For useful summaries, *see* M.H. Benson (2014), *supra* note 9, at 207, Table 2 (summarizing management authorizations for Heron, El Vado, Abiquiu, and Cochiti). *See also WildEarth Guardians*, 314 F.Supp.3d 1178, 1185–86.

[164] *See* Abiquiu WCM, *supra* note 282, at III ("History of Project); *id*. ¶ 3-01 (authorization); *id*. ¶ 3-02 – 3-04 (planning and design, construction, and related projects, respectively); *see generally* Andrew Gahan, U.S. BUREAU OF RECLAMATION, *Historic Reclamation Projects* (May 2013) (including selected references from WATER IN NEW MEXICO, *supra* note 50); JOINT BA, supra note 125, at Pt. I, I-5–I-7 ("The Middle Rio Grande Project"); *id*. at Pt. 1, 1-10 (Middle Rio Grande Project and MRGCD Water Rights).,

[165] Flood Control Act of 1941, P. L. No. 77-228, § 4, 55 Stat. 638 (authorizing "preliminary examinations and surveys for flood control" in, *inter alia*, "Rio Grande and tributaries, New Mexico").

[166] Flood Control Act of 1960, P. L. No. 86-645, 74 Stat 480, 488.

[167] *WildEarth Guardians*, 314 F.Supp. at 1185–86.

As a prefatory matter, please note that the history and operations of two of USACE's Middle Rio Grande Project facilities, Galisteo and Jemez Dams, will not be discussed in detail. Both dams are operated solely for flood control purposes and do not comprise components of the reservoir operations system for the Rio Chama "Wild and Scenic" reach on which this study focuses. Specifically, they are operated as "dry dams," i.e., they only temporarily store flood waters, which pass unimpeded through the flood control structures. Jemez operations have, however, formed part of innovative water operations in the Middle Rio Grande—as recently as fifteen years ago. This anecdote will be discussed, *infra*.

(a) Flood Control Acts of 1948, 1950: Legislative Underpinnings[168]

The Flood Control Act of 1948[169] orients all subsequent flood control developments in the Middle Rio Grande and is the "legislative underpinning" for USACE's operations at Abiquiu.[170] The 1948 Act approved Reclamation's and USACE's Rio Grande Flood Control Program,[171] which had recommended a flood control dam on the Rio Chama.[172] (The 1950 Flood Control Act[173] would, in turn, authorize the remainder of the Rio Grande [Comprehensive] Flood Control Program first authorized under the 1948 Act.)[174] Under the 1948 Act, the capacity of the then-proposed Chamita and Abiquiu reservoirs was effectively limited to 700,000 acre-feet.[175] Under this provision, construction of spillway gates or controlled outlets would be precluded so long as New Mexico continued to have an accrued-debit position under the Rio Grande Compact.[176]

[168] See generally Kelly (2007a), Rio Grande Reservoirs, supra note 62, at 548–59 (describing the legislative history and larger framework for Middle Rio Grande Project, including Abiquiu Reservoir). The 1948 Flood Control Act provides "legislative underpinnings for USACE's Abiquiu Reservoir operations). *Id*. at 547; Albert E. Utton, Utton Ctr., A Legislative History of the Rio Grande Reservoirs (June 29, 1979), [hereinafter Utton (1979), Legislative History]; *see also* Kara Gillon, An Environmental Pool for the Rio Grande, 47 Natural Res. J. 615, 618 (2006) [hereinafter Gillon (2007)]; *id*. at 116–17 and accompanying text.

[169] Flood Control Act of 1948, P. L. No. 81-858, 62 Stat 1171, 1175–82 (codified at 33 U.S.C. § 701((s) (2012).

[170] Kelly (2007a), *Rio Grande Reservoirs*, *supra* note 62, at 547.

[171] § 203(a), 62 Stat. at 1179 (approving Rio Grande Basin Comprehensive Plan, as set for in [1] Chief of Engineers report (Apr. 5, 1948) and [2] Bureau of Reclamation report (Nov. 21, 1947), "all in substantial accord" with the [3] USACE/Interior Agreement of November 21, 1947—*except insofar as* the recommendations in those reports are inconsistent with the provisions of this Act and subject to the authorizations and limitations set forth herein." (emphasis added).)

[172] The subsequent authorization of Cochiti Dam and Reservoir was a direct outgrowth of this legislation. Utton (1979), *Legislative History*, *supra* note 167, at 32.

[173] Flood Control Act of 1950, Ch. 188, Section 204 P. L. No. 81-516, 64 Stat. 170, 176 (1950); *see also* Gillon (2007), *supra* note 167, at nn.100-102 and accompanying text (regarding Flood Control Acts if 1948, 1950, and 1960 which authorized Abiquiu and set forth its operating criteria).

[174] § 204, 64 Stat. at 176 (authorizing, "in accordance with the respective reports hereinafter designated" completion of the Rio Grande Basin [Comprehensive Plan?] authorized in the Flood Control Act of 1948 "as set forth in House Document Numbered 243, Eighty-first Congress.").

[175] Utton (1979), *Legislative History*, *supra* note 167, at 61, n.114.

[176] *Id.*

The Middle Rio Grande Project also included a bail-out of the faltering Middle Rio Grande Conservancy District.[177] In exchange, Reclamation would take title to the MRGCD's facilities and related property interests.[178]

In this vein, the 1948 Flood Control Act called for:

1) the rehabilitation of the MRGCD's water storage and diversion facilities, including El Vado Dam;
2) the channelization of 127 miles of the Rio Grande; and
3) the assumption of the MRGCD's outstanding debt.[179]

For such purposes as these, the Act defined beneficial uses of Project water as "primarily [for]...domestic, municipal, and irrigation purposes."[180]

Importantly, the 1948 Flood Control Act contains explicit provisions requiring that Middle Rio Grande Project facilities—including Abiquiu—be operated in accordance with the Rio Grande Compact. It provided that the project would be operated in accordance with the Compact and, moreover, would be operated "solely" for flood control when New Mexico has accrued debits under the Compact.[181] While this language would seem to imply that the Project could conceivably be operated for other purposes when New Mexico had accrued credit under the Compact, the Flood Control Act of 1960—which details the Project's "Reservoir Regulation Plan"—contains different language. This subsequent language, discussed in detail *infra*, constrained the Project's operation for secondary purposes—eliminating the "accrued debit" condition for sole flood control purpose. For now, the operative point is that the Flood Control Act of 1960, as the latter-in-time statute, arguably contains controlling language with respect to non-primary purposes of project reservoirs.[182]

Finally, the 1948 Flood Control Act established that the Middle Rio Grande Project would not abrogate either New Mexico water law or the United States' obligations towards Indian Tribes and pueblos. The Act first stated its non-effect with respect to vested, state-law-based water rights or New Mexico laws regarding the "control, appropriation, or distribution of water" for irrigation, municipal, or "other

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[177] § 203(a), 62 Stat. at 1179 ("Construction of the spillway gate at Chamita Dam shall be *deferred so long as Mexico shall have accrued debits* as defined by the Rio Grande Compact an*d until New Mexico shall consistently accrue credits* pursuant to the Rio Grande Compact.")

[178] *Id*. at nn.117 and accompanying text (citing Memorandum Opinion and Order, *Rio Grande Silvery Minnow v. Keys, et al*., No. CV 99-1320 JP/RHS-ACE (D.N.M. July 25, 2005) (holding that title to these facilities vested in the United States in the 1950s and remains with the United States); Gillon (2002), *supra* note 101, at nn.111–113; Utton (1979), *Legislative History*, *supra* note 167, at 34–35.

[179] *See* § 203(a), (d) (referencing Rio Grande Comprehensive Plan and authorizing the purchase of outstanding MRGCD debt); § 203(a), 62 Stat. at 1179); *see also* Gillon (2007), *supra* note 167, at nn.116 (citing MIDDLE RIO GRANDE CONSERVANCY DISTRICT, *Water Policies Plan* 22 (C.T. DuMars & S.C. Nunn eds., 1993) and *Middle Rio Grande Water Users Ass'n v. Middle Rio Grande Conservancy Dist.*, 258 P.2d 391, 393 (N.M. 1953) (holding the 1951 contract between MRGCD and Reclamation valid.).

[180] 62 Stat. at 1180–81.

[181] § 203(d), 62 Stat. at 1179.

[182] Utton (1979), *Legislative History*, *supra* note 167, at 2 (noting the 1960 Act drops the "accrued credit" language).

uses."[183] Second, the Act stated it would not interfere with the United States government's existing obligations towards Tribes and Pueblos.[184] This later provision explicitly incorporated "[the United States] obligations to furnish water for irrigation and obligations to any Indian or Tribe or band of Indians whether based on treaty, agreement, or Act of Congress."[185]

(b) Flood Control Act of 1960: Reservoir Regulation Plan[186]

The Flood Control Act of 1960,[187] in turn, authorized Cochiti Dam and Reservoir[188] and contained detailed requirements for the operation of project reservoirs—the so-called "Reservoir Regulation Plan." In further modification to the 1948 Comprehensive Plan, the 1960 Act memorialized recommendations in a late-1950s USACE report that the City of Albuquerque be afforded additional flood control benefit, thus authorizing Cochiti Dam.[189]

As noted above, the Flood Control Act of 1960 also constrained Middle Rio Grande Project purposes; the Project would now be operated "solely" for flood control.[190] Despite the limitation, the 1960 Flood Control Act continued the clear mandate, carried over from the 1948 Flood Control Act,[191] that the Rio Grande Compact was to be the ultimate law of the river with respect to the operation of the Middle Rio Grande Project. This time, the Rio Grande Compact Commission would be the last word regarding "deviations" from normal operations, i.e., those delineated in the Act's "Reservoir Regulation Plan."[192] That is, the Flood Control Act of 1960 provided that the Middle Rio Grande project reservoirs would be operated in compliance with the Rio Grande Compact but that departures from the regulation plan could only occur with the advice and consent of the Compact Commission—or in the case of an emergency.[193]

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[183] 62 Stat. at 1180–81.

[184] 62 Stat. at 1181.

[185] *Id*.

[186] For a useful summary and relevant excerpts, *see WildEarth Guardians*, 314 F.Supp.3d 1178, 1185–92.

[187] Flood Control Act of 1960, P. L. No. 86-645, 74 Stat 480, 488; *see also* 33 C.F.R. § 208.11(d)(9) (2006).

[188] Please note that while Cochiti Dam and Reservoir is clearly a central component of the Middle Rio Grande Project, this report will not discuss Cochiti operations, or relevant legislative history, in detail. For an excellent treatment of Cochiti's authorization, *see* Kelly (2007a), *Rio Grande Reservoirs*, *supra* note 62, at 559–64 (describing the background and legislative history for Cochiti Reservoir, a component of the Middle Rio Grande Project). The Flood Control Act of 1960 authorized, *inter alia*, Cochiti Reservoir, in modifications to the 1948 Comprehensive Plan, per USACE's recommendations, to provide Albuquerque with additional flood control protection. *Id*. at 559–60.

[189] 74 Stat. at 492–93.

[190] (Notwithstanding language in the 1948 Flood Control Act, which suggested other purposes might have passed muster were New Mexico to achieve a Compact credit status.) 74 Stat. at 493 ("Cochiti Reservoir...and all other Reservoirs constructed by USACE as a part of the Middle Rio Grande project, will be operated solely for flood control and sediment control, as described below [in the Reservoir Regulation Plan]).

[191] *Id.*

[192] 74 Stat. at 493.

[193] *Id*. ("[a]ll Reservoirs of the Middle Rio Grande Project will be operated at all times in the manner described above in conformity with the Rio Grande compact, and no departure from the foregoing operations schedule will be made except with the advice and consent of the Rio Grande Compact Commission."

In other words, the Reservoir Regulation Plan mandates Compact compliance and sets flood and sediment control as the primary drivers of reservoir operations.

Indeed, Flood Control Act of 1960's Reservoir Regulation Plan requires that the Middle Rio Grande Project "be operated solely for flood control and sediment control,"[194] but subjected this primary purpose to specific operational conditions.[195] The main constraints dictate that:

1) Cochiti's outflow is limited to the Rio Grande's safe channel at Albuquerque;[196]
2) flood control dictates reservoir system operation;[197] and
3) departures from the [reservoir] regulation plan may only occur only with advice and consent of the Rio Grande Compact Commission.[198]

The Reservoir Regulation Plan further provides that:

4) USACE must try not to store in the upper 212,000 acre-feet of Cochiti storage;[199]
5) all Middle Rio Grande reservoirs must be completely evacuated by March 31 every year, to create storage capacity to absorb spring snowmelt runoff;[200] and
6) the USACE must, at New Mexico's request, make maximum–channel–capacity–deliveries (measured at Albuquerque), when forecasts[201] indicate that Middle Rio Grande Project operations "may affect the benefits accruing to New Mexico or Colorado" under Compact Article VI.[202]
7) transbasin water, imported for recreation and fish and wildlife purposes, is excepted from the 212,000 acre-feet reserved storage in Cochiti Reservoir.[203]

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194 *Id*. ("Cochiti Reservoir...and all other Reservoirs constructed by the U.S. Army Corps of Engineers as a part of the Middle Rio Grande project, will be operated solely for flood control and sediment control...").

195 *Id*. ("...(c) Subject to the foregoing, the storage of water in, and the release of water from, all Reservoirs constructed by the U.S. Army Corps of Engineers as part of the Middle Rio Grande Project will be done as the interests of flood and sediment control may dictate").

196 *Id*. ("...(a) the outflow from Cochiti Reservoir during each spring flood and thereafter will be at the maximum rate of flow that can be carried at the time in the channel of the Rio Grande through the middle valley without causing flooding of areas protected by levees or unreasonable damage to channel protective work").

197 *Id*.

198 *Id*.

199 *Id*. ("[T]he U.S. Army Corps of Engineers will endeavor to avoid encroachment on the upper two hundred and twelve thousand acre-feet of capacity in Cochiti Reservoir[.]").

200 *Id*.

201 *See, e.g.*, Abiquiu WCM, *infra* note 282, at 6-1 – 6-03, ¶ 6-02 ("Flood Condition Forecasts); *id*. at 6-4, ¶ 6-05 ("Drought Forecasts).

202 *Id*.

203 *Id*. ("The foregoing regulation shall not apply to storage capacity which may be allocated to permanent pools for recreation and fish and wildlife propagation...*Provided*, that the water required to fill and maintain such pools is obtained from sources entirely outside the drainage basin of the Rio Grande.").

In other words, the Reservoir Regulation Plan mandates Compact compliance and sets flood and sediment control as the primary drivers of reservoir operations.

(2) San Juan Chama Project[204]

Unlike "native" basin waters impounded by the Middle Rio Grande Project, water imported from the Colorado River Basin by the San Juan-Chama Project is technically exempt from that fundamental limit on water use in New Mexico. The transbasin water scheme was originally authorized by Congress in 1962 as an amendment to the Colorado River Storage Project of 1956. In general terms, the San Juan-Chama Project is the vehicle for New Mexico's use of a large share of its allotment as an Upper Basin state within the Colorado River Basin. As described above, the Upper Colorado River Basin Compact of 1948 allocated the Upper Basin's Colorado River Compact allocation of 7.5 million acre-feet per year among Upper Basin states. In this scheme, New Mexico is statutorily permitted to divert an average, "firm yield" of 96,200 acre-feet from the San Juan River basin by tunnels through the continental divide and into the Rio Grande Basin. While the Rio Grande Compact, by nature, does not limit the use of this imported water, the Compact provides that beneficial use of San Juan-Chama water will occur within New Mexico.[205] Nonetheless, once San Juan-Chama and native waters are commingled, the physical reality renders this limitation an accounting exercise.[206]

(a) Colorado River Storage Project Act, Public Law (P.L.) 84-485 (1956)[207]

The Colorado River Storage Project Act of 1956 (CRSPA) prioritized completion of a planning study that would serve as the technical basis for the San Juan-Chama Project. It also set out the purposes of the Colorado River Storage Project as a whole, in order to "comprehensive[ly] develop the water resources of the Upper Colorado River Basin."[208] With respect to the then-proposed San Juan-Chama diversion, CRSPA required that storage of imported water:

1) be limited to a single off-stream dam and reservoir on a tributary of Rio Chama,
2) be used solely for control and regulation …, and
3) be operated at all times by Reclamation … in strict compliance with the Rio Grande Compact *as administered by the Rio Grande Compact Commission*.[209]

[204] For concise overviews, *see* Abiquiu WCM, *infra* note 282, at 9-2, ¶ 90-1(b) ("Bureau of Reclamation"); Boroughs (2010), *infra* note 585, at 2, 5. *See generally* Gillon (2007), *supra* note 167, at 617–19; Joint BA, *supra* note 125, at Pt. I, I-3–I-5 ("The San Juan-Chama Project"); Utton (1979), *Legislative History*, *supra* note 167; Flanigan & Haas, *supra* note 125, at 374–79.

[205] N.M. STAT. § 72-15-23 (1978), at Art. X.

[206] See Utton (1979), Legislative History, supra note 167, at 23; Department of the Interior, Bureau of Reclamation, Project History, Vol. XV, The San Juan-Chama Project, Colorado—New Mexico 5 (1977) [hereinafter San Juan-Chama Project History], ("the problem of compliance with the Rio Grande Compact resolves itself into assessing the effect operation of the San Juan-Chama Project has on the Otowi Index Supply used to determine New Mexico's obligation to deliver water under the Rio Grande Compact.").

[207] Act of April 5, 1956, P. L. No. 37, 70 Stat. 105 (1956) ("An Act to Authorize the Secretary of the Interior to Construct, Operate, and Maintain the Colorado River Storage Project and Participating Project, and for Other Purposes").

[208] 70 Stat. 106.

[209] *Id.* (emphasis added).

And with respect to overall Project purposes, the Act authorized the construction, operation, and maintenance of "dams, reservoirs, power plants, transmission facilities and appurtenant works" for the following purposes:

1) regulating the flow of the Colorado River, storing water for beneficial consumptive use,
2) making it possible for the States of the Upper Basin to utilize, consistently with the provisions of the Colorado River Compact, the apportionments made to and among them in the Colorado River Compact and the Upper Colorado River Basin Compact, respectively, [and]
3) providing for the reclamation of arid and semiarid land, for the control of floods, and for the generation of hydroelectric power, as an incident of the foregoing purposes.[210]

CRSPA requires compliance with various legislative and treaty components of the Laws of the River for both the Colorado and the Rio Grande. Accordingly, Project facilities must be operated consistent with:

- the Boulder Canyon Project Act,[211]
- the Boulder Canyon Project Adjustment Act,[212]
- the Colorado River Compact,
- the Upper Colorado River Basin Compact,[213]
- the Rio Grande Compact,[214] and
- the 1944 Treaty with Mexico.[215]

Leading up to CRSPA, consideration was given to the effect of a regulating reservoir on the Rio Chama on New Mexico's Rio Grande Compact obligations. Despite San Juan-Chama's inclusion as a project, CRSPA did not immediately authorize the Project so that further studies could be conducted to address whether Project storage would interfere with New Mexico's Compact delivery obligations. The same Rio Grande Joint Investigation that would serve as the technical basis for negotiation of the Compact was also a continuation of pilot studies on such a transbasin diversion from the San Juan River begun in the 1920s. Indeed, the year before CRSPA was enacted, Congress considered legislation that would have authorized the San Juan-Chama Project pursuant to a significant, Compact-informed constraint. That provision would have eliminated "regulatory storage on the Rio Chama to ensure that the project would not interfere with the delivery of Rio Chama flows which, under the provisions of the Rio Grande Compact belong to the downstream users."[216]

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[210] *Id.*

[211] P. L. No. 70-642, 45 Stat. 1057 (1928).

[212] P. L. No. 76-643, 54 Stat. 774 (1940).

[213] *See supra*.

[214] N.M. STAT. § 72-15-23.

[215] § 9, 70 Stat. 110.

[216] Utton (1979), *Legislative History*, *supra* note 167, at 9, n.10 and accompanying text.

(b) San Juan Chama Project Act, P.L. 87-483 (1962)[217]

In 1962, the Colorado River Storage Act of 1956 was amended to authorize the San Juan-Chama Project. The intervening years allowed more detailed study that would result in a definitively multi-purpose project from the beginning.[218] During this time, adjustments were made to the amount of water to be diverted. Because of uncertainty in diversion requirements, New Mexico petitioned Congress for an initial stage of 110,000 acre-feet per year average—compared with the full 235,000 acre-feet diversion originally authorized.[219] In contrast to the uncertainty surrounding the quantity of diversion requirements, however, the project plan clearly considered municipal, industrial, and irrigation supply, including for "tributary irrigation units" further to the east in northern New Mexico.[220] According to the Project Plan, San Juan-Chama was intended to provide an "adequate" water supply for the growing Albuquerque metro area, as well as a "supplement[al]" source of water for the MRGCD's "225,455 acres of irrigable land in the project area."[221]

Between 1958, when a bill considering San Juan-Chama Project authorization was first considered, and 1962, when the Project was authorized, extensive hearings addressed the concerns of downstream states California and Texas, as well as other parties [e.g., Animas-La Plata Project water users]. California was opposed to the Project, concerned that, together with the Navajo Indian Irrigation Project, it would result in New Mexico's using more than its allotment of Colorado River basin water. Downstream Texas, though not opposed to the Project per se, demanded incorporation of certain provisions authorizing legislation that would require and facilitate physical compliance with the Rio Grande Compact. Such measures would clarify water accounting and project operations as well as improve technical understanding of the commingled native Rio Grande and transbasin waters.[222]

The San Juan-Chama project was finally authorized in 1962, as "substantially described" in the October 16, 1957 Reclamation report.[223] The Project's authorizing legislation generally provided for "furnishing water for the irrigation of irrigable and arable lands"[224] and for "municipal, domestic, and industrial uses,…. [and] recreation and fish and wildlife benefits…."[225]

Specifically, the "principal purposes" of the transbasin diversion Project were to supply water to:

- the Cerro, Taos, and Pojoaque tributary irrigation units (39,300 acres);
- the MRGCD [81,600 acres];
- "municipal, domestic, and industrial uses"; and
- "recreation and fish and wildlife…."[226]

The San Juan-Chama Project Act (SJCPA) also specified various aspects of project operations. At a global level, transbasin diversions were capped at 1,350,000 acre-feet over ten years, with a maximum of

[217] Act of June 13, 1962, P. L. No. 87-483, 76 Stat. 96–102; *see generally* Utton (1979), *Legislative History*, *supra* note 167; U.S. DEP'T OF INTERIOR, BUREAU OF RECLAMATION, PLAN FOR THE DEVELOPMENT OF THE SAN JUAN-CHAMA PROJECT (Nov. 1955).
[218] Utton (1979), *Legislative History*, *supra* note 167, at 9–10.
[219] *Id*. at 10, nn. 15, 16 and accompanying text.
[220] *Id*. at 16.
[221] *Id*. at 10, n.13 and accompanying text (citing Project Plan, 1955, at 6).
[222] *Id*. at 11-12 (citing Dixon, 1957).
[223] Act of June 13, 1962, P. L. No. 87-483, § 1, 76 Stat. 96–102.
[224] § 1, 76 Stat. at 96.
[225] *Id*.
[226] § 8, 76 Stat. at 97–99.

270,000 acre-feet in any given year.[227] Operation of "all project works" was, in turn, required to maintain "conformity with the Rio Grande Compact."[228] This conformity is vouchsafed by detailed technical accounting of waters.[229] For the development of the "essential" accounting operations, the Act requires the participation of the Rio Grande Compact Commission—along with its counterpart the Upper Colorado River Basin Compact Commission, and "appropriate" state and Federal agencies.[230]

Significantly, SJCPA also limits project diversions to the "amount of imported water available to such uses from importation to and storage in the Rio Grande Basin in that year."[231] The interpretation of this particular section will be discussed further below, but for now, it will suffice to note that legal scholars have indicated Section 8(d) of the Act has been interpreted as preventing carryover storage of contractor water at Heron Reservoir beyond the putative year-end take delivery deadline.[232]

While SCJPA required the Project comply with relevant provisions of both the Upper Colorado and Colorado River Compacts,[233] perhaps more pragmatically it also addressed the sharing of water shortage and surplus. The amount of Project water that the Interior Secretary could contract out was limited to firm yield, and these water supply contracts were required to contain shortage-sharing provisions. Further, projected runoff would thus be shared pro-rata according to normal diversion requirements. Otherwise, if physical shortfall would result, curtailment would occur in a similar pro-rata fashion. Also, when Upper Basin water determined "legally available" for use in the Upper Basin that would not otherwise be consumed or needed to fulfill Lee's Ferry delivery obligations, the Secretary was also authorized to enter temporary, short-term contracts.[234]

Finally, the San Juan-Chama Project legislation authorized original jurisdiction action before the U.S. Supreme Court. To head off any unforeseen equitable interstate allocation issues, the "Kuchel amendment" was included at the behest of the Senator from California. The Act thus provides consent for joinder of the United States as a party in such suit when Secretary of Interior fails to comply with relevant law in operating the project.[235]

[227] *Id*. § 8(a).

[228] *Id*. §8(c).

[229] *Id.* §13(a).

[230] *Id*. §8(e).

[231] *Id*.

[232] *See* Kelly (2007a), *Rio Grande Reservoirs*, *supra* note 62, at 589; *but see* Emmet Rice, Reclamation Field Solicitor Opinion (Nov. 3, 1983) (memorandum providing legal rationale for carryover storage where benefit "inures" to the Federal government, not any individual San Juan Chama Project water contractor) (cited in URG Water Operations Review, *supra* note 84, Vol. II, at App. I, I–11).

[233] § 12(a) – (b), 76 Stat. at 100–101 (Upper Colorado River Basin allocation); *id*. § 16 (Colorado River Compact Art. III(d): Upper Basin's 7.5 million acre-feet delivery obligation at Lee's Ferry).

[234] § 11(a), 76 Stat. at 99–100.

[235] § 14, 76 Stat. at 101–102; *see also* Kelly (2007a), *Rio Grande Reservoirs*, *supra* note 62, at 591, 595 (explaining that this provision removed the "impasse" between New Mexico and California regarding purportedly illegal use of [Colorado Basin-] San Juan-Chama water for non-Colorado Compact states—i.e., Texas—by way of New Mexico's use of San Juan-Chama water to "pay off" Rio Grande Compact debts to Texas).

(c) Subsequent Developments

(3) *Authorizing Legislation*

(a) Cochiti: Permanent Recreation Pool (1964)[236]

Cochiti Dam and Reservoir were subsequently authorized by the Flood Control Act of 1960. As noted above, however, Cochiti's legislative authorization is beyond the scope of this report. It will suffice to note that Cochiti was authorized pursuant to modifications to the 1948 Comprehensive Plan. Specifically, USACE had recommended that, as a growing metropolitan area, Albuquerque be afforded additional flood control protection.[237]

Less than four years after Congress authorized Cochiti, and just two years after it authorized the San Juan-Chama Project, Congress authorized 50,000 acre-feet of storage at Cochiti, "for conservation and development of fish and wildlife resources and for recreation."[238] The legislation provided for initially filling this pool, as well as an annual evaporation offset of 5,000 acre-feet, from water imported from the Colorado River Basin through the yet-to-be-built San Juan-Chama Project.[239] The filling and refilling of this Cochiti recreation pool, however, was subject to certain sections[240] of the recently passed San Juan-Chama Project Authorization.[241]

This recreation pool was authorized pursuant to a 1960 USACE report, which itself represented an update to the 1948 "Comprehensive Plan."[242] This Report determined that flood flows' residence time at Cochiti depended on certain hydrologic conditions, thus permitting the dedication of some storage space to recreation activities.[243] Nonetheless, USACE had not contemplated storage of the City of Albuquerque's San Juan-Chama Project water, which the City had applied for in the amount of 57,000 acre-feet per year.[244]

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[236] P. L. No. 88-294, 74 Stat. 171–72 (1964).

[237] P. L. No. 86-645, 74 Stat. at 492 (1960). For an excellent treatment of Cochiti's authorization, *see* Kelly (2007a), *Rio Grande Reservoirs*, *supra* note 62, at 559–60. 64 (describing the background and legislative history for Cochiti Reservoir, a component of the Middle Rio Grande Project).

[238] P. L. No. 88-293, 74 Stat. 171–72.

[239] *Id*. § 1.

[240] §§ 8, 12, 13, 14, and 16, 76 Stat. at 97.

[241] § 1, 74 Stat at 171–72.

[242] S. Doc. No. 86-94 at 65 (1960).

[243] *See* Kelly (2007a), *Rio Grande Reservoirs*, *supra* note 62, at n.108 and accompanying text (citing S. Doc. 86-94 at 65).

[244] *Id*. at n.110 (citing S. Doc. 86-94 at 66).

(b) Abiquiu, Elephant Butte: San Juan-Chama Storage (1981)

In 1981, Congress acted to allow storage of San Juan-Chama Project water at both Abiquiu and Elephant Butte Reservoirs.[245] This action came in response to the 10th Circuit Court of Appeals' holding in *Jicarilla Apache v. U.S.*[246] In that case, the 10th Circuit held that the Colorado River Storage Project Act, together with the San Juan-Chama Project Act, precluded Albuquerque from storing Project water in Elephant Butte Reservoir's recreational pool.[247] Reacting to this holding, Congress provided that under the Colorado River Storage Project Act, storage of San Juan-Chama Project water was not precluded "in any reservoir."[248]

This legislation specifically created 200,000 acre-feet of storage space for San Juan-Chama Project in Abiquiu Reservoir, [249] the first authorization of conservation storage at the reservoir. USACE was authorized to contract this space out to "entities which have contracted with the Secretary of the Interior for water from the San Juan-Chama project pursuant to P.L. 87-483",[250] most notably the City of Albuquerque and the MRGCD. The Act of 1981 also authorized the Interior Secretary to "release San Juan-Chama project water to contracting entities for such storage."[251] The legislation required that such agreements for Abiquiu Reservoir storage [252] "*not interfere with the authorized purposes of the Abiquiu Dam and Reservoir project*, and shall include a requirement that each user of storage space shall pay any increase in operation and maintenance cost attributable to the storage of that user's water."[253]

The legislation also authorized San Juan-Chama Project storage in Elephant Butte Reservoir.[254] To this end, the Secretary of the Interior was authorized to enter agreements with San Juan-Chama Project contractors for this storage. Elephant Butte water contractors would be required to pay their proportionate share of storage.[255]

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[245] Act of Dec. 29, 1981, P. L. No. 97-140, §5(a), 95 Stat. 1717.

[246] Flanigan & Haas, *supra* note 125, at 381.

[247] *Id*. at 381 nn. 76–77, 79 and accompanying text (citing *Jicarilla Apache Tribe v. United States*, 657 F.2d 1126, 1131–33, 1139–41 (10th Cir. 1981).

[248] § 5(a), 95 Stat. at 1717 (not be construed to prohibit the storage of San Juan-Chama project water acquired by contract with the Secretary of the Interior pursuant to P.L. 87-483 [the San Juan-Chama Project authorizing legislation of 1962] in any reservoir, including storage for recreation and other beneficial uses by any party contracting with the Secretary for project water.)

[249] For some context for these storage parameters: "The average annual flow of the Rio Chama at Abiquiu Dam (1926 to 1991) is 341,900 acre-feet. The range of flows recorded at Abiquiu Dam varies from 98,300 acre-feet, recorded in 1934, to 752,100 acre-feet, recorded in 1942." These figures *include* the San Juan-Chama trans-mountain water which also passes through Abiquiu Dam. Abiquiu WCM, *infra* note 282, at 8-4.

[250] §5(b), 95 Stat. at 1717–18.

[251] *Id*.

[252] For the only such agreement carried out to-date, *see* 1986 Storage Contract, *infra* note 276.

[253] §5(b), 95 Stat. 1718 (emphasis added).

[254] §5(c), 95 Stat. 1718.

[255] *Id*.

Such attributable costs were defined as "[a]ny increase in operation and maintenance costs resulting from such storage not offset by increased power revenues."[256] Finally, Congress required an accounting of evaporative losses and any "spill" at Elephant Butte attributable to storage at either reservoir "as required by the Rio Grande compact and the procedures established by the Rio Grande Compact Commission."[257]

(c) Abiquiu: Native Rio Grande Storage (1988)

Nearly seven years after Congress first authorized conservation storage in Abiquiu Reservoir, it authorized storage of native Rio Grande Basin waters there within the 200,000 acre-foot San Juan-Chama pool.[258] Specifically, the legislation authorized storage of up to 200,000 acre-feet of "Rio Grande system water" at Abiquiu "in lieu of" San Juan-Chama storage "to the extent that [San Juan-Chama Project water contractors] no longer require such storage."[259] It also authorized USACE to acquire "lands adjacent to Abiquiu Dam on which the Secretary holds [flowage] easements as of the date of enactment of this Act if such acquisition is necessary to assure proper recreational access at Abiquiu Dam."[260] Further, the legislation explicitly required compliance with the Rio Grande Compact and resolution of the Compact Commission regarding the newly authorized storage.[261]

(4) Contracts[262]

(a) City of Albuquerque: 1963 Repayment Contract[263]

A year after the passage of the San Juan-Chama Project authorizing legislation, the City of Albuquerque would contract with Reclamation for Project water.[264] Other water users, such as the MRGCD, would subsequently contract with Reclamation for San Juan-Chama Project water, but the 1963 Repayment Contract with Albuquerque is significant. These latter contracts would incorporate certain terms from the City's Repayment Contract, including provisions regarding water availability and shortage.[265]

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[256] *Id*.

[257] §5(d), 95 Stat. 1718.

[258] P. L. No. 100-522, 102 Stat. 2604.

[259] §1, 102 Stat. 2604.

[260] *Id*.

[261] §2, 102 Stat. 2604; *see also* Abiquiu WCM, *infra* note 282, at 8-1, ¶ 8-02(a) ("Spillway Design Flood") (explaining 1984–85 spillway design flood revision based on revised Probable Maximum Flood, or PMF).

[262] *See generally* Flanigan & Haas, supra note 36, at 377–81 (detailing legal authorities and contractual relationships governing San Juan-Chama water).

[263] Contract between the U.S. Department of the Interior, Reclamation, and the City of Albuquerque, New Mexico for Furnishing a Municipal Water Supply, Contract No. 14-06-500- 810 dated June 25, 1963, art. 6(b) (amended July 6, 1965) [hereinafter 1963 Repayment Contract] (on file with Utton Center).

[264] *Id*.; *see generally* Flanigan & Haas, supra note 36, at 379, nn. 59-73 and accompanying text.

[265] *See* Flanigan & Haas (2007), supra note 36, at 379, at 380–81, nn.65, 66 (citing 1963 Repayment Contract at Arts. 3, 7, 18(b), 18(j))

In terms of water shortage, the contract provided that—"On account of drought or other causes, there may occur at times during any year a shortage in the quantity of water available from the reservoir storage complex for use by the City pursuant to this contract. In no event shall any liability accrue against the United States or any of its officers or employees for any damage, direct or indirect, arising out of any such shortage."

Subject to this shortage clause, the City of Albuquerque thus contracted for 53,200 acre-feet of San Juan-Chama Project water, to be used consumptively by the City.[266] At the time, Project "firm yield" was estimated at 101,800 acre-feet (later Reclamation studies would reduce this figure to the current estimate of 96,200 acre-feet per year[267]). The contract provided that 22,700 acre-feet would be initially available upon the completion of Project works, while the availability of the residual 30,500 acre-feet would become available as a function of anticipated future need.[268] In exchange, the City was required to pay for its pro-rata share of Project construction costs, plus an annual operations and maintenance (O&M) fee.[269] Once the City paid off its share of construction costs, its allocation would become permanent.[270] After constructing the Project, Reclamation would then be obligated to deliver to the City its annual allocation of Project water.[271]

While submitting the City to repayment obligations, the agreement granted Albuquerque an "exclusive right to use and dispose" of its Project water supply.[272] According to the Repayment Contract, such "permissible" use and disposition included:

1) "diverting and applying San Juan Chama Project water directly from the Rio Grande stream system;
2) diverting and applying underground water using San Juan Chama Project water to offset the adverse effects of such underground water withdrawals;
3) or otherwise as the City may desire".[273]

Just two years later, in 1965, the City and Reclamation would amend the contract to reflect 5,000 acre-feet of the City's Project water allocation that would be dedicated to the recently authorized permanent recreation pool at Cochiti Reservoir.[274] Accordingly, Albuquerque would receive 17,700 acre-feet of San Juan-Chama water through 1981 and 48,200 acre-feet thereafter.[275]

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266 1963 Repayment Contract, supra, note 262, at art. 6(b).

267 Kevin Flanigan, *Surface Water Management: Working Within the Legal Framework*, 47 NATURAL RES. J. 515 at 374 (2007) , citing U.S. Department of the Interior, Reclamation, Addendum to Hydrology Report San Juan-Chama Project Yield Update 2 (1989).

268 *Id*. at 18(j).

269 *Id*. at 4, 7.

270 *Id*. at 18(d).

271 *Id*. at 3, 7, 18(j).

272 Flanigan & Haas, supra note 36, at 380.

273 1963 Repayment Contract, *supra* note at 18(d)).

274 *See* discussion, *infra*.

275 Flanigan & Haas, supra note 36, at 380, nn. 72-74 (citing 1963 Repayment Contract at Amendment 1, ¶ 7; *id*. at 18(j)).

The MRGCD's San Juan-Chama contract provided for it to receive 20,900 acre-feet, the largest remaining share of San Juan-Chama Project water.[276]

(b) City of Albuquerque: 1986 Abiquiu Storage Contract[277]

Pursuant to the 1981 Act authorizing expanded storage at Abiquiu Reservoir, the City of Albuquerque contracted with USACE in 1986 for storage of its San Juan-Chama Project water allocation.[278] Under this storage agreement, the City gained access to 170,900 acre-feet of storage space in Abiquiu Reservoir,[279] for which it would pay annually "a pro rata share" proportionate to total space allocated to storing imported water, plus annual O&M and monitoring costs.[280] (Due to accumulation of sediment, this storage space was quantified at 168,000 acre-feet in 2007.)[281] Article 5 of the storage agreement incorporates the requirement of the 1981 Act that contractors purchase the corresponding easements within the Abiquiu's flood and sediment controls pools. The City holds easements corresponding to a maximum storage elevation of 6,220 feet mean sea level (msl) (which is the elevation of the top of Abiquiu's flood and sediment control pools).[282] The City began storing water under this agreement in December 1974;[283] the contract lasts "so long as such water does not interfere with the initially authorized purposes of the project."[284]

The City has the right, under the contract, to "store an undivided total of 170,900 acre-feet of water, obtained for the San Juan-Chama project pursuant to Public Law 87-483 . . . *except* as such space is needed for flood or sediment control purposes[,]" subject to conditions of the required flowage easements.[285] The United States, however, retains significant control over water stored in this space in exigent circumstances, such as floods "in accordance with authorized Project purposes."[286]

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[276] *Id* at 375.

[277] Contract Between United States of America and Albuquerque, New Mexico for Water Storage Space in Abiquiu Reservoir, DACW47-86-C-0009 (Mar. 20, 1986) [hereinafter 1986 Storage Contract] (cited in Gillon (2007), *supra* note 167, at 631).

[278] 1986 Storage Contract., *supra* note 276.

[279] *Id*. at Art. I(b)(1).

[280] *Id*. at Art. 7.

[281] U.S. DEPARTMENT OF INTERIOR, RECLAMATION, 2007 WATER ACCOUNTING REPORT TO THE RIO GRANDE COMPACT COMMISSION ENGINEER ADVISERS 27 (2007).

[282] Gillon (2007), *supra* note 167, at n.107.

[283] U.S. ARMY CORPS OF ENGINEERS, RIO GRANDE BASIN MASTER WATER CONTROL MANUAL, APP. A, ABIQUIU DAM AND RESERVOIR, RIO CHAMA NEW MEXICO, WATER CONTROL MANUAL 8-7 (1995) [hereinafter Abiquiu WCM].

[284] 1986 Storage Contract., *supra* note 276, at Art. 8.

[285] *Id*. at Art. I(b)(1).

[286] *Id*. at Art. I(c).

The storage agreement also explicitly limits the substance of the agreements to the storage of "raw water" only, makes no guarantees in terms of "availability," and limits the government's responsibility with respect to, *inter alia*, evaporation of water stored under the agreement.[287]

Further, the storage agreement constrains the City's transfer of its interests under the contract. Specifically, it states that the City "shall not transfer or assign this contract or any right acquired thereunder, nor sub-allot said water supply storage *space or any part thereof*, nor grant any [connected] interest, privilege or license…, *without the approval* of the U.S. Army Corps of Engineers."[288] The same article, however, states that "unless contrary to the public interest," this restriction "shall not be construed to apply to any water that may be obtained from the water supply storage space by the [City] and furnished to any third party or parties, nor any methods of allocation thereof[.]" This caveat would seem to indicate the City was not precluded from subleasing storage space at Abiquiu, so long as the transaction was not "contrary to the public interest" and the Secretary of the Army or their designate approved the transaction.

Between 1986 and 2008, when the City's Drinking Water Project came on-line, the City has used this contracted Abiquiu space to store the majority of its San Juan-Chama Project water allocation.[289] Since 2008, however, the City's Drinking Water Project has resulted in less water being available for the City to lease.[290] As a result, the City's storage space has been used less. According to one legal scholar, "the Corps believes that it must approve the Authority's subleases, if any, of Abiquiu Reservoir storage space."[291] That said, "the form of approval is not specified in the contract with the Authority."[292] And while under this agreement, the City—or its sub-lessees—would store San Juan-Chama Project water in Abiquiu Reservoir, at least as of 2007, USACE "considers the storage of native water to be a deviation from normal reservoir operations and thus the agency must obtain the advice and consent of the Rio Grande Compact Commission."[293]

Since 2005, the City has nominally shared its storage space in Abiquiu Reservoir with environmental groups. This shared space was created in 2005 by way of negotiations and a resultant settlement agreement related to silvery minnow litigation and is discussed further below.[294]

[287] *Id*. Art. I(d)(2).

[288] *Id*. at Art. 10.

[289] *Id.*

[290] *See* Flanigan & Haas, supra note 36, *passim*.

[291] Gillon (2007), *supra* note 167, at 631.

[292] *Id*. at n.109 and accompanying text (citing 1986 Storage Contract, *supra* note 276, at art. 10).

[293] *Id*. at 631, n.110 and accompanying text (citing URG Water Operations Review, *supra* note 74, at Vol. 1, Ch. 2, II-5–II-6).

[294] *See* Minnow Settlement Agreement, *infra* n.309, at 2–4; Pt. II(B)(4)(a)(ii).

4. Environmental Law

a) Endangered Species Act[295]

By far the most significant development in the management of water in the Middle Rio Grande valley was the listing of the silvery minnow, which triggered ESA protections. Minnow-related legal protections have complicated New Mexico's efforts to comply with the Rio Grande Compact by changing constraints of state water priorities, intersecting with Federal obligations to Native American Pueblos, and operating as a Rorschach test for ideological views of water. In terms of legal hierarchies, the ESA in theory forms the cornerstone of the *modern* Law of the River for the Rio Grande. Federal law such as the ESA may preempt contrary state law, according to the Supremacy Clause of the U.S. Constitution.[296] The silvery minnow was historically one of the most abundant fish on the Rio Grande. First listed as endangered in 1994,[297] it has been extirpated from all but roughly five percent of its historical habitat, located primarily between Socorro and Elephant Butte. The minnow population was further impacted in April of 1996 when the MRGCD dewatered a forty mile stretch of the river during a low-flow period.[298]

In December 2016, the USFWS released its fourth Biological Opinion[299] on Federal water operation in the Middle Rio Grande valley affecting the endangered minnow. Since the first minnow BiOp was issued in 2001, the vulnerable fish's fate has evolved along a complex and litigious path. Before briefly summarizing that history below, it will be helpful to highlight a few relevant landmarks. Following a 1999 court-ordered species recovery plan and critical habitat designation from Cochiti to Elephant Butte, WildEarth Guardians (WEG) filed a lawsuit over Reclamation's and USACE's failure to consult with USFWS regarding their water operations as required under the ESA. WEG then pressed for Reclamation and USACE to apply their control over imported San Juan-Chama Project water as well as native Rio Grande flows, with a discretionary eye towards the environmental (flow) needs for the minnow.[300] Throughout the early 2000s, successive Biological Opinions were issued, challenged, and operationalized.

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295 Endangered Species Act, 16 U.S.C. §§ 1531–1544; *see also generally* Kery (2003), *Overview*, *supra* note 60, at 37–39.

296 *See, e.g.*, Robin Kundis Craig, *Does the Endangered Species Act Preempt State Water Law*, Kansas L. Rev. [symposium, 2013].,

297 Endangered and Threatened Wildlife and Plants; Final Rule to List the Rio Grande Silvery Minnow as an Endangered Species, 59 Fed. Reg. 36988, 36988–95 (July 20, 1994) (codified at 50 C.F.R. § 17.11(h).

298 *See* Settlement Agreement between MRGCD and U.S. Fish and Wildlife Service (May 9, 1997).

299 Press Release, U.S. Fish and Wildlife Service, et al., Efforts to Protect Endangered Species in the Middle Rio Grande Continue with Renewed Commitments from Key Water Management Agencies (Dec. 5, 2016).

300 *WildEarth Guardians v. United States Bureau of Reclamation*, No. 1:14-cv-00666 (D.N.M. filed July 24, 2014). WildEarth Guardians is newly pursuing related litigation.

The court conditionally upheld the 2001 Biological Opinion but ultimately dictated injunctive relief through unilaterally-imposed flow targets, among other measures, when serious drought hit in 2001 and effectively "broke" the Biological Opinion.[301] In the meantime, the MRGCD and other parties intervened in the proceedings, where the court ruled that Reclamation did have discretion over imported San Juan-Chama water and that it could require MRGCD and other contractors to curtail San Juan-Chama Project water diversions.[302]

Reclamation took various water management actions in response to these ESA requirements and this highly uncertain legal and hydrological context. It instituted a program of leasing imported San Juan-Chama Project water (the "Supplemental Water Program");[303] participated in the newly-created, multi-stakeholder Middle Rio Grande Endangered Species Collaborative Program ("Collaborative Program"); and drew up, along with other water users and managers, the "Conservation Water Agreement"—all to keep water in the river, or generate storage capacity in upstream reservoirs.[304]

In 2003, a new Biological Opinion was issued. This Biological Opinion, which Congress subsequently mandated as the "law of the river" for the period 2003–2010,[305] dictated differentiated flow targets on a wet year/dry year basis;[306] required that decreases in flow rates be "ramped down"; and provided for silvery minnow salvage operation when the river became disconnected.[307]

Subsequent to the landmark 2003 Biological Opinion, various voluntary, collaborative efforts have been conducted with the aim of achieving ESA compliance while meeting municipalities' water needs, all in the context of ongoing drought. For example, in April of that year, MRGCD and Santa Fe allocated 217,500 acre-feet of relinquishment credit water under the Emergency Drought Water Agreement.[308]

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[301] Lara Katz, *History of the Minnow Litigation and Its Implications for the Future of Reservoir Operations on the Rio Grande*, 47 NAT. RES. J. 675 (2007) [hereinafter Katz (2007)].

[302] *Id* at 680.

[303] *Id* at 679.

[304] *Id* at 689.

[305] Energy and Water Development Appropriations Act, 2004, P.L. No. 108-137, § 208, 117 Stat. 1827, 1849-50 (2003) (passed by Jeff Bingaman and Pete Domenici, providing that no Federal funds would be applied to the San Juan-Chama Project for the benefit of the silvery minnow unless such water purchased from a willing seller pursuant to relevant OSE permitting, and deeming that compliance with the 2003 BiOp would comprise compliance with Endangered Species Act requirements for a ten-year period).

[306] Dry year flow targets under the 2003 BiOp, applicable to the Rio Grande from the outlet of Cochiti Dam and Reservoir through San Marcial, comprise a "continuous flow" requirement in the winter and spawning season, from November 16 through June 15, and a minimum 100 cfs during the post-spawning and summer months. *See, e.g.* BUREAU OF RECLAMATION, RIO GRANDE PROJECT ANNUAL OPERATING PLAN: WATER OPERATIONS MODELING 26 (2016).

[307] U.S. FISH AND WILDLIFE SERVICE, BIOLOGICAL AND CONFERENCE OPINION ON THE EFFECTS OF ACTIONS ASSOCIATES WITH THE PROGRAMMATIC BIOLOGICAL ASSESSMENT OF THE BUREAU OF RECLAMATION'S WATER AND RIVER MAINTENANCE OPERATIONS, ARMY CORPS OF ENGINEERS' FLOOD CONTROL OPERATION, AND RELATED NON-FEDERAL ACTIONS ON THE MIDDLE RIO GRANDE, NEW MEXICO (2003), [hereinafter 2003 BO].

[308] Emergency Drought Water Agreement (Apr. 22, 2003) (on file with author). Similar agreements were carried out as amendments to this original 2003 agreement in 2008 and 2016. Amendment No. 1 to the Emergency Drought Water Agreement of 2003 (Mar. 31, 2008); Emergency Drought Water Agreement of 2016 (Apr. 22, 2016).

In 2005, the City of Albuquerque settled with WildEarth Guardians, who had protested the City's Office of State Engineer's (OSE) permit application for their San Juan-Chama Project contract water,[309] yielding 30,000 acre-feet of Abiquiu Reservoir storage space for an "environmental pool."[310] Significantly, too, Reclamation continues to operate its Supplemental Water Program, leasing primarily San Juan-Chama Project water from San Juan-Chama contractors like the City of Albuquerque, for the benefit of the silvery minnow. This program was begun in 1996,[311] continued under the requirements of the 2003 Biological Opinion, and now comprises a core "Conservation Measure" under the new 2016 Biological Opinion.[312]

Since 2003, at least $125 million has been spent on ESA compliance on the Rio Grande; a significant portion of this money has been dedicated to Reclamation water leasing.[313] While such measures are clearly contemplated in the new Biological Opinion, one significant constraint on such continued water management flexibility is Albuquerque's increasing use of their entitlement to San Juan-Chama Project water. This development results in less surplus water being available for lease, and correspondingly less excess to Abiquiu Reservoir storage space, which ABCWUA holds under OSE permits and for which it holds the relevant easements. As a result, the various Rio Grande water managers have been forced to consider a diversified suite of "Conservation Measures," such as managing the operation of reservoirs on the Rio Grande and its major tributary, the Rio Chama, for increased water management flexibility.

With this brief overview of ESA related history in the Middle Rio Grande, the remainder of this section will proceed as follows. First, it will present the recent historical background and present selected highlights and lessons from minnow related litigation from 2000 to 2010. In doing so, it will examine the 2005 settlement agreement between the City of Albuquerque and WildEarth Guardians, which grew out of the litigation and which may contain, in part, a roadmap to developing conservation storage—or an environmental pool—at Abiquiu Reservoir that is critical to conducting more flexible reservoir operations on Rio Chama. It will analyze the decision in the WildEarth Guardian litigation that focused on the issue of the USACE's discretion to consult with FWS over its reservoir operations at Abiquiu and Cochiti.

Second, this section will briefly examine the "Minnow Riders" both in terms of how they resulted from the minnow litigation and their key provisions. Third and finally, it will present selected excerpts and draw lessons from historical Biological Opinions (2001 and 2003), as well as analyze the current (2016) Biological Opinion with an eye to what it portends in terms of alternative reservoir operations.

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[309] Settlement Agreement Between Rio Grande Silvery Minnow v. Keys Plaintiffs, the City of Albuquerque, and the Albuquerque-Bernalillo County Water Utility Authority (Feb. 23, 2005) (on file with author) [hereinafter Minnow Settlement Agreement].

[310] *Id*. *See also generally* Gillon (2007), *supra* note 167; Flanigan & Haas, *supra* note 125.

[311] Katz, *supra* note 300 at 679.

[312] U.S. FISH AND WILDLIFE SERVICE, FINAL BIOLOGICAL AND CONFERENCE OPINION FOR BUREAU OF RECLAMATION, BUREAU OF INDIAN AFFAIRS, AND NON-FEDERAL WATER MANAGEMENT AND MAINTENANCE ACTIVITIES ON THE MIDDLE RIO GRANDE, NEW MEXICO 102 (2016), [hereinafter 2016 BiOp].

[313] *Id*. at 8.

(1) Rio Grande Silvery Minnow

(a) Historic Litigation[314]

The saga over the silvery minnow came to a partial end in 2010, when the 10th Circuit Court of Appeals vacated all previous District Court rulings regarding, *inter alia*, Reclamation's discretion in the allocation of Middle Rio Grande Project water for the minnow's protection.[315] That litigation commenced 11 years earlier in 1999 when environmental groups opposed Reclamation's and the USACE's failure to consult with USFWS over allegedly discretionary water operations in the Middle Rio Grande and filed suit in the case styled *RGSM v. Keys*. Plaintiffs alleged that the agency engaged in discretionary water operations—i.e., diversion and storage of Rio Grande water—which jeopardized the minnow.[316] Notwithstanding the claim-targeted Middle Rio Grande Project operations, waters subject to this litigation varied from San Juan-Chama Project water stored in Heron Reservoir, to native Rio Grande MRGCD irrigation water, to water New Mexico was obligated to deliver to Texas under the Rio Grande Compact.[317]

In 2000, the first reported decision—regarding a critical habitat designation—was issued amidst a worsening drought.[318] In *MRGCD v. Babbitt*, the court upheld the MRGCD's challenge to USFWS' critical habitat designation for the minnow between Cochiti and Elephant Butte Reservoirs and required USFWS to undertake an Environmental Impact Statement before it made the designation.[319] The 10th Circuit would later uphold that ruling in *MRGCD v. Norton*.[320]

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[314] For excellent treatments, *see* Katz (2007), *supra* note 300; Susan Kelly, UTTON CTR., *The Rio Grande Silvery Minnow: Eleven Years of Litigation*, in *WATER MATTERS!* (2011) [hereinafter Kelly (2011)] (bringing coverage of silvery minnow litigation up to date, after 10th Cir. Court of Appeals ruling); Kelly & Urbina, *Reservoirs Overview*, *supra* note 12. Cases as referenced herein:

> [1] *Middle Rio Grande Conservancy District v. Babbitt*, No. CV 99-00870 (D.N.M. Dec 27, 2000) (challenging critical habitat designation; later consolidated with the minnow case)
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> [2] *Rio Grande Silvery Minnow v. Keys*, 469 F.Supp.2d 973 (D.N.M. 2002)
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> [3] *Rio Grande Silvery Minnow v. Keys*, 356 F.Supp. 2d 1222 (D.N.M. 2002)
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> [4] *Rio Grande Silvery Minnow v. Keys*, 333 F.3d 1109 (10th Cir. 2003)
>
> [5] *Rio Grande Silvery Minnow v. Keys*, 355 F.3d 1215 (10th Cir. 2004) (vacating previous decision as moot, upon defendants' petition for rehearing en banc)
>
> [6] *Rio Grande Silvery Minnow v. Keys*, No. CV99-1320 JP/RHS-ACE (filed D.N.M. Nov. 11, 2004)
>
> [7] *Rio Grande Silvery Minnow v. Keys*, et al. & MRGCD, 469 F.Supp.2d 1003 (2005)
>
> [8] *Rio Grande Silvery Minnow v. Keys*, 599 F.3d 1165 (2010)

[9] *Rio Grande Silvery Minnow v. Bureau of Reclamation*, 601 F.3d 1096 (2010)

[315] Kelly (2011), *supra* note 313, at 1 (citing *Rio Grande Silvery Minnow v. Bureau of Reclamation v. Bureau of Reclamation*, 601 F.3d 1096 (D.N.M. 2010).

[316] Kelly (2011), *supra* note 313, at 2 (citing *Rio Grande Silvery Minnow v. Keys*, et al., CIV 99-1320-JP/KBM (City of Albuquerque and MRGCD, et al., intervening as plaintiffs).

[317] *Id.*

[318] *Id.*

[319] 206 F.Supp.2d 1156 (D.N.M. 2000).

[320] 294 F.3d 1220 (2002).

Also in 2000, the court in *Rio Grande Silvery Minnow v. Keys* issued two stipulated Orders that aimed to prevent drying of what were believed to be the most vulnerable reaches of the Rio Grande.[321] Under the agreements, the City of Albuquerque and MRGCD were paid to provide water for the minnow,[322] and roughly 200,000 acre-feet of San Juan-Chama Project water was released to keep the river wet to Elephant Butte.[323]

In 2001, the required consultation was completed and the environmental plaintiffs, in turn, challenged USFWS' June 29, 2001 Biological Opinion, which contained a "jeopardy" determination.[324] In challenging the Biological Opinion, plaintiffs wanted Reclamation to use discretion in delivering San Juan-Chama Project water to meet minimum flow targets contained in the Biological Opinion for the minnow. They also wanted Reclamation to curtail irrigation water deliveries, primarily to the MRGCD.[325]

The same day that the 2001 Biological Opinion was issued, the state of New Mexico and the Federal government, including both the Department of the Interior and USACE, entered into the "Conservation Water Agreement" (CWA).[326] The CWA authorized the use of up to 100,000 acre-feet of water, otherwise required to meet New Mexico's Compact delivery obligations, to keep the Rio Grande wet. Importantly, the agreement temporarily authorized a "Conservation Pool" (i.e., an environmental pool) in Abiquiu and Jemez Reservoirs, to provide storage space for the controlled release of this water. As a "deviation" from normal operation of the Middle Rio Grande Project, the Flood Control Act of 1960 (P.L. 86-645) required the consent of the Rio Grande Compact Commission for such an operation, which the Commission provided in a unanimous resolution.[327]

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[321] *Rio Grande Silvery Minnow v. Keys*, et al., CIV 99-1320-JP/KBM (Docket Number 117).

[322] Kelly (2011), *supra* note 313 at 2.

[323] Kelly (2011), *supra* note 313, at 3, n.8 (citing Interstate Stream Commission data).

[324] U.S. FISH & WILDLIFE SERVICE, ALBUQUERQUE OFFICE, PROGRAMMATIC BIOLOGICAL OPINION ON THE EFFECTS OF ACTIONS ASSOCIATED WITH THE BUREAU OF RECLAMATION'S, U.S. ARMY CORPS OF ENGINEERS', AND NON-FEDERAL ENTITIES' DISCRETIONARY ACTIONS RELATED TO WATER MANAGEMENT ON THE MIDDLE RIO GRANDE, NEW MEXICO (June 29, 2001).

[325] Kelly (2011), *supra* note 313, at 3 (citing *Rio Grande Silvery Minnow v. Keys*, et al., CIV 99-1320-JP/KBM, April 2002, Memorandum Opinion and Order).

[326] Conservation Water Agreement Between the State of New Mexico, U.S. Department of the Interior and the U.S. Army Corps of Engineers (June 29, 2001) [hereinafter Conservation Water Agreement].

[327] Kelly (2011), *supra* note 313 at 3.

In the spring of 2002, the Federal district court in *Rio Grande Silvery Minnow v. Keys* upheld the 2001 Biological Opinion.[328] The court held that Reclamation had discretion to release both San Juan-Chama and native Rio Grande water for the benefit of the minnow. However, the Court also held that USACE had no such discretion over their respective reservoir operations.[329]

Later in 2002, worsening drought resulted in a new consultation process, and USFWS issued a new Biological Opinion.[330] The *Rio Grande Silvery Minnow v. Keys* court upheld the environmental plaintiffs' request for emergency injunctive relief to facilitate compliance with the 2001 Biological Opinion in the form of a release of San Juan-Chama water.[331] In its ruling, the court required the Federal government meet interim flow standards imposed by the court, which were lower than those of the 2001 Biological Opinion. It further required Reclamation to curtail San Juan-Chama Project deliveries to contractors, if necessary.[332] The court also ruled the 2002 Biological Opinion was "arbitrary and capricious."[333]

A new Biological Opinion was issued in March 2003.[334]

In June 2003, the 10th Circuit Court of Appeals upheld the district court's 2002 ruling.[335] (This ruling, however, was subsequently vacated as moot on grounds that the lower court's 2002 ruling had expired.[336])

Also in 2003, the Conservation Water Agreement of 2001 was amended when the United States and New Mexico entered into the Emergency Drought Water Agreement."[337] The agreement allocated a maximum of 217,500 acre-feet of Compact "relinquishment credit water"[338] to MRGCD, Reclamation, and Santa Fe—in the amounts of up to 140,000, 70,000, and 7,500 acre-feet, respectively.[339]

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[328] *Rio Grande Silvery Minnow v. Keys*, et al., CIV 99-1320-JP/KBM, April 2002, Memorandum Opinion and Order.

[329] *Id*. at 33, 41, 49 (cited in Kelly (2011), *supra* note 313, at 3).

[330] U.S. FISH & WILDLIFE SERVICE, ALBUQUERQUE OFFICE, BIOLOGICAL OPINION AND CONFERENCE REPORT ON U.S. BUREAU OF RECLAMATION'S AMENDED WATER MANAGEMENT OPERATIONS ON THE MIDDLE RIO GRANDE THROUGH DECEMBER 31, 2002 (September 12, 2002).

[331] Kelly (2011), *supra* note 313, at 3–4.

[332] Kelly (2011), *supra* note 313, at 3–4.

[333] *Rio Grande Silvery Minnow v. Keys*, 356 F. Supp. 2d 1222, 1234 and 1237 (D.N.M 2002).

[334] U.S. FISH AND WILDLIFE SERVICE, ALBUQUERQUE OFFICE, BIOLOGICAL AND CONFERENCE OPINIONS ON THE EFFECTS OF ACTIONS ASSOCIATED WITH THE PROGRAMMATIC BIOLOGICAL ASSESSMENT OF THE BUREAU OF RECLAMATION'S WATER AND RIVER MAINTENANCE OPERATIONS, ARMY CORPS OF ENGINEERS' FLOOD CONTROL OPERATIONS, AND NON-FEDERAL ACTIONS ON THE MIDDLE RIO GRANDE, NEW MEXICO (March 17, 2003).

[335] *Rio Grande Silvery Minnow v. Keys*, 333 F.3d 1109 (10th Cir. 2003).

[336] *Rio Grande Silvery Minnow v. Keys*, 355 F.3d 1215 (10th Cir. 2004).

[337] Emergency Drought Water Agreement, New Mexico Interstate Stream Commission (2003).

[338] *Id.*

[339] *Id.*

Congress responded later in 2003 to the 10th Circuit's ruling upholding Reclamation's discretionary authority to curtail water deliveries if necessary (the ruling would later be vacated[340]). In a rider to an appropriations bill, Congress restricted the use of San Juan-Chama Project water for purposes of meeting Endangered Species Act requirements.[341] In this so-called "minnow rider," Congress also deemed that compliance with the 2003 Biological Opinion would qualify as compliance with the ESA.[342]

This rider was subsequently converted into a permanent measure, setting the 2003 Biological Opinion as the "law of the river" until 2013.[343]

In 2005, the City of Albuquerque settled with the environmental plaintiffs, and the Court approved the agreement.[344] The mechanics of the settlement agreement are discussed in greater detail below. Most importantly, the agreement established a 30,000 acre-foot "environmental pool" of storage space at Abiquiu Reservoir where the plaintiff environmental organizations, including WildEarth Guardians, could store water.[345] In exchange for this and other concessions from the City of Albuquerque, the plaintiffs dropped their claims and, further, agreed not to challenge Section 205 of the 2004 minnow rider.[346]

Later in 2005, the district court held on remand from the 10th Circuit that the 2003 and 2004 minnow riders rendered moot the issue of Reclamation's discretion regarding San Juan-Chama Project water deliveries.[347] The court also held the issue of Reclamation's discretion regarding Middle Rio Grande Project operations remained justiciable. In arriving at the latter holding, the court reasoned that the minnow riders' were silent as to these waters; it also pointed to a non-showing that Federal defendants would not return to an "impermissibly narrow scope of discretion" regarding use of waters of the Middle Rio Grande Project.[348]

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340 *Supra* note 334.

341 Energy and Water Development Act of 2004, § 208(a), P. L. No. 108-137, 117 Stat. 1827, 1849–50, (2003) [hereinafter 2003 Rider].

342 *Id* at § 208(b).

343 Consolidated Appropriations Act of 2005, P. L. No. 108-447, § 205, 118 Stat. 2809, 2949 (2004).

344 *See* Minnow Settlement Agreement, *supra* note 309, at 2–4 (approved by *RGSM* court, *see* 469 F.Supp.2d 1003 (D.N.M. 2005)); *see also infra* Pt. II(B)(4)(a)(ii).

345 *Id.*

346 *Id.*

347 *Rio Grande Silvery Minnow v. Keys*, 469 F.Supp.2d 1003 (2005).

348 Kelly (2011), *supra* note 313, at 7.

In 2010, on appeal from Reclamation, MRGCD, the Water Utility, and the State of New Mexico, the 10th Circuit ruled again in *Rio Grande Silvery Minnow v. Keys*. In the second of two opinions on the matter that year (the first addressed, inconclusively, the El Vado quiet title issue[349]) the Court of Appeals overruled all of the lower court's 2005 holdings.[350] The Court found that plaintiffs' claims related to consultation regarding Federal water managers' putative discretion in connection with the by-then-expired-and-replaced 2001 and 2003 Biological Opinions were moot.[351] Accordingly, the Court held that any claim of relief was removed by the 2003 Biological Opinion superseding earlier Biological Opinions.[352]

(b) Albuquerque/Wild Earth Guardians Settlement[353]

As mentioned above, the settlement agreement between the City of Albuquerque and *Rio Grande Silvery Minnow v. Keys* plaintiffs authorized an environmental pool within the City's authorized storage space at Abiquiu Reservoir. According to the agreement, the purpose of creating this environmental pool was to "protect and restor[e] the ecological integrity of the Rio Grande" and, through assurances Reclamation would not curtail the City's San Juan-Chama Project water, to "provide greater certainty" with respect to its Drinking Water Project.[354] In exchange for the creation of this environmental pool,[355] the plaintiffs released their San Juan-Chama related claims,[356] and plaintiff Sierra Club agreed not to oppose the City of Albuquerque Drinking Water Project[357] or challenge the 2004 minnow rider.[358] Of note, environmental plaintiffs were not barred under the settlement agreement from bringing suit for violations to the Biological Opinion, or from reinitiating consultation in case of such violations.[359]

The settlement agreement also laid the framework for an innovative water management scheme to achieve environment flows on the Rio Grande. First, it required the City and Water Authority to "support the establishment and implementation of a pilot water leasing initiative for the Middle Rio Grande Area via agricultural forbearance to increase flows in the Rio Grande and protect endangered species."[360] Second, it provided seed funding for a pilot water leasing program through an appropriation of $225,000 by the

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[349] *Rio Grande Silvery Minnow v. Bureau of Reclamation,* 599 F.3d 1165 (10th Cir. 2010).

[350] *Rio Grande Silvery Minnow v. Bureau of Reclamation,* 601 F.3d 1096 (10th Cir. 2010).

[351] *Id.*

[352] *Id.*

[353] Minnow Settlement Agreement, *supra* note 309; Gillon (2007), *supra* note 167, at 629–30; Katz (2007), *supra* note 300, at 688, n.73 and accompanying text (explaining selected provisions settlement and noting plaintiffs, while barred from challenging the lawfulness of the [2003 Biological Opinion], plaintiffs are not barred from bringing suit for violations of the Biological Opinion, or from reinitiating consultation in case of such violations).

[354] Minnow Settlement Agreement, *supra* note 309 at Preamble.

[355] *Id*. at III(3)(a), (b)(i)–(vii).

[356] *Id*. at III(1)(b) – (d).

[357] *Id*. at III(1)(d).

[358] *Id*. at III(1)(a).

[359] Katz, *supra* note 300, at 688, n. 73 and accompanying text (noting plaintiffs are not barred from bringing suit for violations for the Biological Opinion, or from reinitiating consultation in case of such violations).

[360] Minnow Settlement Agreement, *supra* note 309, at III(1)(f)

Water Utility and by adding to residents' water bills an option to pay an additional $1 per month.[361] Towards the end of using the storage space to release environmental flows, the parties agreed to use the stipulated pilot water leasing program funds to "attempt to execute environmental water lease agreements with one or more Pueblos or other Middle Rio Grande water users[.]"[362]

The settlement agreement specifically provided that the 30,000 acre-foot permanent storage space would become available "for lease, at no charge" within a year after Albuquerque's Drinking Water Project had started operating.[363] The environmental organizations could store "conservation water" that they "or others" acquired through "lease, purchase, or donations" from "willing participants."[364] The Agreement required that the resulting Environmental Pool serve the purpose of "benefit[ting] the Rio Grande or Bosque habitat and…species listed on the Federal threatened or endangered species[,] *consistent with the goals of the Collaborative Program*."[365]

The Agreement also contained provisions detailing the governance—i.e., operations, management, and regulation—of the storage space.[366] Perhaps most critically, to these terms, the storage space is subject to relevant regulatory approval and is limited based on physical unavailability, "due to factors or conditions outside the control of the Authority." Use of the environmental pool is similarly limited in that its use may not "otherwise impair or impede the Authority's ability to store and release water for Authority purposes." Additionally, the Water Authority retains the right to use this particular 30,000 acre-foot pool under two sets of circumstances: "to the extent that" water is not available for storage by environmental groups in any year or the Authority has its own "Conservation Water" (as defined in the agreement). Further, the Authority may lease environmental pool space to *other* third parties to store Conservation Water. Finally, the Agreement may be terminated should conservation space in other reservoirs be made available that would render the Agreement unnecessary.[367] This storage space actually went unused for roughly ten years; as described below, the environmental pool saw its first use in 2016.[368]

(c) WildEarth Guardians v. USACE

In 2014, WildEarth Guardians[369] filed suit again over USACE's allegedly discretionary water operations. Plaintiff WildEarth Guardians claimed that USACE's Middle Rio Grande Project water operations constitute "discretionary" agency action that, under ESA Section 7, triggers consultation that USACE had

[361] *Id*. at III(3)(c), (3)(d).

[362] *Id*. at III(5)(b).

[363] III(3)(a).

[364] *Id*.

[365] *Id*. (emphasis added).

[366] *Id*. at III(3)(b).

[367] *Id*. at III(3)(b)(i)-(vii).

[368] See Zita Fletcher, First-of-its-kind Water Transfer in New Mexico, Rio Rancho Observer (Sept. 19, 2016); see also Staci Matlock, Contract Sets Aside Abiquiu Storage Space for Rio Grande, Santa Fe New Mexican, A-5 (Sept. 10, 2013), 1; Laura Paskus, Water Deeply, Giving Back to the Rio Grande, One Deal, One Drop at a Time, https://www.newsdeeply.com/water/articles/2018/08/01/giving-back-to-the-rio-grande-one-deal-one-drop-at-a-time.

[369] WildEarth Guardians was, of course, party to the minnow litigation that had settled in minnow-related claims with respect to the City of Albuquerque.

not engaged in.[370] As noted above, USACE had consulted on Middle Rio Grande water operations, along with Reclamation, in the early 2000s. That process, of course, resulted in the Biological Opinion of 2003. However, that Opinion nominally expired in 2013. (The successor Biological Opinion was not finalized until December 2016.)

As the 2003 Biological Opinion neared expiration, USACE commenced consultation, which broke down in 2013 when USFWS indicated it could not follow an agency-specific consultation process.[371] Following USACE's withdrawal from consultation, in 2014 USACE issued a "Reassessment" of its legal obligations regarding the Middle Rio Grande Project.[372] USACE's "2014 Reassessment" addressed more than a dozen discrete water operations, noting where it asserted it had insufficient discretion to deviate from normal operations as to render consultation unnecessary.[373] Mostly significantly, it determined it had no discretion with respect to:

- safe channel capacity designation(s);
- flood control operations;
- release of carryover floodwaters from Abiquiu;
- storage of San Juan-Chama Project and native Rio Grande water at Abiquiu;
- pass-through operations; and,
- interagency coordination.[374]

In the district court's view, USACE arrived at these "no discretion" determinations by "considering and interpreting"[375] language from relevant authorities, including congressional authorizations. That is, the Court agreed with USACE's narrow construction of authorization of the Middle Rio Grande Project[376] and storage of San Juan-Chama Project[377] as well as native[378] Rio Grande Basin water in Abiquiu Reservoir (as well as related water supply contracts). USACE noted, in part, that these determinations turned solely on "engineering judgment."[379] Further, USACE determined "no discretion" was involved in its interagency coordination for the delivery of Rio Grande water because such action "simply is a requirement of the complex management system" and "cannot be construed as an action which, *in and of itself*, could affect a listed species or its designated critical habitat."[380] Relatedly, USACE determined that such "pass-through" operations are "nondiscretionary and passive[.]"[381]

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[370] Federal Defendants' Revised Motion, *WildEarth Guardians v. United States Bureau of Reclamation*, No. 1:14-cv-00666 (D.N.M. filed July 24, 2014); *see WildEarth Guardians v. United States Army Corps of Engineers*, 314 F.Supp.3d 1178, 1184–85 (D.N.M. June 6, 2018, amended Aug. 14, 2018); *see also National Association of Home Builders v. Defenders of Wildlife* [*Home Builders*], 551 U.S. 644 (2007) (defining "discretion" in this context); *WildEarth Guardians v. United States [Environmental Protection Agency] EPA*, 759 F.3d 1196 (10th Cir. 2014) (defining what counts as an "action" that triggers § 7(a)(2)).

[371] *WildEarth Guardians*, 314 F.Supp.3d at 1186.

[372] *Id*.

[373] *See id*.

[374] *Id*. at 1186–91.

[375] *See, e.g.*, *id*. at 1188.

[376] These authorization include, *inter alia,* the Flood Control Act of 1960 ("1960 FCA") and 1964 ("1964 FCA").

[377] P.L. 97-140.

[378] P.L. 100-522.

[379] *See, e.g.*, *id*. at 1186.

[380] *Id*. at 1191 (citing USACE's citation of 50 C.F.R. § 402.02).

[381] *Id.*

The district court held in its Memorandum Opinion and Order, first, that USACE's 2014 Reassessment was "not a post-hoc rationalization" for USACE's decision not to proceed with consultation."[382] The court also held that USACE interpretation of the Endangered Species Act was entitled to *Skidmore*, not *Chevron*, deference.[383] Finally, the court held USACE had insufficient discretion over the following operations to require consultation with USFWS:

- reservoir operations,
- creation and maintenance of certain storage pools in the reservoirs, or
- operations for the benefit of endangered species.[384]

In other words, the court found all the water operations components listed above to be non-discretionary.[385] In arriving at this conclusion, the court found the agency's 2014 Reassessment (i.e., its decision on discretion) credible, even "substantively persuasive,"[386] and therefore not arbitrary or capricious. The district court rejected plaintiff *Guardians'* various arguments that USACE's discretionary decision was arbitrary and capricious. First, the Court rejected the argument that the plain language of the 1948 Flood Control Act and the Flood Control Act of 1960 granted USACE discretion to operate its Middle Rio Grande Project facilities for the benefit of endangered species.[387] In rejecting this argument, the Court noted that Congress did not incorporate USACE's recommendation in a USACE's report to Congress that the Project should incorporate "fish and wildlife development." The 1948 Flood Control Act only approved the USACE report to the extent it was consistent with the FCA, which indicated "*all* [Middle Rio Grande Project] reservoirs...*shall* be operated solely for flood control," subject to the only exception of deviations authorized by the Rio Grande Compact Commission.[388] The Court also explained that when Congress subsequently authorized "fish and wildlife development" in the Flood Control Act of 1960, it did so expressly requiring that such water storage space be filling with *non-native* water, i.e., transbasin diversions.[389] Finally, the Court declined to find "discretion" where deviation from normal operation could be authorized by the Compact Commission, reasoning that the logical conclusion of this premise would be that "any agency could take any constitutional action if it just secured permission from Congress."[390]

Second, the district court rejected WildEarth Guardian's argument that USACE's recent actions, such as consulting with USFWS or deviating from normal operations at Cochiti, rendered the 2014 Reassessment's discretion decision arbitrary or capricious.[391] In terms of prior Cochiti deviations, the

382 *Id*. at 1192.

383 *Id*. at 1192–94; *see generally* Flatt & Tarr (2011), *supra* note 26, at Pt. III(B), nn.205–14 and accompanying text (discussing types of agency actions); *id*. at nn.215–27 and accompanying text (discussing judicial standards of review relevant to such agency action).

384 *Id*.

385 *Id*. at 1194–98.

386 *See, e.g.*, *id*. at 1196.

387 *Id*. at 1199–1200.

388 *Id*. at 1200 (citing 1948 Flood Control Act).

389 *Id*.

390 *Id*.

391 *Id*. at 1203–04.

court noted these were only possible with (1) temporary congressional authorization and (2) consent of the Rio Grande Compact Commission.[392] The Court explained that "'discretion' that comes only with the consent of another body is not the requisite discretion that mandates [ESA] §7(a)(2) consultation when Congress imposes the consent requirement."[393] Notwithstanding its decision to consult in the past, the District Court relied on the Supreme Court's decision in *Home Builders*[394] to determine that USACE's 2014 Reassessment discretion decision represented a permissible change of position since it followed proper procedures.[395]

Third, the Court did not find convincing WildEarth Guardians' argument that the 2003-05 minnow riders constituted congressional endorsement of "the idea" that USACE has discretion over its Middle Rio Grande Project Operations.[396] According to this argument, language in the 2003 rider referring to Reclamation's "discretion" regarding San Juan-Chama Project water—together with language in the 2005 rider authorizing the Secretary of the Army to carry out the project to comply with the 2003 Biological Opinion, implied that USACE has discretion of its Middle Rio Grande operations. The court disagreed, highlighting USACE's reasonable belief that it expressed in its 2014 Reassessment that certain additional activities would clash with authorizing Flood Control Acts and "would disrupt the delicate balance of water rights in the region."[397] The Court explained, first, that the 2003 Biological Opinion had expired.[398] Second, it explained that the 2003 riders' discretion language was immediately qualified with the phrase, "*if any,*" language that was carried through in the 2004 and 2005 riders.[399] Third, the court highlighted the existence of similarly constraining language in the 2007 Water Resources Development Act (WRDA) that authorized USACE to engage in "restoration projects" that were "*consistent with* other Federal programs, projects, and activities."[400]

b) Wild and Scenic Rivers Act[401]

While the Endangered Species Act does not apply to the Rio Chama since the silvery minnow has been extirpated from that river,[402] a remote stretch of the river between El Vado and Abiquiu Reservoirs has been afforded environmental protections for its unique aesthetic and natural values.[403] This reach of Rio

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392 *Id*.

393 *Id*. (citing Doc. 124 at 34-35).

394 551 U.S. at 658–59, 127 S.Ct. 2518.

395 *Id*. at 1203–04.

396 *Id*. at 1204.

397 *Id*.

398 *Id*.

399 *Id*.

400 *Id*. (emphasis added).

401 *See* UTTON CTR., *Legal Analysis of Reservoir Operations: Law of the River Compilation* 17 (Sept. 14, 2018) (legislative history references and "Other History" summary); USFWS, *Digest of Federal Resource Laws of Interest to the U.S. Fish and Wildlife Service: Wild And Scenic Rivers Act* ("Laws Digest"), https://www.fws.gov/laws/lawsdigest/wildriv.html.

402 Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Rio Grande Silvery Minnow; Final Rule, 68 FR 8088 8135 (Feb. 19, 2003).

403 *See, e.g.*, N.M. Game & Fish Dep't, *Wildlife Notes: Silvery Minnow* (no date),

Chama flows through a canyon up to 1,500 feet deep that cuts many of the rich, high-desert, Colorado Plateau red rock that the artist Georgia O'Keeffe popularized in her paintings from her studio at the nearby Ghost Ranch.[404] The headwaters of Rio Chama lie just north of the New Mexico border, in the Carson National Forest of the San Juan Mountains in southwestern Colorado.[405] From there, it flows roughly 120 miles until it joins the Rio Grande at Española.[406] In this course, the river is dammed three times, from upstream to downstream: at Heron, El Vado, and Abiquiu.

According to river guide Marc McCord, the Rio Chama between El Vado and Abiquiu is "rife with natural grandeur." He adds, "[r]iverbanks are lined with beautiful, old-growth trees of the Carson National Forest. Signs of civilization are non-existent."[407] Notably, there are no significant diversions of water on the Rio Chama between El Vado and Abiquiu.[408] The only notable diversion is to a small field alongside the river owned by the Benedictine Order of Catholic monks at Christ in the Desert Monastery, who grow hops for beer.[409]

(1) Legislative Scheme

In 1968, Congress created the National Wild and Scenic Rivers system.[410] The list of NWSRA-designated rivers currently comprises over 3,200 "free-flowing river segments."[411] The NWSRA thus established a system of "wild," "scenic," and "recreational" rivers, with the purpose of "complement[ing]" the "established national policy of dams and other construction" with "a policy that would preserve other selected rivers or sections thereof in their free-flowing condition to protect the water quality of such rivers and to fulfill other vital national conservation purposes."[412] To this end, NWSRA-designated rivers must be free-flowing and have "outstandingly remarkable" scenic or recreational values.[413] In the taxonomy of designated rivers, "wild" rivers are "free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted."[414] Although undeveloped, they may be accessible in some areas by road.[415] Noted water and environmental law scholar Sandra Zellmer stated that NWSRA has become a "powerful tool for protecting stream flows in a wilderness area."[416]

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http://www.wildlife.state.nm.us/download/education/conservation/wildlife-notes/aquatic/Rio-Grande-silvery-minnow.pdf.

[404] *See* Abiquiu WCM, *supra* note 282, at 4-3, ¶ 4-02, -03 ("Topography" and "Geology and Soils").

[405] *See* Southwest Paddler Outdoor Recreation Guide, available at http://southwestpaddler.com/docs/riograndenm14.html.

[406] *Id.*

[407] *See* Marc W. McCord, SOUTHWEST PADDLER, *Upper Rio Chama Report* (no date), http://southwestpaddler.com/docs/riograndenm13.html.

[408] *See* U.S. Forest Service, Rio Chama Management Plan (Nov. 1990).

[409] *See* Monastery of Christ in the Desert at https://christdesert.org/about/sustainable-stewardship/.

[410] Wild and Scenic Rivers Act, P. L. No. 90-542, 82 Stat. 906 (October 2, 1968) [hereinafter WSRA].

[411] Nat'l Park Serv., Nationwide Rivers Inventory (Dec. 31, 2017), https://www.nps.gov/999subjects/rivers/nationwide-rivers-inventory.htm

[412] WRSA, 16 U.S.C. § 1271 (2006).

[413] *Id*. §§ 1271, 1273(b).

[414] *Id*. § 1273(b)(1).

[415] *Id*. at 1273(b)(2).

[416] Sandra Zellmer, *Wilderness, Water, and Climate Change*, 42 EVTL. L. 313, 361 (2012).

In the Wild and Scenic Rivers framework, "wild" rivers are afforded the most protection owing to their nature as "essentially primitive" waters.[417] Due to their own outstandingly remarkable values, NSWRA also protects "scenic" and even "recreational" rivers—i.e., those "readily accessible by road or railroad, may have some development along their shorelines, and may have undergone some impoundment or diversion in the past."[418] Regardless of the tripartite classification, all wild and scenic-designated rivers are protected from dam construction and other water resources development.[419]

Once designated, either by state or congressional actions,[420] water managers are required to characterize the designated-rivers' "detailed boundaries" for purposes of preparing a management plan.[421] The management plan is designed to protect the river's "esthetic, scenic, historic, archaeologic, and scientific features" so that the river's outstanding resource values are "protect[ed] and enhanc[ed.]"[422] Through the management plan and the NWSRA's provisions, designated river reaches are protected from land and resource development in the "river corridor."[423] In this way, land, timber, and mineral-resource development are constrained and Federal agencies are precluded from developing any "water resources project[s]" that may adversely affect the river's values.[424]

(2) Rio Chama River Act of 1988

(a) Key Provisions

In 1988, Congress added the Rio Chama, between El Vado and Abiquiu, to the National Wild and Scenic Rivers system.[425] Specifically, the Wild and Scenic-designated stretch of Rio Chama is that "segment extending from El Vado Ranch launch site (immediately south of El Vado Dam) downstream approximately 24.6 miles to elevation 6,353 feet above mean sea level."[426] Specifically, the river's "wild" segment of the river is designated as beginning at the El Vado Ranch launch site downstream to the beginning of Forest Service Road 151, i.e., the Chama Canyon.[427] The "scenic" segment, in turn, is defined as the "segment downstream from the beginning of Forest Service Road 151 to elevation 6,353 feet shall be administered as a scenic river."[428] Under the Rio Chama River Act, the segment of the Rio Chama not encompassed by USFS lands—"from an elevation 6,283.5 feet…downstream to elevation 6,235 feet"—is required to be jointly managed by USACE, BLM, and the USFS.[429]

As a result of a compromise related to expanded storage at Abiquiu Reservoir for native Rio Grande Basin water,[430] the Rio Chama River Act affords Rio Chama "default protections" between elevation

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417 Zellmer, *supra* note 415, at n.375 and accompanying text.

418 16 U.S.C. § 1273(b)(3); Zellmer, *supra* note 415, at n.376 and accompanying text.

419 16 U.S.C. §§ 1273(b), 1276(d), 1278(a), 1284(c).

420 *Id*. § 1275(a), (b); *see also* Zellmer, *supra* note 415, at nn.368–70 and accompanying text.

421 16 U.S.C. §§ 1274(b)–(d).

422 *Id*. § 1281(a).

423 Zellmer, *supra* note 415, at n.383 and accompanying text.

424 16 U.S.C. § 1278(b); *see also* Zellmer, *supra* note 415, at n.382 and accompanying text.

425 Rio Chama River Act of 1988, P. L. No. 100-633, 102 Stat. 3320.

426 § 1, 102 Stat. at 3320 (amending Section 3(a) of the Wild and Scenic Rivers Act, 16 U.S.C. 1274(a)).

427 *Id*.

428 *Id*.

429 *Id*. § 3.

430 Kelly *supra* note 62 at 573-575.

6,353 feet msl and that "point approximately 4.0 miles downstream at elevation 6,283.5 feet msl."[431] These default protections are those granted to rivers that, under Section 5(a) of the NWSRA, are being considered "for study for potential addition to the national wild and scenic rivers system."[432]

Protections for this downstream-most segment of the WSRA-designated Chama may not interfere with those USACE operations of Abiquiu Dam and Reservoir related to the then recently expanded San Juan-Chama and native Rio Grande storage space.[433] Of note, the downstream-most four-mile stretch of river had been considered the "heart and soul" of the area prospectively protected by the NWSRA from encroachment by expansion of storage space at Abiquiu Reservoir.[434]

(b) Legislative History

Under the original Wild and Scenic proposal, these four river-miles would have been subject to periodic inundation by Abiquiu Reservoir since their elevation lay below the crest of Abiquiu Dam's to-be-heightened spillway.[435] Based on a then-recently updated USACE's hydrology study in 1986, the USACE updated its estimate of the probable maximum flood (PMF) on the Rio Grande using improved weather forecasting and larger runoff records.[436] Under the rubric of this updated calculation, the USACE made certain safety-related engineering modifications to Abiquiu Dam. As a function of the widened spillway, Abiquiu's total storage increased to 1.2 million acre-feet.[437]

This potential for increased conservation storage at Abiquiu is actually what led to the proposal for Wild and Scenic River designation for Rio Chama upstream of the Abiquiu Reservoir.[438] A Wild and Scenic designation of the downstream-most four-mile reach would have precluded then-non-authorized purposes, such as conservation storage.[439] New Mexico's then-State Engineer, S.E. Reynolds, interpreted legislation authorizing 200,000 acre-feet of San Juan-Chama Project water storage at Abiquiu (P.L. No. 97-140) as authorizing such storage *over and above* the 555,000 acre-feet sediment and flood control space. This meant that, according to Reynolds, total storage at Abiquiu in 1987 was 755,000 acre-feet.[440] At that time, however, USACE believed that the 200,000 acre-feet San Juan-Chama storage was located *within* Abiquiu's flood control pool. This interpretation would require San Juan-Chama Project water be evacuated from Abiquiu in the event of flood control of such magnitude.

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431 *Id*. § 2.

432 *Id*.

433 *Id*.

434 Kelly *supra* note 62, at 572–73, nn.260–61 and accompanying text (citing Rio Chama Hearings Pt. I at 143–44, citing testimony of Phillip Wallin, Trust for Public Lands).

435 Kelly *supra* note 62, at n.252 and accompanying text (citing Rio Chama River, New Mexico: Hearing on S. 850 Before the Subcommitee on Public Lands, National Parks and Forests, of the S. Comm. on Energy & Natural Resources, Pt. I, 100th Cong., at 14 (1987) (Testimony of Lt. Col. Kent Gonser, USACE, Albuquerque District Commander).

436 *Id*.

437 Abiquiu WCM, supra note 282.

438 Kelly *supra* note 62 at 572.

439 *Id*. at 573, n.262 (citing Rio Chama Hearings Pt. I at 62) (testimony of S.E. Reynolds).

440 *Id*. at 574.

As a compromise, Congress enacted P.L. 100-522, which authorized native storage at Abiquiu within the unused San Juan-Chama storage space.[441] According to one scholar, this legislation "assuaged some of the fears of Wild and Scenic-designation opponents that increased conservation would be forever precluded as a result of the designation."[442]

It bears mentioning that "inclusion of a reach of river in the National Wild and Scenic Rivers System allows the Federal government to claim a reserved water right for flows sufficient to meet the purposes of the wild, scenic or recreational designation."[443]

5. State Water Law[444]

a) Prior Appropriation[445]

(1) Overview

The doctrine of prior appropriation was first adopted in New Mexico in 1891 in an opinion by the Territorial Supreme Court.[446] In 1907, the Territorial legislature adopted a comprehensive water law code in which water rights administration was centralized with the (now) Office of the State Engineer.[447] Upon statehood in 1912, New Mexico's constitution formally codified the principles of prior appropriation and beneficial use along with the doctrine of public ownership of water—which had all been incorporated in the Water Code of 1907.[448] This constitution also operated to vest pre-1907 water rights that had been recognized in the 1907 Code, which was an attempt to "reduce existing practices regarding surface-water use to statutory form without substantial alteration."[449] Article XVI of the Constitution thus recognized "all existing right to the use of any water in this state for any useful or beneficial purpose."[450]

[441] P. L. No. 100-522, 102 Stat. 2604.

[442] Kelly (2007a), *Rio Grande Reservoirs*, *supra* note 62, at 575.

[443] UTTON CTR., *New Mexico Environmental Flows Workshop Report Synthesis* 14 (workshop held March 15, 2010) (remarks of Adrian Oglesby); *see also* Cynthia Brougher, CONG. RES. SERV., *The Wild and Scenic Rivers Act and Federal Water Rights* (Jan. 9, 2009), https://www.rivers.gov/documents/crs-water-rights-2009.pdf ("The act also implies the availability of Federal water rights necessary to accomplish the purposes of the act[.].... In practice, Federal reserved water rights have not always been claimed if alternative means (e.g., water rights acquired under state law) are adequate. Necessary water flows sometimes have been secured under state law, through cooperative agreements, and by purchases from willing sellers.") (also, quoting from NWSRA: "Designation of any stream or portion thereof as a national wild, scenic or recreational river area shall not be construed as a reservation of the waters of such streams for purposes other than those specified in this chapter, or in quantities greater than necessary to accomplish these purposes.").

[444] New Mexico Statutes Annotated Chapter 72.

[445] For a useful summary, *see, e.g.*, Kery (2003), *Overview*, supra note 60, at 2–5 ("Prior Appropriation").

[446] *Trambley v. Luterman*, 1891-NMSC-016, 6 N.M. 15, 27 P. 312.

[447] UTTON CTR., *Basic Water Law Concepts* (2015), at 1-2 [hereinafter UTTON CTR. (2015a)]

[448] *Id*.

[449] *Id*. at 1-2, 1-4.

[450] N.M. Const. art. XVI, § 1. ("All existing right to the use of any water in this state for any useful or beneficial purpose are hereby recognized and confirmed.")

The State's formal adoption of the doctrine of prior appropriation and its sister doctrine, beneficial use, are set out in the State's constitution.[451] "Public" waters are subject to appropriation, and the state was granted jurisdiction over these waters; the "better right" would be given by "priority of appropriation."[452]

These waters subject to appropriation are defined as "unappropriated water of every natural stream, perennial or torrential, within the state of New Mexico."[453] In turn, "beneficial use" is mandated as the "measure and the limit of the right to the use of water[.]"[454]

These basic tenets of water law are also codified by statute[455] and have evolved over more than one hundred years of judicial decisions, administrative regulation, and legislation.[456] We highlight a few salient points below.

(2) Nature, Measure, and Limit of a Water Right

Beneficial use is not defined under the New Mexico Constitution. Case law and statutory law, however, have characterized it as irrigation, domestic, municipal and industrial, game and fish, and endangered species uses. There is no priority scheme by type of use for allocation of water during shortages."[457] It should also be noted that historically a water right required an actual diversion of water as well as beneficial use of the water.[458] At the same time, the State Engineer may grant permits to appropriate water where proposed use is "not contrary to the conservation of water within the state and is not detrimental to the public welfare of the state," assuming availability of unappropriated water."[459] Environmental flow rights do not require a diversion to put water to beneficial use and their emergence in New Mexico has shown a diversion is not required to develop a water right.

(3) Water Rights Priorities

Under the prior appropriation doctrine, water is allocated by relative priority of initial appropriation. During times of shortage, water is first allocated to "senior" appropriators; depending on supply, "junior" water rights holders may receive reduced or no supply.[460] The seniority of rights depends on when a

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451 *Id*. §§ 2, 3.

452 *Id*. § 2 ("The unappropriated water of every natural stream, perennial or torrential, within the state of New Mexico, is hereby declared to belong to the public and to be subject to appropriation for beneficial use, in accordance with the laws of the state. Priority of appropriation shall give the better right.")

453 *Id*.

454 *Id.* § 3 ("Beneficial use shall be the basis, the measure and the limit of the right to the use of water").

455 *See*, *e.g.,* NMSA § 72-1-1 (1907) (defining "public" waters); *id*. § 72-1-2 (containing, *inter alia*, prior appropriation, beneficial use, appurtenancy, and relation-back requirements).

456 For a concise summary of important New Mexico water law judicial opinions, *see* UTTON CTR., *New Mexico Water Law Case Capsules*, in *WATER MATTERS!* (2015) [hereinafter UTTON CTR. (2015(b)]. For a useful summary of water rights adjudication, *see, e.g*., UTTON CTR., *Adjudications*, in *WATER MATTERS!* (2015) [hereinafter UTTON CTR. (2015c)]. And for a comprehensive summary of judicial decisions that have shaped water law in New Mexico, *see* Matthew Reynolds, *Trial and Error: How Courts Have Shaped Prior Appropriation in New Mexico*, 57 NAT. RESOURCES J. 26.

457 UTTON CTR. (2015a), *supra* 446, at 1-4.

458 *See State v. Miranda*, 83 N.M. 443, 444, 493 P.2d 409, 410 (1972) (requiring actual diversion of water).

459 NMSA 1978, § 72-5-6.

460 UTTON CTR. (2015a), *supra* note 446 at 10-1.

person applied a certain quantity of water to specific, "beneficial" use. These priority rules are codified by statute.[461] Vested pre-1907 rights are thus protected by the State Constitution.

After 1907, new appropriations of surface water required the user to obtain a permit from the State Engineer, and the priority date for any resulting right is generally that of the first use.[462]

(4) Water Rights Adjudications[463]

Adjudications are statutorily-mandated lawsuits to resolve claims to water use, including water rights corresponding to individual and corporate, as well as Pueblo, Tribal, and Federal government interests. "The purpose of an adjudication is to formally describe water uses in a stream system so that the State Engineer can effectively carry out his statutory mandate to apportion and administer water within that system."[464] This administrative-judicial process operates to "define and formalize all rights to a stream system's water supply."[465] Adjudications are, characteristically, "very simple in design [but] very complex in execution."[466] Out of necessity, then, the State Engineer, the New Mexico legislature, water users, and local communities have looked elsewhere to solve the most critical question in water law—what to do when there is not enough water to go around.

(5) Priority Administration[467]

The State Engineer, for its part, has "broad authority" to administer water rights under New Mexico's prior appropriation system.[468] But it has endeavored to avoid strict enforcement of water rights priorities and may instead enforce local agreements.[469] The New Mexico Supreme Court, in 2012's *Tri-State v.*

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[461] NMSA 1978, § 72-1-2 (1907).

[462] UTTON CTR. (2015a), *supra* 446, at 1-3 – 1-4. NMSA § 72-1-2 (1907) ("Priority in time shall give the better right."); *id*. ("In all cases of claims to the use of water initiated prior to March 19, 1907, the right shall relate back to the initiation of the claim, upon the diligent prosecution to completion of the necessary surveys and construction for the application of the water to a beneficial use."); *id*. (" All claims to the use of water initiated thereafter shall relate back to the date of the receipt of an application therefor in the office of the territorial or state engineer….").

[463] *See generally* Kery (2003), *Overview*, supra note 60, at 29 ("Adjudication").

[464] UTTON CTR. (2015a), *supra* 446, at 1-4; *see also Snow v. Abalos*, 1914-NMSC-022, 18 N.M. 681, 140 P.1044. ("It was the evident design of the Legislature, by chapter 49, S. L. 1907, to have adjudicated and settled by judicial decree all water rights in the state, to have determined the amount of water to which each water user was entitled, so that the distribution of water could be facilitated, and the unappropriated water to be determined, in order that it might be utilized."); § 72-2-9 (1907) ("The state engineer shall have the supervision of the apportionment of water in this state according to the licenses issued by him and his predecessors and the adjudications of the courts."); § 72-4-15 (1907) (requiring State Engineer to deliver results of its stream system hydrographic survey to the attorney general for prosecution, at the request of the state Engineer and for the State, of a lawsuit to "determin[e] [] all rights to the use of such water") § § 72-4-19 (1907) (providing for final decree of stream system adjudicated to be filed with the State Engineer).

[465] UTTON CTR. (2015a), *supra* 446, at 1-5; *see also* UTTON CTR. (2015c), *supra* note 455, at 3-2 (providing an overview of the adjudication process, including the roles of the courts, Attorney General, and State Engineer in the adjudication process).

[466] UTTON CTR. (2015a), *supra* 446, at 1-5; *see also* UTTON CTR. (2015c), *supra* note 455, at 3-6.

[467] *See generally* Kery (2003), *Overview*, supra note 60, at 5–6 ("Administration of Water Rights").

[468] UTTON CTR. (2015a), *supra* 446, at 1-5.

[469] *Id*.

D'Antonio,[470] upheld the State Engineer's statutorily designated authority to administer water rights priorities in unadjudicated basins on such a basis.[471] This statutory basis using local agreements to deal with water shortage actually codifies—and elevates—long-standing customs. While it is axiomatic to say that water shortage is not shared under prior appropriation, "[h]istorically, there have been many water sharing agreements among water users in times of shortage, including water rotation and scheduling agreements."[472]

Now with *Tri-State*'s stamp of approval, the Active Water Resources Management (AWRM) rules provide that the State Engineer may use evidence of water use other than decreed water rights in order for the water master to manage available water supplies in times of shortage.[473] The AWRM regulatory scheme authorized four types of administration other than strict priority administration:

1) *direct flow administration*, which involves "protection of available direct flow water for diversion and use by in-priority administrable water rights, and protection of direct flow water from out-of-priority diversion[,] and may incorporate "changes to the water master's determination of which water rights are in-priority and which are out-of-priority *on a daily basis*";
2) *storage water administration*, "by a water master of the release from reservoirs and subsequent downstream diversion of storage water in accordance with the requirements of the applicable administrable water rights for such release and diversion";
3) *depletion limit administration*, which is based on the "amount of surface water that is available for depletion by both surface water rights and hydrologically connected groundwater rights"; and
4) *alternative administration*, which is "based on [a] water sharing agreement among affected water right owners[.]"[474]

It also bears mentioning that priority administration only applies to imported water in its basin of origins; nonetheless imported water provides a "cushion" in times of shortage.[475] In this way, water rights deriving from a water supply contract with Reclamation, such as under the San Juan-Chama Project, are "not considered when any senior water right owner requests a call on the natural flows of the river."[476] Therefore, "[s]eniors [who are not project water contractors] are legally obligated to let the imported water flow past their points of diversion."[477]

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470 *Tri-State Gen. & Trans'n Ass'n., Inc. v. D'Antonio*, 2012-NMSC-039, 289 P.3d 1232.

471 NMSA 1978, § 72-2-9.1 (2003) (mandating State Engineer adopt rules for priority administration before completed adjudication).

472 UTTON CTR. (2015a), *supra* 446, at 1-5.

473 NMAC Part 19.25.13.1 *et seq*.

474 *Id*. 19.25.13.7(C)(1)–(4); *see generally* Paul Bossert & Greg Ridgley, UTTON CTR., *Active Water Resources Management*, *WATER MATTERS!* 11-1 (2015); Carol Romero-Wirth and Susan Kelly, UTTON CTR., *Water Rights Management in New Mexico and Along the Middle Rio Grande: Is AWRM Sufficient?* (Nov. 2012), http://uttoncenter.unm.edu/pdfs/water_rights_mgmt.pdf.

475 UTTON CTR., *Priority Administration*, in *WATER MATTERS!* 10-1 (2015) [hereinafter UTTON CTR. (2015d)].

476 *Id*.

477 *Id*.

b) Water Rights[478]

A water right is not "perfected" or vested—i.e., complete—until a permit to appropriate has been issued by the State Engineer, proof of beneficial use is supplied and the State Engineer, in turn, has issued a license to appropriate water.[479] In authorizing a permit, either outright or conditionally, the State Engineer must first consider the availability of unappropriated water.[480] Second, the State Engineer must determine where the proposed appropriation is "contrary to the conservation of water within the state" or "detrimental to the public welfare of the state." Third, the State Engineer must consider whether other water rights will be impaired.[481] If these conditions are met, the State Engineer "shall endorse his approval on the application," which thus ripens into a permit to appropriate.

Before discussing the water rights most relevant to our analysis of reservoir operations (Federal water projects generally must be conducted in accordance with state water law[482]) it will be useful to draw a conceptual distinction between diversion and storage permits in state water law. A storage right corresponds to the right to store water for future use, as compared to the appropriative or consumptive nature of a water right.[483] Storage rights are similar to water rights in most ways: they are both subject to priority administration.[484] A storage right must not injure senior appropriators; the priority date of a storage right is the application date.[485]

Colorado provides a legal framework for the creation and exercise of storage rights,[486] but does not recognize that water storage is a beneficial use per se (except for flood control purposes), although it does constitute an enabling condition for future beneficial use.[487] New Mexico, on the other hand, has long held that water storage is a beneficial use.[488]

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478 *See generally* Kelley, A., Water and Water Rights, Lexis Publishing (1991).

479 NMSA 1978, § 72-5-6 (2007).

480 *Id*.

481 *City of Roswell v. Berry*, 452 P.2d 179, 182 (N.M. 1969).

482 Reclamation Act of 1902, § 8.

483 Joshua Mann, *A River Runs Through It: A Legislative and Administrative History of the Six Pueblos' Right to Storage "Prior and Paramount" Water at El Vado*, 49 NAT. RESOURCES. J. 733, 765 (2007).

484 *Id*.

485 *Id*.

486 Colorado General Assembly recognized as far back as 1879 that storage rights are adjudicable water rights. *See* Casey Funk, Basic Storage 101, 9 U. DENV. WATER L. REV. 519 (1997–98) at n.13 (citing COLO. REV. STAT. § 37-87-101 (2005); *see also* § 37-92-103(12) (2005) ("'Water right' means a right to use in accordance with its priority a certain portion of the waters of the state by reason of the appropriation of the same."); *Id*. at nn.22-28, nn.46-49 (citing *People ex rel. Park Reservoir Co. v. Hinderlider*, 57 P.2d 894, 896 (Colo. 1936) for its holding that Colorado's Constitution required that "direct" and "storage" water rights be treated equally).

487 Funk, supra note 485, at nn.17-19 and accompanying text.

488 Mann, *supra* note 482, at 765.

Theoretically, storage rights in New Mexico are subject to curtailment by the State Engineer; this would involve limiting storage upstream of senior rights-holders.[489] This is unlikely, however, as the State Engineer rarely enforces priority, and has never done so in the Middle Rio Grande.[490] One commentator notes that one result of the State Engineer's priority enforcement reluctance is that "the Six [Middle Rio Grande] Pueblos cannot always get their full supply from the natural flow [of the Rio Grande]." To comply with delivery obligations for the Pueblos' "Prior and Paramount" rights, water is instead stored at El Vado Reservoir[491]—something of an insurance policy.

(1) MRGCD

As we move to discuss the water rights that are most relevant to reservoir operations in the Middle Rio Grande—those of its two biggest water users, MRGCD and ABCWUA—it bears mentioning that both entities store significant amounts of water in upstream reservoirs. The MRGCD stores water primarily at El Vado Reservoir; interestingly, neither of its two permits are "plain vanilla."[492] This first permit, No. 1690, which dates from 1930, grants MRGCD a right to store water at El Vado.[493] The second, No. 0620, strictly speaking represents the State Engineer's approval of MRGCD's application to change the points of diversion to consolidate the dozens of acequias.

(a) Categories of Water Rights in MRGCD

There are seven distinct types of water rights within the MRGCD. The MRGCD's formation comprised the consolidation of irrigation works—ditches, diversion works, etc.—of the six Middle Rio Grande Pueblos as well as dozens of acequias. Accordingly, MRGCD would serve both existing irrigators—including Pueblos—as well as newly irrigable lands, through its drainage and development efforts. This complex history generates a concomitantly complex system of water law, policy, and management—all the more uncertain in an unadjudicated basin.

Briefly, these distinct water rights include both surface water and groundwater rights, as well as both diversionary and storage rights, corresponding to different priorities.[494] First, some individual irrigators own pre-1907 surface water rights; these rights vested before the state's first water code and the State Engineer does not, thus, exercise jurisdiction over them, except insofar as these individuals apply for a required permit to transfer their rights. Second, surface water rights that were developed between 1907 and 1927, when the MRGCD was formed, are permitted by the State Engineer. Third, the MRGCD itself has two permits with the State Engineer, Nos. 1690 and 0620, which correspond to diversionary rights appurtenant to 42,482 acres of newly reclaimed lands—including roughly 11,000 acres of Pueblo land.

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[489] *Id.*

[490] *Id.*; *see also* UTTON CTR. (2015d), *supra* note 474, at 10-4.

[491] Mann, *supra* note 482, at 765, n.138 and accompanying text.

[492] N.M. OFFICE OF THE STATE ENG'R, Permit No. 1690 (application filed May 27, 1930 and approved August 20, 1930); and, Permit No. 0620 (application filed pursuant to MRGCD's Official Plan, which the Conservancy Court approved in August of 1928, shortly after the Act of 1928 was passed by Congress) (permitted granted by State Engineer Herbert Yeo on January 26, 1931).

[493] N.M. OFFICE OF THE STATE ENG'R, Permit No. 1690 (application filed May 27, 1930 and approved August 20, 1930).

[494] For concise summary, *see* Kery (2003), *Overview*, supra note 60, at 26–27.

For their part, the six Middle Rio Grande Pueblos have two varieties of water rights on the main-stem Rio Grande. Their "Prior and Paramount" water rights comprise surface flows necessary to irrigate 8,847 acres of Pueblo land which were being irrigated before the formation of MRGCD. These Prior and Paramount rights are based on aboriginal sovereignty. In contrast, the roughly 11,000 acres of Pueblo land that have been reclaimed since the MRGCD was formed have shared priority with all the other newly-reclaimed lands within the MRGCD.

Groundwater rights within MRGCD comprise the fifth "color" or water right in the MRGCD. If appropriation occurred before 1956, when the State Engineer "declared" the basin, the rights are not approved by a State Engineer permit; post-1956 wells are supposed to be permitted through the State Engineer. In turn, rights made available by water supply contracts with the Department of the Interior to San Juan-Chama Project water comprise the penultimate type of water right within MRGCD. The MRGCD holds rights to 20,900 acre-feet per year under this scheme. Finally, the MRGCD holds, under permit No. 1690, rights to store 198,110 acre-feet of water at El Vado Reservoir.

In sum, the State Engineer so far has recognized a total of 298,339 acre-feet of consumptive use[495] per year across these seven types of legally-distinct water rights with the MRGCD's boundaries.[496]

(b) MRCGD Permit No. 1690

Permit No. 1690 authorized the storage of 198,110 acre-feet of water in El Vado Reservoir, which the application noted would be "used as a regulating reservoir," and the water to be stored would "supplement the natural flow of the Rio Grande *during the irrigation season*."[497] The State Engineer's authorization was contingent on the sole conditions that the permit "not [be] exercised to the detriment of any others having prior valid existing rights to the waters of said stream system[.]"[498] Neither the application nor the permit itself, expressly differentiated between types of water rights to be thus stored, nor did they exclude from storage in El Vado Reservoir any rights under Permit 0620 (see below).[499] MRGCD's application for Permit No. 1690 did, however, explain that El Vado storage would, citing the District's Official Plan, be necessary to "safeguard…the existing rights and the supply for new lands…."[500] According to one scholar, this suggests the permit contemplated storage of the Six Pueblos' "Prior and Paramount" water.[501]

[495] I.e., from Rio Grande surface flows.

[496] Kery (2003), *Overview*, supra note 60, at 27.

[497] Mann, *supra* note 482, at 766 (citing OSE Permit No. 1690, on file with the Utton Center) (emphasis added).

[498] *Id*.

[499] *Id*. at 766–67.

[500] Application for Permit No. 1690, at 22.

[501] Mann, *supra* note 482 at 767 (citing N.M. OSE Permit No. 0620).

(c) MRGCD Permit No. 0620[502]

In its application for Permit No. 0620, MRGCD requested "chang[ing] the points of diversion and place of use of certain waters."[503] Specifically, the points of diversion (POD) of nearly five dozen historical irrigation ditches—or acequias—were to be moved to the headworks of the MRGCD's six main canals and four diversion dams.[504] Moreover, the applications claimed appropriative rights appurtenant to over 120,000 acres of land, including:

1) "perfected" pre-MRGCD irrigated lands in the amount of the roughly 80,000 acres to which the District asserted it was successor in title and which comprised the Six Pueblos "prior and paramount," and
2) roughly 40,000 acres to be newly irrigated, a figure which included the Pueblos' "newly reclaimed" lands.[505]

(2) ABCWUA Permits[506]

The Albuquerque-Bernalillo County Water Utility Authority (ABCWUA, or Authority) is statutorily required to "set policy and regulate, supervise and administer the water and wastewater utility of Albuquerque and Bernalillo County."[507] Accordingly, ABCWUA is explicitly subject[508] to provisions of the New Mexico statute[509] regarding municipal and county water development plans, including the water rights change of use/purpose provisions of Chapter 72.[510]

c) Conservancy Law[511]

(1) Background

As the quantity of its rights under its Permits Nos. 1690 and 0620 would imply, the MRGCD is another major actor in Middle Rio Grande water management. Oddly enough, the pioneering conservationist, Aldo Leopold, allegedly pushed for MRGCD's formation during his tenure as Secretary of the Albuquerque Chamber of Commerce.[512] Formed to drain waterlogged lands and to provide flood control

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502 N.M. OFFICE OF THE STATE ENGINEER, Permit No. 0620 (application filed pursuant to MRGCD's Official Plan, which the Conservancy Court approved in August of 1928, shortly after the Act of 1928 was passed by Congress) (permitted granted by State Engineer Herbert Yeo on January 26, 1931).

503 Permit No. 0620 Application, 1.

504 *Id*.

505 *Id*.

506 *See* NMSA 1978, § 72-1-10 (2005) (creating the ABCWUA, requiring the City of Albuquerque to transfer to property interests like San Juan-Chama contract to the Authority); *see also* ALBUQUERQUE BERNALILLO COUNTY WATER *Util. Auth., Water Res. Mgmt. Strategy* (2007), http://www.abcwua.org/uploads/files/Your%20Drinking%20Water/WRMS_Update_101207.pdf;

507 NMSA 1978, § 72-1-10(B)(1).

508 NMSA 1978, § 72-1-10(G)(1).

509 NMSA 1978, § 72-1-9.

510 NMSA 1978, § 72-1-10(G)(3).

511 *See generally* Kery (2003), *Overview*, supra note 60 ("Conservancy Districts" and "The Middle Rio Grande Conservancy District")

512 Middle Rio Grande Conservancy Dist., Senate Memorial 21, Task Force Studying the Electoral Process of the Middle Rio Grande Conservancy District: Findings and Recommendations 1–2 (no date).

and irrigation, the MRGCD would forever alter the natural hydrology of the Rio Grande. The MRGCD's history is intimately connected to the present with Federal reclamation law. As discussed above, through the Reclamation Act of 1902 and subsequent reclamation law, the government stepped in to the business of developing large-scale irrigation projects in the arid West.[513] In order to qualify as a Federal reclamation project, local irrigators had to self-organize; for example, through the conservancy or irrigation districts thus formed, irrigation water was delivered to local farmers.[514] For purpose of clarification, note that all seventeen Western states have laws governing irrigation districts, which are also referred to, somewhat interchangeably, as water conservation, conservancy, improvement, or reclamation districts.[515]

New Mexico's Constitution provides for such conservancy laws, authorizing the legislature to "provide by law for the organization and operation of drainage districts and systems."[516] With this authority, the legislature passed two laws concerning irrigation districts within Federal reclamation projects prior to the passage of the New Mexico Conservancy Act in 1923, which would form the legal basis for the MRGCD.[517] First, in 1917, the legislature provided for the organization of districts for the "drainage" of lands falling within the boundaries of any Federal reclamation project in the state.[518] Under this provision, drainage districts could be formed upon majority vote of "resident freeholders owning one-third in area of the lands" for the purpose of "cooperat[ing] with the United States government in effecting and carrying out…the construction of drainage works necessary to maintain the irrigability of lands[.]"[519] Second, in 1919 the legislature similarly provided for the organization of irrigation districts.[520] Under this legislation, these districts would have—upon the vote of a majority of "resident freeholders" who owned "more than one-half of lands" in such a district power not only to cooperate with the U.S. government to construct drainage works to improve irrigability, but for the construction of irrigation works themselves.[521]

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[513] *See* Reisner, Marc, Cadillac Desert: The American West and its Disappearing Water. Penguin (1993).

[514] *Id.*

[515] Kery (2003), *Overview*, supra note 60, at 21.

[516] N.M. Const. art. XVI, § 4 4 ("The legislature is authorized to provide by law for the organization and operation of drainage districts and systems.").

[517] Other statutes in the time period governed irrigation districts *outside* of Federal reclamation projects, including *inter alia*, the *Acequia* Act (governing *acequia* irrigation practices) (cited in Lisa Brown, *The Middle Rio Grande Conservancy's Districts Protected Water Rights: Legal, Beneficial, or Against the Public Interest in New Mexico*, 40 NATURAL RES. J. 1, 3–4 (2000)).

[518] An Act Providing for the Organization, Conduct, Management, and Control of Drainage Districts upon Federal Reclamation Projects and for Co-Operation between Such Districts and the United States Government, 1917 N.M. Laws 22 (codified at NMSA 1978, §§ 73-8-1 to -60) (Drainage Districts within Federal Reclamation Projects)

[519] *Id* at. § 73-8-1.

[520] An Act Providing for Irrigation Districts Organized for the Purpose of Co-Operating with the Government of the United States under Terms of the Federal Reclamation Law and Other Federal Laws and Repealing Existing Laws in Conflict Herewith, 1919 N.M. Laws 20 (codified at NMSA 1978, §§ 73-10-1 to -47).

[521] *Id*. at § 73-10-1.

(2) Conservancy Act and the MRGCD

As noted above, the MRGCD—the largest water user in the Middle Rio Grande—was organized pursuant to the New Mexico Conservancy Act of 1923.[522] This legislation gave conservancy courts jurisdiction to establish conservancy districts.[523] The Conservancy Act, by its own terms, applies to those conservancy districts organized for the purposes of:

a) flood control,

b) drainage, and

c) supplemental water storage for irrigation needs.[524]

As a base, the Conservancy Act required these districts to be "conducive to the public health, safety, convenience and welfare."[525] Formation of the district followed a stepwise procedure that required, first, proper petition of a majority of landowners comprising one-third of lands.[526] Second, it required approval by the conservancy court of a conservancy plan[527] prepared by a properly constituted board of directors after public hearing.[528]

The MRGCD's original purposes were, as found by a district court in a 1925 order creating the District:

1) to regulate the stream channels of the Rio Grande and Rio Chama; and

2) to regulate the flow of said streams…; and thereby,

3) to reclaim, drain, or fill the wet and overflowed lands and to protect public, municipal and private property from inundation and injury; and,

4) to reclaim and irrigate the arid and unproductive lands adjacent to said rivers as herein described.[529]

The Conservancy Act provided a caveat, however. The MRGCD was required to use its water and property rights "in such a manner as to"…"promote the welfare of the district and of all the inhabitants thereof[,] the safest, most economical and most reasonable use of such waters, protect the water rights of the lands and landowners of the district, and encourage and promote agriculture and industry."[530]

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[522] Note that the current Conservancy Act, that of 1927, 1927 N.M. Laws, ch. 45 (codified at NMSA 1978, Ch. 73, arts. 14–17). repealed and replaced the original Conservancy Act of 1923, 1923 N.M. Laws, Ch. 140. *See Gutierrez v. Middle Rio Grande Conservancy Dist.*, 34 N.M. 346, 282 P.1 (1929).

[523] 1923 N.M. Laws 140 (codified at NMSA 1978, §§ 73-14-1 to -5) (authorizing District's organization).

[524] NMSA 1978, § 73-14-4(A) (1927) (amending the 1923 Act) (the "applicability" statute).

[525] NMSA 1978, § 73-14-1 (1927).

[526] NMSA 1978, § 73-14-5(a) (1927).

[527] NMSA 1978, § 73-14-36 (1927); *see also* NMSA 1978, § 73-14-17 (1927).

[528] NMSA 1978, §§ 73-14-7 (1927), 73-14-8 (1927), 73-14-9 (1927).

[529] *In re Rio Grande Conservancy Dist.*, No. 14,157, Slip Op. (N.M. Dist. Ct. Aug. 26, 1925), *aff'd In re Proposed Middle Rio Grande Conservancy District*, 242 P.683 (N.M. 1925).

[530] NMSA 1978, § 73-14-47(B) (1927).

Both within and beyond its original purposes focusing on flood control and drainage,[531] the MRGCD wields particularly broad powers under the Conservancy Act. These powers include enumerated ones, such as those necessary to make improvements for "public health, safety, convenience, and welfare"[532] and the rights and powers corporation, such as to sue and incur debts,[533] as well as those of political subdivisions of the state, which may take property through eminent domain, tax, and issue bonds.[534] MRGCD may also wield significant unenumerated powers through operation of the authorization "to perform all acts necessary and proper for carrying out the purposes for which the district was created and for exercising the power with which it is invested."[535]

These unusually broad powers that the legislature intended to grant conservancy districts are evidenced by express language it incorporated. For example, the Conservancy Act is to be construed liberally with regards to the police powers it authorized (e.g., health, safety, and welfare).[536] The legislature also incorporated a clear conflict of laws statement whereby the Conservancy Act would prevail against conflict provisions of other statutes."[537]

The MRCGD's significant water management powers are therefore not surprising. As a starting point, unlike acequias, the District can own water rights.[538] This provision is notable because, although substantial water rights within the district may correspond to individual irrigators with priorities, the District may develop or acquire new rights—via purchase, condemnation, development, or otherwise.[539]

Under the Conservancy Act's 1927 Amendment, the MRGCD is also exempted from certain state water law provisions, such as loss by non-use. Accordingly, "[t]he rights of the district to the waters of the district, or the use thereof, or the land within the district and property owned by it shall not be lost by the district by prescription or by adverse possession, or for nonuse of the waters."[540] One commentator notes, however, that this provision resulted in a "cloud over the state engineer's jurisdiction" and that it may actually contradict water conservation and public interest provisions in the state's constitutional, common, and statutory law.[541]

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[531] NMSA 1978, § 73-14-4(A).

[532] NMSA 1978, §§ 73-14-2, -3(P) (1927)

[533] NMSA 1978, § 73-14-13 (1965).

[534] *Id*.

[535] *Id*. at -13(B); *see also* NMSA 1978, § 73-14-48 (1927).

[536] NMSA 1978, § 73-17-20 (1927).

[537] NMSA 1978, § 73-17-23(C) (1927).

[538] NMSA 1978, § 73-14-39 (1927) (district board may "acquire. . . own, lease, use and sell, to hold encumber, control and maintain any . . . water right"); *id*. at -47(F).

[539] NMSA 1978, §§ 73-14-39, -14(F).

[540] NMSA 1978, § 73-17-21 (statute upheld as not violating State's constitutional equal protection clause in *City of Raton v. Vermejo Conserv. Dist.*, 101 N.M. 95, 678 P.2d 1170 (1984)) (compare NMSA 1978, §§ 72-12-18, 72-5-28 (common law abandonment and forfeiture rules for surface water rights)).

[541] Brown, supra note 516, at 8, 9 (comparing 40-year period for municipalities' water resource planning without incurring forfeiture, NMSA 1978, § 72-1-9 (1985), as substantiated with reasonable demand projections).

Colorado's Conservancy Act, which served as a model for New Mexico's, contains no such non-use provision, further evidencing the outlier nature of this provision, both within New Mexico law and Western water law. This same commentator notes that "there is no explanation for its continued existence," absent adequate explanation of New Mexico-specific context in case law.[542]

The MRGCD's non-use special exemption under the Conservancy, however, is not without potential challenges. The New Mexico Supreme Court has held that it does not violate the state's equal protection clause. The court, in *City of Raton*, found that "the state's unique and extensive regulation of such districts ensures maximum beneficial use of water."[543] However, one scholar finds this decision concerning on the basis of its inherent "technocratic bias" against the acequia system.[544] Roughly ten years earlier, the same court held that that there must be a "rational and natural basis" for a statute, "based on a substantial difference between those to whom it does and those to whom it does not apply, and that it is so framed as to embrace equally all who may be in like circumstances and situations."[545] While *City of Raton* held non-use provisions precluded abandonment of conservancy district water rights, that Court did not address statutory forfeiture.[546] Accordingly, this is a material distinction which could leave the MRGCD's non-use protection vulnerable.

Unlike abandonment,[547] the surface water forfeiture statute does not contain an intent element.[548] Indeed, the State Supreme Court in *Erickson v. McLean* stated that forfeiture "may be worked directly against the intent of the owner of the right to continue in the possession and the use of the right."[549] But even if the MRGCD may not lose its water rights by nonuse, it may lose them as a result of abuse. As the *Erickson* court clearly articulated, water is of elemental importance and water-scarce conditions in New Mexico "demand from the state an exercise of its police power, not only to ascertain rights, but also to regulate and protect them."[550] Public interest considerations will be discussed below, but for now it will suffice to note that the New Mexico Court has found that the State's police powers may be delegated to the OSE.[551]

542 *See* Brown, supra note 516, at 17 (citing, inter alia, Colo. Rev. Stat. §§ 37-45-101 to -153 (1973) and noting that some Colorado irrigation districts have even lost water rights to abandonment, id. at 17, n.109).

543 *City of Raton v. Vermejo Conserv. Dist.*, 678 P.2d 1170 (N.M. 1984).

544 Brown, supra note 516, at 11–17

545 540 P.2d 238, 240 (N.M. 1975).

546 Brown, *supra* note 516, at 15.

547 State ex rel. Erickson v. McLean, 308 P.2d 983, 987–88 (N.M. 1957).

548 Brown, supra note 516, at 2 at n.3 (citing NMSA 1978, § 72-5-28).

549 Erickson, 308 P.2d 983, 987.

550 *Id*.

551 Brown, *supra* note 516, at n.99 (citing State ex rel. *Reynolds v. Aamodt*, 800 P.2d 1061,1062 (N.M. 1990)).

IV. "SOFT LAW": OPERATIONAL FRAMEWORK

A. Upper Rio Grande Water Operations Model (URGWOM)

1. *Overview*[552]

The foregoing discussions of the legal framework makes clear that water in the Rio Grande Basin is managed to meet specific demand on a particular suite of constraints. Dams and reservoirs are key water operational way points for water in this system, through which flow many "colors" of water, as described above. Operations at Heron, El Vado, Abiquiu, Cochiti and Elephant Butte Reservoirs thus store and release to meet a variety of demands on different temporal scales, with water that is both "native" to, and imported from, outside the Rio Grande Basin. To facilitate this complex legal, management, and operational scheme, water is transferred between different accounts—reservoirs are often the primary mechanism.[553] Reservoirs serve as banks; water managers—both government agencies and quasi-government institutions serve as brokers; and law and policy are the "rules of the game."[554]

The Upper Rio Grande Operations Model (URGWOM), is a decision-support and systems modeling tool for the management and accounting of water in this complex system, as well as related planning efforts.[555] URGWOM is built on RiverWare, a platform put out by the University of Colorado-Boulder's Center for Advanced Decision Support for Water and Environmental Systems (CADSWES).[556] This tool facilitates "operational decision-making, responsive forecasting, operational policy evaluation, system optimization, water accounting, water rights administration, and long-term resource planning."[557] RiverWare also offers probabilistic modeling capabilities,[558] a useful feature for planning in the context of climate change.

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[552] For a synopsis of URGWOM, *see* Craig Boroughs, Marc Sidlow, and Steven Bowser, *Representing Policy for Operations in the Upper Rio Grande Water Operations Models*, Presented at 2ND JOINT FEDERAL INTERAGENCY CONFERENCE, June 27-July 1, 2010. These authors summarize URGWOM's capabilities in this way:

> A fundamental needed...is assisting managers in delivering supplies to all water users on time, in the desired quantities, and with minimum conflict between users with a specific focus on deliveries, exchanges, and leases of water allocated to contractors for San Juan-Chama Project water. URGWOM is used to provide the community of water managers and water users with a clear, consistent, and a common set of data. With the established model for the Rio Grande system in New Mexico including methods representing the key physical process in the basin and established accounts, rule-based simulations can be completed with the URGWOM ruleset set up to simulate baseline operations of the system and resulting river and systems conditions. Rules are coded for meeting all the different demands using available supplies for those specific water uses as tracked with separate accounts. Coded rules allow for Annual Operations Plan to be developed with accurate representation of different implemented water agreement and any deviations from typical operations. . . *Changes in operations or other proposed actions can be analyzed with URGWOM to evaluate the impact on the water supply, river flows, and water deliveries*.

[553] *See generally* Dave Owen and Colin Apse, *Trading Dams*, 48 U.C. Davis L. Rev. 1043, 1080–1102 (2015) (discussing a variety of potential environmental transfers involving dams, including treatment of requisite legal framework, possible regulatory leverage, and information needs).

[554] *Id.*

[555] *See generally* UTTON CTR., *Law of the River: Policy and Operations* (May 23, 2018) (Excel column "OTHER RECLAMATION PROGRAMS: URG Water Ops Model"); Stockton, *supra* note 557, at 7–8; URG WATER OPERATIONS REVIEW, *supra* note 84, Vol. I, at 2-2 (Key Tools: URGWOM Planning Version")

[556] Boroughs, *supra* note 10, at 4.

[557] UNIV. OF COLO.–BOULDER, CENTER FOR ADVANCED DECISION SUPPORT FOR WATER AND ENVIRONMENTAL SYSTEMS, *River Ware*, https://www.colorado.edu/cadswes/creative-works/riverware.

[558] *Id*.

In modeling of water storage and delivery operations, URGWOM models focus respectively on accounting, water operations, forecasting, and planning. The physical system, including both the river and reservoirs, is represented in the accounting model, which rectifies inflows and outflows throughout the system. The accounting model deals only with historical data. The water operations model, in turn, adds a forecasting capability to the accounting model. Accordingly, the operations model uses accounting data as a foundation to predict future storage and release of water; in due order, this model applies policy rules, as needed. The forecast model builds on the model's simulation capabilities, using spring runoff forecasts and historical hydrographs to predict daily flows at the different control points contained in the water operations model. Finally, the planning model involves a simplified rule structure in order to carry out longer term forecasting runs, which are computationally more intensive.[559]

2. *Upper Rio Grande Water Operations Review*

Reclamation and USACE, along with the New Mexico Interstate Stream Commission, used URGWOM in the landmark 2007 study of water operations of the Upper Rio Grande Basin, from the river's headwater in Colorado through New Mexico.[560] This Upper Rio Grande Water Operations Review[561] and the associated Environmental Impact Statement addressed the agencies' development of an "integrated plan" for water operations at Reclamation's and USACE's existing facilities upstream of Fort Quitman, Texas.[562] The backdrop of this interagency effort was the exigency of meeting new habitat and species needs under the Endangered Species Act while also meeting existing demands under conditions of protracted drought.[563] Given the Rio Grande's "highly variable flow regime," the newly-developed URGWOM permitted the study to "evaluate the operations of multiple water management facilities as a system, *enabling technically valid comparison of different scenarios*."[564] The Water Operations Review's goal was thus to use URGWOM to "evaluate the model to evaluate a full range of water operations in an integrated systems approach and to examine whether the full range of discretionary actions were being implemented for better ecosystem management."[565]

In investigating water operations and associated discretionary actions, the Water Operations Review looked in detail at five main areas:

1) reservoir operations,
2) opportunities for operational optimization of the system as a whole,
3) planning for future water operation,

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[559] Stockton, *supra* note 554, at 7; Boroughs, *supra* note 10, at 1–2; *see also* U.S. Army Corps of Engineers, *URGWOM Summary* (no date), https:/www.spa.usace.army.mil/Missions/Civil-Works/URGWOM (providing useful URGWOM overview and containing host of links detailed URGWOM information including, *inter alia*, model documentation and data, technical review, committee notes, and model output for different rule-based simulations (e.g., monthly forecast runs and current year "Annual Operating Plan" model runs)).

[560] URG WATER OPERATIONS REVIEW, *supra* note 84, Vol. I, at I-1 – I-2, II-1 – II-2.

[561] *Id.*

[562] *Id at* Vol. I, at I-1.

[563] *Id*.

[564] *Id*. (emphasis added).

[565] *Id*.

4) capabilities for improved decision-making, and
5) compliance with extant authorities.[566]

Within these focus areas, the Review incorporated the need to operate the system within existing legal authorities, including extant water allocation schemes and prior appropriation. Compliance with these authorities permits Reclamation, USACE, and the State of New Mexico to:

1) "store and deliver water for agricultural, domestic, municipal, industrial, and environmental uses";
2) meet Rio Grande Compact delivery obligations to Texas;
3) provide flood control; and
4) meet obligations under legal, treaty, and contract.[567]

The Review identified the low-water flows and endangered species needs, as well as water conveyance efficiency and sediment and flood control capabilities as the "major" water operations issues in this inherently complex space. URGWOM's planning model permitted USACE, Reclamation, and the New Mexico Interstate Stream Commission (NMISC) to navigate this inherent complexity, including overlapping and variable jurisdictional, hydrologic, and climatologic demands.[568]

3. URGWOM Policy Rules

URGWOM incorporates approximately 180 discrete policy rules into its water operations simulations.[569] URGWOM supports water managers' operations need to meet various water demands under multiple constraints, including those contained in legal authority. This process reduces, in part, to an accounting exercise, where water demands for people, agriculture, and the environment are met with both native Rio Grande Basin water and non-native, imported San Juan-Chama Project water. Of course, there are many more colors of water when different water ownership (i.e., different types of water rights) is considered.[570] Water operations in URGWOM use policy rules to track water in different accounting, starting with the overarching issues of whether a particular demand is to be met with native and non-native water.[571]

[566] *Id*. at I-1 – I-2.

[567] *Id*.

[568] This space includes State, Federal, and Tribal jurisdictions and substantive roles ranging from managing U.S. government's Federal trust responsibilities to hydrology, riparian ecology, and river geomorphology. *Id*. at I-2. *See also id*. at II-1 (explaining URGWOM's long-term planning module was the outcome of a process that water managers pursued to develop a tool that would "facilitate the sharing of daily water operations data" and clearly memorialize "existing procedures by which the river has come to be managed.").

[569] URGWOM Ruleset, *supra* note 10, at 4–5.

[570] *See, e.g.*, *supra* note 493 and accompanying text (detailing seven types of water rights with the MRGCD's boundaries).

[571] Boroughs, *supra* note 10, at 4–5.

Policy rules, therefore, are a fairly high-resolution attempt at modeling, both in substance and in terms of hierarchy, the legal authorities controlling the allocation and use of water in the basin, as well as the associated (or derivative) regulatory and operational mandates. Attachment to this report presents an annotated summary of URGWOM's ruleset, excerpting important rules and, in outline form, attempting to capture their hierarchical status. The intent of Attachment B is to help managers identify where there is operational flexibility allowed by the rules that guide URGWOM outputs. The remainder of this section presents a further summarizing of the most relevant policy rules, in a synthesis whose structure derives from the overarching legal and management hierarchy.[572]

a) Native Rio Grande Water

Heron Reservoir stores only imported San Juan-Chama water, so URGWOM is set to bypass native Rio Grande flows. Downstream, native flows are captured in El Vado Reservoir. Storage occurs there to the extent required, first, to ensure supply of "Prior and Paramount" water to the Six Middle Rio Grande Pueblos should the mainstem Rio Grande provide insufficient flows to meet Prior and Paramount needs and, second, for the irrigation need of the MRGCD. Importantly, El Vado storage is controlled by the Rio Grande Compact. As a post-1929 reservoir, El Vado storage of native Rio Grande water for the MRGCD is prohibited when Compact Article VII is in force. Further downstream, native Rio Grande flows are bypassed through the Middle Rio Grande Project (Abiquiu and Cochiti Reservoirs), unless the exigencies of flood control dictate their temporary storage. In certain circumstances, flood waters may be detained until after the irrigation seasons.[573]

(1) Emergency Drought Water Agreement(s)[574]

URGWOM also has the capability to model important historical reservoir operations agreements. Under the first such institutional arrangement, the 2008 Emergency Drought Water Agreement (EDWA), New Mexico was able to store native water at El Vado Reservoir when it would have otherwise been precluded by operation of Compact Article VII. This 2008 agreement was actually an amendment to the Conservation Water Agreement of 2001, which arose out of negotiations surrounding the 2001 Biological Opinion.[575] Under the EDWA, which was enacted again in 2016,[576] New Mexico relinquished (delivered) "credit water" to Texas at Elephant Butte; Texas's assent to this relinquishment had the effect of permitting New Mexico to physically store the same amount of water upstream in El Vado Reservoir as a hedge against drought. This specially-stored water was allocated by the agreement between Reclamation, MRGCD, and certain municipalities. URGWOM tracks these different accounts. As an engineer and URGWOM expert has noted, "URGWOM has served as an excellent tool for agencies and stakeholders to analyze the impact of such agreement on various indicators in the basin."[577]

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572 This material draws heavily from the synthesis presented in Boroughs, *supra* note 10, at 6–8.

573 *See Id*.

574 *See generally* Gillon (2007), *supra* note 167 at 123–37 and accompanying text (analyzing Conservation Water Agreement, which is predecessor to Emergency Drought Water Agreement).

575 *Id.*.

576 *See* Bureau of Reclamation, Calendar Year 2017 Report to the Rio Grande Compact Commission (March 2018) at 16.

577 *See id.* at 6

(2) Cochiti Reservoir Operations Deviations[578]

The second type of institutional arrangement for water management flexibility that URGWOM has modeled are deviations from "normal operations" at Cochiti Reservoir, which are primarily operated for flood and sediment control purposes.[579] The objective of such operations is to provide spawning and recruitment flows for the ESA-protected silvery minnow. When runoff conditions would not otherwise permit such flows, water is temporarily stored and released to provide a spring pulse flow that mimics the natural pulse of snowmelt runoff. (As noted previously, the Flood Control Act of1960 requires that such deviations from the Act's Reservoir Regulation Plan be authorized by the Rio Grande Compact Commission.[580]) URGWOM has permitted an evaluation of such deviations, which axiomatically differ from typical reservoir operations, on "system conditions."[581]

b) Water Uses

URGWOM also offers the ability to track reservoir releases of both native Rio Grande Basin and imported San Juan-Chama Project water for different water uses.[582] The lion's share of these water uses comprise MRGCD irrigation diversions and ABCWUA's Drinking Water Project.[583] URGWOM also tracks so-called "letter water deliveries," by which Federal water project contractors—e.g., MRGCD and ABCWUA—leave water in the river to "pay back" groundwater depletions which have impacted surface flows.[584] URGWOM further tracks water in "borrow/pay back" schemes by which one contract borrows water from another contractor and agrees to subsequent repayment.[585]

(1) MRGCD

MRGCD diverts water at four points between Cochiti and Elephant Butte Reservoirs, namely the Cochiti, Angostura, Isleta, and San Acacia diversions. URGWOM treats these diversions as exogenous, that is, this data is input into the model based on crop irrigation requirements. To accurately reflect the physical system, URGWOM also accounts for irrigation return flows to the river.[586]

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578 *See generally* M.H. Benson (2014), *supra* note 9, at nn.166–67 and accompanying text; Gillon (2007), *supra* note 167, at n.102 and accompanying text; *id*. at 635 (explaining constraints to such a deviation).

579 *See* Kelly (2007a), Rio Grande Reservoirs, supra note 62.

580 *Id.*

581 Boroughs, *supra* note 10, at 6–7.

582 *Id*. at 7–8.

583 *Id.*

584 *Id.*

585 *Id*.

586 *Id*. at 7.

(2) ABCWUA

In turn, diversions by ABCWUA's Drinking Water Project (DWP) are nominally supplied by the Authority's San Juan-Chama Project allocation. As noted above, the Drinking Water Project diversions depend on current river flows; before ABCWUA diverts its full allocation, minimum rivers flows must be obtained.[587] As permitted, these diversions require Project water to be carried by an equal amount of native Rio Grande water.[588] Therefore, ABCWUA's DWP physically diverts twice the Authority's allocation by volume, but 50 percent of the diversion returns to the river as return flow.[589] When river flows are too low for ABCWUA to divert water, the DWP's inflatable diversion dam deflates, allowing the remaining flows to pass unimpeded.[590]

(3) Target Flows (Under the 2003 Biological Opinion)

From 2003 until late 2016, Biological Opinion mandated flow targets at certain locations in the Middle Rio Grande Valley attempted to vouchsafe endangered species' and related habitat needs.[591] These targets were seasonal but also differed based on relative annual flows: under the 2003 Biological Opinion, each year was designated as "wet," "dry," or "average" and flow targets decreased with natural runoff.[592] URGWOM would compute water releases necessary to meet these flow targets. Sometimes, compliance with these flow targets would necessitate release of supplemental water supplies, such as San Juan-Chama water leased by Reclamation[593] or native Rio Grande Basin water stored pursuant to the Emergency Drought Water Agreement.[594] URGWOM can track these releases and storage balances.[595]

(4) Letter Water Deliveries

These deliveries are made pursuant to letters addressed to Reclamation and issued by the Office of the State Engineer that, based in part on OSE's groundwater modeling, indicate San Juan-Chama contractors' obligations to leave Project water in the river.[596] As a matter of policy, the flows are distributed between the irrigation season, to avoid curtailment of MRGCD diversions, and the off-season, to facilitate Compact deliveries to Elephant Butte.[597] This exchange of San Juan-Chama Project water for groundwater is treated as a debt and subsequent payback scheme; URGWOM accounts for water and the delivery schedules calculated by the State Engineer are input into the mode.[598]

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[587] ABCWUA Water 2120: Securing Our Water Future at Ch. 3.3 (2016)

[588] *Id.*

[589] *Id.*

[590] *Id.*

[591] 2003 Biological Opinion *supra* note 335.

[592] *Id.*

[593] Reclamation, Calendar Year 2016 Report to the Rio Grande Compact Commission at 44 (March 2017).

[594] *Id* at 15.

[595] *See, e.g.,* Boroughs, *supra* note 585, at 6–7.

[596] *Id*. at 7.

[597] *Id*.

[598] *Id*.

c) Operations to Meet Demands

URGWOM simulations match water demand with supply from upstream reservoirs, accounting for physical losses and other system processes. For a defined suite of downstream needs—e.g., MRGCD and ABCWUA diversions as well as target flows, the model calculates total demands for the Rio Grande Basin and San Juan-Chama Project water. URGWOM rules then compare these theoretical releases with physical constraints, including the parameters of flood control operations. In water-short conditions, available supply is allocated based on exogenous priorities. These priorities are input based on water use type.[599]

V. BOUNDARIES OF EXISTING LEGAL INFRASTRUCTURE

A. Resilient Water Law and Policy[600]

One premise of this report is that diverse water managers and stakeholders share the operative goal that, under the constraints of drought and generally increased use and storage demand, water must be delivered to people and ecosystems. Sustainability scholars have argued that this challenge demands a resilient response, one that operates "beyond sustainability" and must acknowledge the operative demands and realities of the "novel system."[601] For its part, the Rio Chama Flow Project has prioritized interdisciplinary lobbying, planning, and the scientific study of managed flood pulses in the Wild and Scenic reach of the otherwise highly engineered Rio Chama between El Vado and Abiquiu Reservoirs. Even Congress has recognized the importance of such demands, having added the promotion of "flow dependent ecological resiliency" to Reclamation's mandate.[602] The December 2016 Biological Opinion appears to be an attempt at such a resilient response.

This 2016 Biological Opinion attempts to balance these increasingly complex operating criteria and competing water demands,[603] such as environmental flows for endangered species, and water for Pueblos, municipalities, and irrigated agriculture. In service of this goal, the 2016 Biological Opinion explicitly conditions its no-jeopardy finding on *voluntary* "Conservation Measures."[604] Most of these require a high degree of multi-stakeholder collaboration, which necessarily would unfold within a contested and litigated space.

The 2016 Biological Opinion's new Conservation Measures require not just stakeholder collaboration but also Federal water managers' *de facto*, if not *de jure*, discretion, within a jurisdictionally, ideologically, and biologically complex environment. Such operational collaboration and discretion increasingly marks the polycentric governance system that is emerging on the Middle Rio Grande; it is also characteristic of the transformation and resilience that diversity produces. The 2016 Biological Opinion interprets discretion as a vector for achieving environmental flows and trust-building among stakeholders—in line

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[599] *Id*. at 8.

[600] *See generally* Utton Center, Water Resilience in a Time of Uncertainty (2015).

[601] *See* Benson, *supra* note 9.

[602] Science and Engineering to Comprehensively Understand and Responsibly Enhance (SECURE) Water Act (2009) at Sec. 4(g), approved in Omnibus Public Lands Act of 2009, P.L. 111–11 (Mar. 30, 2009).

[603] U.S. Fish and Wildlife Service, Final Biological and Conference Opinion for Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico (Dec. 2, 2016).

[604] *Id* at 18.

with practical water management and governance lessons learned over the past two decades. This vision lies in contrast to the view of many litigious environmentalists that agency discretion is, per se, detrimental to the interests of the environment because government agencies do not wield it properly. However, such rationale ignores that the Rio Grande is a novel system that cannot easily be "restored" by fiat but must be managed cooperatively. In this environment, managing Rio Grande Reservoir operations for flexibility is a key variable. This flexibility requires discretion on the part of both Federal water managers and river stakeholders. The 2016 Biological Opinion's discretionary space thus comprises legal, environmental, and practical dimensions.

The 2016 Biological Opinion also serves as a microcosm for larger questions surrounding, and approaches to, sustainability and water management in the arid west. For example, what is the proper place for collaboration as opposed to litigation in water politics? Some environmental groups have emphasized the perils of such discretion and the benefits of adversarial legal action. In contrast, stakeholder groups and water management, law, and policy practitioners comprising the Rio Chama Flow Project, which counts the Utton Center as a participating institution, emphasize the practical and environmental benefits of collaborative approaches. In this context, real, if incremental, changes allow for adaptive management of a novel system.

B. Reservoir Operations: Key Issues (Interagency/Multi-stakeholder Exchanges and Agreements)

1. Supplemental Water Program (San Juan-Chama Water)

Under the Supplemental Water Program, Reclamation leases surplus San Juan-Chama Project water, which it stores in Abiquiu Reservoir in "up to" 20,000 acre-feet of space leased from the Water Authority; the water is subsequently released for the silvery minnow.[605] Reclamation then exchanges this Project water for native Rio Grande water; accordingly, MRGCD only diverts San Juan-Chama water and so an equal amount of native water flows unimpeded, for "beneficial instream flow."[606] This accounting scheme presents no major legal issues since San Juan-Chama water is not required, under the Rio Grande Compact,[607] to be delivered to Texas and this Project water must be consumed within the Middle Rio Grande. More broadly, the Supplemental Water Program "provides additional water for endangered species needs"[608] through five Program components:

1) surplus San Juan-Chama Project water leases;
2) assent to contractors' waiver Heron carryover storage requests;
3) Low Flow Conveyance Channel (LFCC) water management;
4) temporary off-channel storage (at "refuges"); and
5) groundwater pumping.

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[605] Gillon (2007), *supra* note 167, at 632, n.119 and accompanying text (citing Agreement between the U.S. Department of the Interior, Bureau of Reclamation and the ABCWUA to Lease Abiquiu Reservoir Storage Space (on file with author). The agreement was signed August 17, 2005. *See* ABCWUA Authority Minutes 5 (Aug. 17, 2005).

[606] *Id*. at nn.120–23 and accompanying text.

[607] 1938 Rio Grande Compact, Art. X.

[608] *Engineer Advisers Report*, at 10–11, in RIO GRANDE COMPACT COMMISSION, ANNUAL REPORT (2001) (citing 2001 Final Rio Grande Supplemental Water Program Programmatic Environmental Assessment) (cited in UTTON CTR., *Policy and Operations*, *supra* note 37, at "RGCC.Ann.Rpt-Eng'rAdv" tab) [hereinafter RGCC EA 2001]

Treatment of LFCC, off-channel storage, and groundwater pumping are beyond this report. As noted above, leased San Juan-Chama water is "released for diversion and use by the MRGCD"; this Program transaction allows for "an equivalent amount of native Rio Grande water (less conveyance losses) to remain undiverted."[609]

According to Reclamation, the Supplemental Water Program is the San Juan-Chama Project's "primary conservation measure" for ESA Section 7 compliance.[610] The ultimate goal of this measure it to avoid jeopardy to listed species or adverse modification to their habitat. Reclamation contends it has maintained compliance with the 2003 Biological Opinions, reasonable and prudent alternatives (RPA) and reasonable and prudent measures, including flow targets. Thirteen years on, however, Reclamation reports "reduced opportunities" for leasing of San Juan-Chama Project water, which the agency characterized as a "mainstay" of the Supplemental Water Program.[611]

The reduced availability of San Juan-Chama water for leasing, largely a function of the Water Authority's Drinking Water Project coming online in 2008, together with extended drought, has left the Supplemental Water Program vulnerable. These exigencies demand innovative water management of available supplies, according to Reclamation. As will be discussed further below, the current Biological Opinion has moved away from the strict wet year/dry year-pegged seasonal flow targets of the previous Biological Opinion to an adaptive management model. Further, it is anticipated that non-Federal agencies such as the MRGCD will need to bear a greater burden of providing environmental flows that have previously been achieved through the Supplemental Water Program.

2. Conservation Water Agreement (Native Rio Grande Basin Water)[612]

In another effort to shore up water for the endangered silvery minnow and its Rio Grande habitat, Reclamation and other parties entered into an innovative agreement in 2001 to store relinquishment credit water. First broached by the State of New Mexico as a settlement offer during the early stages of the minnow litigation in March 2001,[613] the Conservation Water Agreement (CWA) aimed to facilitate compliance with the 2001 Biological Opinion's "Reasonable and Prudent Alternatives."[614]

Under the CWA, New Mexico would take advantage of its Compact's credit status to store native Rio Grande relinquishment credit water in upstream reservoirs for subsequent release for instream use. This arrangement was subject to various conditions precedent in the form of regulatory approvals. As a deviation from normal operations, the agreement required the Rio Grande Compact Commission's

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[609] *Engineer Advisers Report*, at 26, in RIO GRANDE COMPACT COMMISSION, ANNUAL REPORT (2002) (cited in UTTON CTR., *Policy and Operations*, *supra* note 37, at "RGCC.Ann.Rpt-Eng'rAdv" tab) [hereinafter RGCC EA 2002]. This exchange is governed by the July 3, 2001 Rio Grande Water Management Agreement between the United States and MRGCD.

[610] U.S. BUREAU OF RECLAMATION, *Water Marketing Activities within the Bureau of Reclamation* 24 (Dec. 2016), https://www.usbr.gov/watersmart/docs/2016/2016watermarketingreport.pdf.

[611] *Id*.; *see also* Flanigan & Haas, *supra* note 125.

[612] Gillon (2007), *supra* note 167, at 633–36 (summarizing and analyzing agreement, including rationale, contractual provisions, legal authority, operational aspects, and "lessons learned").

[613] *Id*. at n.123 and accompanying text (citing Letter from Stephen Farris, N.M. Asst. Att'y Gen. et al., to Andrew Smith, U.S. Dep't of Justice et al. (Mar. 5, 2001), http:// www.ose.state.nm.us/doing-business/mrgsettle/3-5-01-Settlement-Proposal.pdf.

[614] *Id*. at 633.

"advice and consent," which was obtained via resolution in advance.[615] It also required approval from USACE, as a non-emergency deviation, as well as National Environmental Policy Act (NEPA) compliance by USACE for that same action.[616] Finally, the Agreement was subject to the terms of a permit issued by the Office of the State Engineer.[617] The permit required CWA water be released "for beneficial uses occurring in the Rio Grande"[618] for purposes of complying with the Endangered Species Act or managing Rio Grande Compact delivery obligations.[619]

Under the Agreement, "Conservation Water" was defined as:

. . . water stored and made available consistent with state law by New Mexico as a conservation pool above Elephant Butte Reservoir[,] [i.e.,] native Rio Grande water that, if not stored, would otherwise have flowed downstream to Elephant Butte Reservoir and contributed to New Mexico's compact deliveries.[620]

Total storage under the CWA was limited to 100,000 acre-feet in Abiquiu and Jemez Reservoirs, which would then be released—up to 30,000 acre-feet per year—between 2001 and 2003. Water stored, but not used, in a given year would not be lost but carried over.[621]

The Agreement authorized storage of water in excess of downstream demand and was feasible due to three discrete conditions. First, at the time New Mexico had a credit status under the Rio Grande Compact. Second, hydrologic conditions did not preclude upstream storage under Compact Art. VII since there was more than 400,000 acre-feet in storage at Elephant Butte. Finally, storage space was available at Abiquiu and Jemez Reservoirs.[622]

The confluence of these enabling conditions, together with the CWA's negotiation and implementation, indicate what is required to operationalize reservoirs' operations flexibility, using the now authorized Environmental Pool at Abiquiu or otherwise.[623] As environmental lawyer Kara Gillon argued, "[m]any of the documents used to implement the CWA will serve as templates for [such] agreements…draw attention to the conditions on storing and releasing water in [the] Environmental Pool."[624]

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[615] *Id*. at 634.

[616] *Id*.

[617] Conservation Water Agreement, *supra* note 325, § 5.D, at 4; Permit No. SP-4822 (Apr. 28, 2003).

[618] Gillon (2007), *supra* note 167, at n.134 (citing Conservation Water Agreement, *supra* note 325, § 5.D, at 4).

[619] *Id.* at nn.137 (citing Permit No. SP-4822).

[620] *Id*. at n.130 (citing Conservation Water Agreement, *supra* note 325, § 3, at 2).

[621] *Id*. at n.128 (citing Conservation Water Agreement, *supra* note 325, § 4, at 3).

[622] *Id*. at 635.

[623] *Id*. at 636.

[624] *Id*.

3. Emergency Drought Water Agreement(s)

Soon after the 2003 Biological Opinion was issued,[625] New Mexico and the United States entered into the Emergency Drought Water Agreement (EDWA),[626] a successor to the Conservation Water Agreement. Enabling operation of the 2003 EDWA, Texas accepted relinquishment of 122,500 acre-feet of relinquishment water.[627] This agreement itself allocated a total of 217,500 acre-feet of relinquishment credit water between MRGCD (140,000 acre-feet), Reclamation (70,000 acre-feet), and the City of Santa Fe (75,000 acre-feet); Reclamation's portion would be used for endangered species purposes.[628] Under the EDWA, release of the MRGCD's and Reclamation's allocations were annually limited to 46,667 and 20,000 acre-feet, respectively (except in 2003, when Reclamation's cap was 30,000 acre-feet).[629] As with the CWA, New Mexico also agreed that MRGCD, Reclamation, and Santa Fe had carryover rights for "any unused portion of a particular year's allocation."[630]

The 2003 EDWA was amended in 2008.[631] Pursuant to the 2008 Amendment, New Mexico's relinquishment of 125,000 acre-feet of credit water to Texas permitted the State to furnish the remainder of the allocations contemplated in the 2003 Agreement to MRGCD, Reclamation, and Santa Fe.[632]

Another three-year Emergency Drought Water Agreement was signed in 2016.[633] This Agreement, which corresponded to the then-soon-to-be-released Biological Opinion,[634] allocated 110,000 acre-feet of relinquishment credit water to satisfy both Endangered Species Act needs as well as MRGCD irrigation demands.[635]

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[625] 2003 BiOp, *supra* note 335 (issued March 17, 2003).

[626] Emergency Drought Water Agreement Between the State of New Mexico, U.S. Dept. of Interior and the U.S. Army Corps of Engineers, Contract No. 03-WC-40-886 (April 22, 2003) [hereinafter 2003 EDWA].

[627] RGCC EA 2003, *supra* note 677, at 22, 34 (citing 2003 EDWA, *supra* note 675).

[628] *Engineer Advisers Report*, at 26, in RIO GRANDE COMPACT COMMISSION, ANNUAL REPORT (2003) (cited in UTTON CTR., *Policy and Operations*, *supra* note 37, at "RGCC.Ann.Rpt-Eng'rAdv" tab) [hereinafter RGCC EA 2003].

[629] RGCC EA 2003, *supra* note 677, at 26.

[630] *Engineer Advisers Report*, at 26, in RIO GRANDE COMPACT COMMISSION, ANNUAL REPORT (2004) (cited in UTTON CTR., *Policy and Operations*, *supra* note 37, at "RGCC.Ann.Rpt-Eng'rAdv" tab) [hereinafter RGCC EA 2004].

[631] Emergency Drought Water Agreement, Amendment No. 1 (Mar. 31, 2008) [hereinafter 2008 EDWA].

[632] *Engineer Advisers Report*, at 11, in RIO GRANDE COMPACT COMMISSION, ANNUAL REPORT (2008) (citing Feb. 5, 2008 Relinquishment Agreement) (cited in UTTON CTR., *Policy and Operations*, *supra* note 37, at "RGCC.Ann.Rpt-Eng'rAdv" tab) [hereinafter RGCC EA 2008]

[633] Emergency Drought Water Agreement of 2016, Between New Mexico, Middle Rio Grande Conservancy District, U.S. Bureau of Reclamation, and Dept. of Interior Solicitors' Office 3 (Apr. 22, 2016) [hereinafter 2016 EDWA].

[634] *Id*. at 1, § 2 (citing 2015 Biological Assessment, which paved the way for the Dec. 2016 Biological Opinion); *id*. at 2, § 2(f) (conditioning MRGCD's allocation on District making its "best efforts" at meeting flow requirement of 2003 Biological Opinion or those of "any subsequent Biological Opinion") and, *while it has "stored native Rio Grande water available*," supporting Silvery Minnow Recovery Implementation Program).

[635] *Id*. at 1, §§ 1, 2 (citing November 2012, February 2013, and March 2015 letters from New Mexico Rio Grande Compact Commissioner which relinquished credit water to Texas, pursuant to the Rio Grande Compact article).

Under the Agreement, "Emergency Drought Water"[636] was allocated outright to the MRGCD (78,000 acre-feet); leased to Reclamation (19,000 acre-feet) at a cost of $1.9 million;[637] and 13,000 acre-feet was to be used, "at the direction of" New Mexico's Interstate Stream Commission, "by the [MRGCD] or the United States, *consistent with* [New Mexico's] *commitments in the 2015 Biological Assessment*."[638] Reclamation may only store or release up to 10,000 acre-feet in any given year;[639] MRGCD' storages and releases are annually limited to 45,000 acre-feet.[640] Notably, MRGCD is required to manage Reclamation's 19,000 acre-feet allocation under the Agreement "for the sole purpose of ESA compliance."[641]

In making these allocations for endangered species' needs and irrigated agriculture, the 2016 EDWA recognizes the operative "hydrologic realities and limitations on the water supply in the middle Rio Grande Basin."[642] It aimed, accordingly, to "collaboratively provide for the coordinated storage, release and management of water." Emergency Drought Water is thus required to be "beneficially used, consistent with New Mexico law" in accordance with the relevant Biological Opinion "and/or *as part of the planned Middle Rio Endangered Species Collaborative Programs Recovery Implementation Program*[.]"[643] Operation of the EDWA is thus controlled by the parameters of the Biological Opinion and Recovery Program, within the broad confines of the Rio Grande Compact and New Mexico water law. In terms of the December 2016 Biological Opinion, the parties' agreed that this allocation of relinquishment credit water "will be considered a combined contribution to the 2015 BA offsetting and conservation measures."[644]

VI. IDENTIFYING CORE FLEXIBILITIES AND CONSTRAINTS

A. Abiquiu Storage

Gillon (2007) provided a robust, empirical framework for using Abiquiu's Environmental Pool, an outgrowth of the City of Albuquerque's 2006 settlement with environmental groups. Her framework outlines prospective steps, sources of water, and the collaboration that would be needed to operationalize this storage.[645] The three main steps are (1) subleasing storage with the Water Authority pursuant to the Settlement Agreement); (2) sourcing water, as from Reclamation's Supplemental Water Program or in partnership with the State's Strategic Water Reserve; and (3) obtaining regulatory compliance, including

[636] *Id*. at 1, § 2 (defining Emergency Drought Water as "up to 110,.000 acre-feet of relinquishment credit water" that MRGCD and the United States agree to "seek to capture, store, and release," subject to require "approvals and regulatory requirements").

[637] This amount equates to $100 per acre-foot of water. *Id*. at 1,§ 2(c).

[638] *Id*.

[639] *Id*. at 1, § 2(b).

[640] *Id*. at 2, §2(d).

[641] *Id*. at 2, §2(e).

[642] *Id*. at 1, § 2(a).

[643] *Id*. (emphasis added).

[644] *Id*. at § 2(c).

[645] Gillon (2007), *supra* note 167, at 636–37 ("Options for an Environmental Pool").

the Compact Commission's advice and consent for any deviations from normal MRG project operations and NEPA coverage.[646]

B. Compact Commission-approved "Resolution Hydrograph"

1. Overview[647]

At its March, 2016 annual meeting, the Rio Grande Compact Commission authorized a "temporary modification" to El Vado Reservoir operations for a limited time in May and June of 2016[648] for the "limited purpose" of producing a pulse flow to benefit silvery minnow spawning.[649] The Compact Commission's "advice and consent" was required because necessary storage of this pulse water was native Rio Grande Basin water, occurring in a post-1929 reservoir, otherwise prohibited by the Compact, were Article VII storage provisions to "go back into effect."[650] Under the agreement, up to 40,000 acre-feet could be stored in El Vado Reservoir, which neither Reclamation nor MRGCD could use during the deviation for any other purpose than to benefit the minnow.[651] While the pulse flow would effectively "ride the wave" of the natural spring runoff, any "depletions" that occurred as the water transited from El Vado—down the Rio Chama, through Abiquiu Reservation and onto the mainstream of the Rio Grande, before being stored at Elephant Butte—were required to be offset[652] through New Mexico's application of its Strategic Water Reserve rights.[653]

According to the original proposal for the El Vado deviation, which was formulated by members of the Rio Chama Flow Optimization Group, the flow event would also afford the opportunity to scientifically study the environmental efficacy of such a flow, in an "eco-flow adaptive management paradigm."[654] For its part, the USFWS said such a flow would "definitely benefit" the minnow,[655] as a function of its mimicking and augmenting the natural spring snowmelt runoff event on the Rio Grande.[656] Similar "study" was the goal of previous iterations of reservoir operation flexibility on the Rio Grande, in the case

[646] *Id*. at nn.143–49 and accompanying text.

[647] This section draws heavily from McKenzie (2016), *supra* note 52, at 20–23 (on file with Utton Center).

[648] The pulse flow, if any was to occur, was to be completed by June 15. Rio Grande Compact Commission, Resolution Regarding Temporary Modification of Operations at El Vado Reservoir in New Mexico during May and June 2016 (Mar. 31, 2016). [hereinafter 2016 El Vado Resolution]

[649] *Id*.

[650] When the Resolution was agreed to, Article VII storage restriction were not yet in place, but were projected to be soon.

[651] *Id*.

[652] Flood Control Act of 1960, 79 Stat. at 493.

[653] 2016 El Vado Resolution, *supra* note 698.

[654] Mike Harvey, RIO CHAMA FLOW [OPTIMIZATION] PROJECT, 2016 Pulse Flow: "Resolution Hydrograph" (Oct. 12, 2016) (PowerPoint presentation, given at *Rio Chama Flow Project Advisory Council Meeting*) (on file with author).

[655] *Id.*

[656] 2016 El Vado Resolution, *supra* note 698, at 1 (the flow event was to be timed to "match the timing, fill low flows, and/or augment the natural" spring runoff on the Rio Grande mainstem.").

of the 2009–13 Cochiti deviations,[657] yet Rio Chama Flow Project proposed and is carrying out more detailed bio-geomorphological research than previous conducted. For example, the group that includes affiliated graduate students from the University of New Mexico has been researching mobilization of debris flow and flushing of muds,[658] modelling surface water flows to calibrate flows required for floodplain inundation, and the process of bank and terrace erosion and concomitant release of gravels.[659]

Ultimately, 31,417 acre-feet of water was stored from May 6th through 20th in 2016, and the same volume of water was released from May 21st to June 14th. The USGS stream gage on the Rio Chama below Abiquiu recorded a roughly two-day, 4,000 cfs peak flow, which was then regulated to approximately 1,000 cfs, and subsequently ramped back up for eight days, at just over 2,000 cfs.[660] At the initial 4,000 cfs "flushing flow," scientists reported "excellent floodplain inundation" on the Rio Chama and effective mobilization of debris flows and mud left over from a significant El Niño pattern the previous year.[661] Despite the regulated nature of this pulse flow, the same scientists indicate that, in terms of magnitude if not duration, such a 4,000 cfs flow event is not uncommon on the Rio Chama and can occur on Rio Chama, between the El Vado and Abiquiu Reservoirs, during the summer monsoon season.[662] Relatedly, the New Mexico Engineer Adviser to the Rio Grande Commission notes that, owing to Article VII storage restriction, spring runoff and summer monsoon flood flows of up to 6,000 cfs regularly "passed" through Abiquiu and Cochiti Reservoirs.[663]

While a 4,000 cfs initial pulse was released from El Vado in the "Resolution Hydrograph," that does not mean the same hydrograph occurred below Abiquiu. That is because USACE, as part of its normal flood control operations, is required to regulate flows at the outlet of Abiquiu to a maximum "safe channel capacity" of 1,800 cfs. Whenever the pulse flow hydrograph is above 1,800 cfs, which is for most of its 25-day duration, water was necessarily stored, if temporarily, at Abiquiu, even though *de jure* storage arrangements, such as leasing space from ABCWUA, were not made. Unlike this temporary storage at Abiquiu, the pulse flow proceeded unimpeded below Cochiti Dam, where releases are limited to a much higher safe channel capacity of 7,000 cfs.[664] Reports indicate fall Rio Grande Silvery Minnow numbers responded favorably to this spring pulse flow.[665]

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[657] Letter from Antoinette Grant, U.S. Army Corps of Engineers, to Estevan Lopez and Brent Rhees (Nov. 12, 2013) (regarding expiration of the Cochiti Deviation) (on file with author). *See also* John D'Antonio Jr., *supra* note 79, at 17 (noting the Corps' that such deviations were "unreliable tool[s]" for Silvery Minnow spawning).

[658] Characterizing mud flushing that results from such a pulse flow events relates to a grain size distribution that are more suitable for fishing spawning. *See, e.g.*, Harvey 2022, Summary of Rio Chama Ecological Technical Studies, University of New Mexico (Ecological Appendix to this River Operations Study).

[659] *See* Harvey, 2022. *supra* note 658. *See also* Advisory Committee Meeting, *infra* note 713.

[660] *Id*. at 4.

[661] *Id*.

[662] *Id*.

[663] RIO CHAMA FLOW OPTIMIZATION PROJECT, *Advisory Council Meeting* (Oct. 12, 2015) (comments of Rolf Schmidt-Peterson on file with author) [hereinafter Advisory Committee Meeting].

[664] Cochiti Water Control Manual.

[665] *See, e.g.* Advisory Committee Meeting, *supra* note 713 (comments of Carolyn Donnelly on file with author).

2. *Legal and Practical Underpinning*[666]

As a threshold matter, the Rio Grande Compact Commission assented to the El Vado deviation because New Mexico was not in an accrued debit position under the Rio Grande Compact.[667] The Compact Commission, however, cannot assent to such a deviation when New Mexico has an accrued debit under the Compact, as was the case in 2017,[668] and as New Mexico trends away from net credit status.[669] Water, as stored and released during the 2016 El Vado Deviation, would need to be stored in El Vado Reservoir and released only upon a request from Texas when there is a net debit status.[670] When Compact requirements do, however, permit such a pulse flow, the primary benefit lies in how short-term, one-to-two-week storage in El Vado Reservoir can facilitate a "wait and hold" operation as the natural snowmelt runoff builds in magnitude. Thus released and "riding" the natural runoff wave, the water suffers lower "carriage losses" on its way to subsequent storage in Elephant Butte. In other words, this type of operation works as a win-win, where deliveries are still made to downstream users and to Elephant Butte for Compact compliance, flows which benefit minnow spawning.

However, when Compact requirements would not permit a 2016-type Deviation, Reclamation has proposed investigating, legally and practically, using Prior and Paramount water in order to avoid Compact requirements, along with stored relinquishment credit water, held in Reclamation and MRGCD's name.[671] There are unresolved legal questions on both fronts, which left unresolved, would leave Reclamation dwindling, but not negligible, water leasing options under its Supplemental Water Program.

At issue in considering the varying implications—i.e., the legal and practical nuances—of these different water management options is flexibility and certainty. That is, must water managers continue to operate on a very *ad hoc* basis in proposing and operationalizing such pulse flows?[672] Or can they realize a degree of transactional-type strategic planning, which would likely lead to more efficient, calibrated application of water for environmental needs? Under the latter, improved flexibility and certainty would likely yield more consensus-based decision-making, supported by scientifically tested hypotheses and related adaptive management.

On a more practical level, notes from a 2015 Compact Commission report indicate that the previous iteration of the El Vado Deviation, in the spring of 2015, furnished valuable lessons that were

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[666] This section draws heavily from McKenzie (2016), *supra* note 52, at 20–23 (on file with Utton Center).

[667] 2016 El Vado Resolution, *supra* note 699.

[668] Advisory Committee Meeting, *supra* note 713

[669] At least as of summer 2015, New Mexico's accrued credit was nearly drained. Personal communication with Elaine Hebard, water planner, in Albuquerque, NM (June 21, 2015). *See also,* RIO GRANDE COMPACT COMMISSION, REPORT OF THE RIO GRANDE COMPACT COMMISSION 32, 35 (2013), http://www.ose.state.nm.us/Compacts/RioGrande/RGCC%20Reports/RGCC%202013.pdf) (the latest report available, reporting New Mexico credit water status as of Jan. 1, 2014 as between +62,400 acre-feet (AF), according to New Mexico's accounting, and +77,700 AF, according to Texas' accounting).

[670] *Id*.

[671] According to previous Emergency Drought Water Agreements, allocating New Mexico's relinquishment credit water.

[672] Personal communication with Mark Stone, Ph.D., UNM civil engineer professor and member of Rio Chama Flow Optimization Project Advisory Committee (Dec. 5, 2016) (notes on file with author).

incorporated into the design of the 2016 Compact Commission Resolution approving the new pulse flow. Operationally, the 2015 El Vado deviation was comprised of the storage of rainfall runoff in May 2015 that was "augmented by re-regulation of inflow at El Vado, which was used to provide a seven-day long spawning peak of around 2,000 cfs."[673] This straightforward description, however, belies the complex yet fundamental uncertainties and disagreements related to the accounting of delivery obligations that, in turn, dictate when Compact provisions such as the storage restriction of Article VII are in place.

At its most recent, 2016 meeting in Santa Fe, the Rio Grande Compact Commission (RGCC) Engineer Advisers failed to reach a consensus on Compact accounting. According to Engineering from Colorado, this failure stems from:

"continuing disagreement regarding Colorado and New Mexico Credit Water that Reclamation released in 2011 and possibly in 2012, the appropriate accounting of 2011 and 2012 Colorado and New Mexico deliveries that were affected by Reclamation's release beyond the available Usable Water, and the directly relevant 2006 direction of the RGCC to Reclamation."[674]

Because of this lack of agreement owing to, originally, Reclamation's alleged unauthorized releases of credit water from Elephant Butte in 2001 and 2012, Colorado presented from 2011 to 2015 two different methods of Compact accounting.[675] While it is beyond the scope of this article to discuss the particularities of the Compact accounting methods and their provenance, it suffices to note that these accounting differences resulted in different positions from Reclamation's and New Mexico's respective perspectives, regarding how the Spring 2015 El Vado Deviation operations occurred[676] (recall that the Compact Commission's assent to such a pulse flow is required when Article VII storage restrictions are in effect), including when and how water was stored in El Vado.

New Mexico related its concerns about and analysis of the 2015 El Vado deviation, intending to, "separate [the] various operations at El Vado Reservoir, [and] to provide transparency for any modified operation that is authorized by the RGCC."[677] Reclamation indicates that "water stored under [the] March 24 [2015] [R]esolution [of the Compact Commission], [was] subsequently released" to support a roughly two week, 2,000–3,000 cfs[678] spring pulse on the main stem Rio Grande. It made no mention, however, of how water was stored. In contrast to Reclamation view, the New Mexico Engineer Adviser to the Compact Commission related that Reclamation "stored inflowing water to El Vado continuously from the start of the year through late May, *paying no heed to any of the Article VII restriction dates*."[679] In fact,

[673] Rio Grande Compact Comm'n, Report of the Engineer Advisers, 2015 (Mar. 31, 2016).

[674] *Id*. at 27 (in an addendum submitted to the 2016 Engineer Adviser's Report). *But see id*. at 29 (providing the New Mexico official position on the Compact accounting missteps that gave rise to this ongoing lack of consensus).

[675] *Id*. at 27–28. *See also id.* at 29–30 (presenting New Mexico's comparative analysis of the effect of Texas' and Reclamation's Compact accounting under Method 1 and by New Mexico under Method 2.

[676] *Id*. at 29–30.

[677] *Id*. at 29.

[678] n.b. During the period of this spring pulse, El Vado releases, according to the USGS gaging state on the Rio Chama (above Abiquiu Reservoir), were between 500 and 1,000 cfs.

[679] *Id*. at 32 (emphasis added).

stream gaging above El Vado indicates that Reclamation stopped El Vado storage around June 15,[680] having stored 81,600 acre-feet during the time in which Article VII storage restrictions were in effect—before April 11 and after June 8, according to final Reclamation accounting models.[681]

Article VII timing differences were ultimately irrelevant, except in the hypothetical sense that between April 4th and June 7th of 2015 it *could have stored* 12,900 acre-feet more water than it did.[682] According to New Mexico, El Vado Reservoir could have been operated differently,[683] and its hypothetical accounting shows the non-negligible effect on El Vado storage (as a function of Article VII trigger dates, reservoir operations optimization, etc.). This stored water could have been applied and used to comply with the State's delivery obligations under Compact Article IV, while also helping achieve Biological Opinion flow targets for ESA compliance and supply irrigation water.[684]

Given this controversy, New Mexico sought to incorporate these concerns and lessons learned in the 2016 iteration of the El Vado Deviation.[685] At New Mexico's request, the newer, "refined" pulse flow Resolution included a number of conditions, most notably that the "Article VII storage restriction must be in effect *by all proposed accounting methods* before the modified operation can begin" and that the deviation "must be conducted solely for the purpose of aiding to create a silvery minnow spawning flow."[686]

VII. Finding Institutional Flexibility

Finding a balance between flexible management and operating certainty is a perpetual challenge in water management. In governmental institutions, there is always a tension between maintaining functional stability and adapting to changing circumstances. Those who are regulated or served by government want and need a stable operating environment. However, dynamic circumstances require government to respond to immediate needs in our ever-changing world.

Water management is an incredibly dynamic operating environment, especially in the American Southwest. Water managers face dramatically changing conditions from one water year to the next. They do so within what is perceived as a tightly constrained legal and regulatory environment. Nonetheless, over time New Mexico water managers have shown great imagination in developing new tools within existing legal authorities.

The development of new water management tools does not occur overnight. At times it seems that New Mexico's water managers are able to respond remarkably quickly to new challenges. However, in the background of these apparently rapid responses there have always been pre-existing collections of information, positive working relationships, and conversations about new ideas that range from the

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[680] *Id*.

[681] *Id*.

[682] *Id*. at 33

[683] *I.e.*, according to Compact accounting Method 1, not Method 2, as employed by Reclamation.

[684] *Id*. at 32. For perspective, 12,900 acre-feet of stored water is sufficient to allow the MRGCD to meet two weeks of summer irrigation demand, or Reclamation to meet several months' worth of BiOp flow targets. *Id*. at 33.

[685] *Id.* at 35.

[686] *Id*. (emphasis added).

embryonic to the full developed. New water management regimes are often the result of decades of discussion and contemplation.

Rules are made by people and can be changed by people. New laws are passed, new regulations are crafted, and new agreements are forged all the time. While it may seem absolutely impossible to challenge the status quo due to fears of disrupting society and the economy, the truth is that all rules can be changed. Ideally, water management regimes are constantly being improved through well-thought-out responses to changed circumstances.

A. Past Flex Points

This report has described a number of past water management actions that have illustrated the ability of water managers to find flexibility within their existing operating environment. Historically, these flex points have been identified in response to floods, droughts, infrastructure failure, and concerns for the environment.

The degradation for the Rio Grande watershed, incited by the rapid development of land and water in the San Luis Valley during the late 1800s, served as the catalyst for major changes in the existing water management regime. Within forty years, the development of the Rio Grande in Colorado resulted in sever water shortages and increased flood risks in New Mexico, Texas and Mexico. Only a couple decades later, an international convention had been negotiated to share water between the United States and Mexico. Contemporaneously, the United States government created the Reclamation Service, imposed the prior appropriation doctrine on New Mexico water law, and began development of the Rio Grande Project.

The aggradation of the Middle Rio Grande, also caused in no small part by the development in the San Luis Valley, resulted in water-logged lands and increased flood threats. By the 1920s, New Mexico's urban leaders were busy creating the Middle Rio Grande Conservancy District to drain the lands, build levees, and create irrigation water storage on the Rio Chama. The real possibility of expanded irrigation in the Middle Rio Grande in an already water-short basin motivated the negotiation of the Rio Grande Compact. The inadequacy of the Middle Rio Grande Conservancy District to control floods and groundwater levels resulted in Federal intervention through the creation of the Federal Middle Rio Grande Project in 1948. The need to provide Albuquerque with additional flood control resulted in the authorization and construction of Cochiti Reservoir and the creation of the Reservoir Regulation Plan in 1960.

The imposition of the Endangered Species Act and the attendant requirements for protecting the Rio Grande silvery minnow created a number of less dramatic but critically important moments of management flexibility in the Middle Rio Grande. These responses have been predominantly in the area of soft law rather than dramatic changes to Federal or state law.

In the early 2000s, there was a flurry of management changes related to the Rio Grande silvery minnow that were motivated by Endangered Species Act litigation. New management agreements and collaborations were employed. Reclamation created the Supplemental Water Program to source water supplies for the minnow. The Middle Rio Grande Endangered Species Collaborative Program, a new organization of multiple stakeholders, was established to protect the silvery minnow while allowing existing and future water use to continue.

The 2001 Conservation Water Agreement was a remarkable new tool negotiated by parties to the silvery minnow litigation as a way to use New Mexico's Rio Grande Compact credits in new and creative ways for the benefit of the minnow. It required the consent of the Rio Grande Compact Commission to deviate from normal operations, which was granted. It served as the basis for the 2003, 2008, and 2016 Emergency Drought Water Agreements. All of these agreements allow for flexible water management within the constraints of Biological Opinions, New Mexico water law, and the Rio Grande Compact.

B. Future Flex Points

It is difficult to predict what will motivate water managers to find and exercise flexibility in their future work. However, there are a number of unresolved issues along the Rio Chama, in the Middle Rio Grande, and beyond that seem ripe for creative thinking.

First and foremost is the ongoing Supreme Court litigation regarding groundwater use within the Rio Grande Project. That litigation was catalyzed by the adoption of a new operating agreement for the Rio Grande Project. That attempt at creating a new flexible management regime for water deliveries from Elephant Butte Reservoir to Texas stretched beyond New Mexico's threshold for flexibly interpreting the Rio Grande Compact. Settlement negotiations for this litigation present an intriguing forum for discussion of creative interpretations of the Rio Grande Compact.

The resolution of Pueblo water right claims is another opportunity for creative water management thinking. The resolution of Pueblo water right claims in northern and central New Mexico has included commitments to create regional water supply systems and implement conjunctive management of ground and surface waters. Future Pueblo water rights claims in the Middle Rio Grande may include claims for ecological water, like spring pulse flows and maintained base flows. Pueblo water right claim settlement negotiations may present the opportunity to reconsider how the Rio Chama and Rio Grande reservoirs are used and operated.

The ongoing corrective action study of El Vado Dam presents an opportunity to think creatively about not only how the dam's current operations can be protected but also how it can be improved to better serve its users. For example, perhaps the repairs to the dam could include upgrades that would allow operators to better control the sediment that is transported downstream. It may be that the need to store water elsewhere during the repair of El Vado will require water managers to be more flexible in their interpretation of existing reservoir authorities.

C. Current Flex Points for Rio Chama Reservoirs

Given the focus of the Rio Chama Flows Project on operations at Heron, El Vado, and Abiquiu Reservoirs, this report concludes with a last look at these three critical water works. All three of these reservoirs are operated in compliance with Rio Grande Compact—but deviations from their standard operations can be granted by the Rio Grande Compact Commission.

1. Heron Reservoir

Heron Reservoir is owned and operated by Reclamation. It has a conservation capacity of 401,320 acre-feet. It was authorized in 1962, along with the entire San Juan-Chama Project. Heron Reservoir is used to store San Juan-Chama Project water only. The importation of San Juan-Chama water into the Rio Grande Basin provided much needed flexibility given that it is authorized to be used for a multitude of purposes. Most notably, San Juan-Chama water can be used for fish and wildlife purposes such as endangered fish.[687] San Juan-Chama water also added flexibility to basin-wide storage scenarios as it can be now stored in any reservoir.[688]

For the first twenty years of San Juan-Chama Project operations, it was believed that San Juan-Chama contractors must evacuate their annual allotment of water from the reservoir by December 31st of every year. This was based on an interpretation of a provision in the Colorado River Project Storage Act. In 1983 the San Juan-Chama Project Engineer proposed that carryover of water be allowed until March 31st of the following year. This was suggested to alleviate the negative effects of reduced flows in January on the trout population in the Rio Chama.

Carryover waivers were first thought to be illegal but then were quickly found to be allowed. A field solicitor issued a legal memorandum on September 7, 1983 that held that carryover of San Juan-Chama water from year-to-year in Heron was not allowed. After discussions with Reclamation's Southwest Regional Director the same field solicitor issued a revised legal memorandum less than a month later, this time confirming that reading the law to allow for carryover storage is a more proper interpretation. In that same legal memorandum, the solicitor blessed a carryover waiver for the City of Albuquerque, despite acknowledging that Albuquerque's San Juan-Chama contract had a no-carryover clause in it. Furthermore, the solicitor expressed the opinion that other carryover waivers could be granted on a case-by-case basis when there are benefits to the United States through more effective Project operations.[689]

2. El Vado Reservoir

El Vado Reservoir was constructed between 1933 and 1935 by the Middle Rio Grande Conservancy District. It has a current conservation capacity of 186,250 acre-feet. It was originally intended to store the irrigation waters of the Middle Rio Grande farmers, including the six southern Pueblos. Federal authorization was provided for the storage of Pueblo water in El Vado and the assessment of operations and maintenance charges on their behalf to be paid for by the United States.[690]

El Vado differs from other reservoirs discussed in this report because it was not built by the Federal government and does not have explicit Federal restrictions on how it may be used, other than those set forth in the Rio Grande Compact. It is used to store both native and San Juan-Chama water. It is used to store supplemental water for endangered species. It is also used to store senior Pueblo irrigation water rights. El Vado is often used as a re-regulating reservoir to simplify water operations between Heron and Abiquiu Reservoirs. In 2015 and 2016, the Rio Grande Compact Commission authorized new flexibility at El Vado when it approved for a deviation in operations to allow for water to be stored and released for the benefit of the Rio Grande silvery minnow despite ongoing storage restrictions.

El Vado already provides examples of flexible water management. After the designation of the Wild and Scenic reaches of the Rio Chama in 1988, a team was assembled to develop the Rio Chama Instream Flow Assessment. Strategies were developed to release water from El Vado in a manner that would not only serve downstream irrigators but would also enhance the trout fishery and recreational boating opportunities.

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[687] Act of June 13, 1962, P. L. No. 87-483, 76 Stat. 96–102.

[688] Act of Dec. 29, 1981, P. L. No. 97-140, §5(a), 95 Stat. 1717.

[689] Emmet Rice, Reclamation Field Solicitor Opinions (Sept. 7, 1983 & Nov. 3, 1983).

[690] 45 Stat. 312 (March 13, 1928).

It may be the storage of Pueblo water rights that presents the greatest potential for implementing future management flexibility at El Vado. Currently only the Pueblos' Prior and Paramount water rights are stored in El Vado. The amounts and procedures for storage and release of Pueblo water are dictated by a 1981 agreement between the Secretary of the Interior and the Middle Rio Grande Conservancy District. This agreement could be renegotiated in the future. Moreover, when the Pueblos decide to assert their water right claims, storage at El Vado could be a major component of water right settlement discussions. For example, it may be found prudent for the Pueblos' Prior and Paramount irrigation water rights to be carried over from year-to-year in El Vado.

3. Abiquiu Reservoir

Abiquiu Reservoir is one of the largest in New Mexico with a conservation capacity of 1,369,000, although it has never been filled above 402,000 acre-feet. It was first approved in 1948, construction began in 1956, and reservoir operations began in 1963. Abiquiu was authorized as a flood and sediment control facility. In 1981 Congress authorized the Secretary of the Interior to store up to 200,000 acre-feet of San Juan-Chama water in Abiquiu so long as such storage did not interfere with the primary flood and sediment control functions of the reservoir.[691] In 1988, Congress also authorized the Secretary of the Army to store 200,000 acre-feet of native Rio Grande water in Abiquiu, so long as San Juan-Chama contractors do not need the space.

The flood control space within Abiquiu is 502,000 acre-feet. Given that 200,000 acre-feet has been allocated to San Juan-Chama or native water storage, if flood control demands are predicted to be in excess of 302,000 acre-feet, USACE will begin to evacuate water from the 200,000 acre-foot conservation pool. USACE can deviate from normal operations at Abiquiu with permission from the Rio Grande Compact Commission. USACE analyzes planned deviations based on the case-by-case merits of the situation. Impacts to flood potential, reservoir conditions, and expected benefits and consequences are all considered. For example, in 2001 USACE allowed for a deviation by approving the storage of Rio Grande Compact credit water in Abiquiu for the benefit of endangered species. In 2014 the City of Albuquerque acquired land above the current fill limit elevation of 6,220 feet, with the hopes of increasing its storage in Abiquiu.

In 2018, Congress authorized USACE to create peak flows on the Rio Grande through temporary deviations of operations and both Cochiti and Jemez Reservoirs for a period of five years, once the deviations are resumed. USACE is required to consult with Cochiti and Santa Ana Pueblos on these deviations.

In the Water Resource Development Act of 2020, Congress reiterated that both San Juan-Chama water and native water can be stored in Abiquiu Reservoir and also increased the fill limit elevation from 6,220 feet to 6,230 feet. This will provide another much needed point of flexibility in water operations along the Rio Chama and in the Middle Rio Grande.

D. The Flexibility of Law and Policy

Ultimately, we must remember that all laws, policies, and other water management rules are human and social constructs. The rules that govern us today were created by yesterday's leaders. It is incumbent on today's water managers to evaluate today's rules and analyze as best they can how effective these rules will be in both the predictable and unforeseen future. As this report acknowledged, rule changes are not made overnight but rather through long-term contemplation, socialization, and optimization of physical

[691] P. L. No. 100-522, 102 Stat. 2604.

and political circumstances. Making water management more flexible is a complex endeavor that requires mastery of many different disciplines but ultimately depends on the open-mindedness of today's water managers. The authors of this report commend Reclamation for seeking to develop a better understanding of how operational flexibilities are identified, developed, and implemented.

Attachment A. Excerpts from Engineer Adviser's Report in Rio Grande Compact Commission Annual Reports, 2000-2019

Available from Albuquerque Area Office

Attachment B. Individual Rules – Details and Discussion (v5.0.2)

Note that these rules were in place in 2019. A number of conditions related to ESA operations have changed since this was written.

B.1.0 Check For Needed Initial Conditions and Series Inputs

B.2.0 SetInputsToSyntheticValuesIfNotDirectlyInput

B.3.0 ForecastErrors

"The rules in this policy group are used to compute a percent forecast error for each month with reference to estimated inflows to El Vado Reservoir. *If the rules are turned on, the computed forecast error is then used to incorporate uncertainty in forecasted flows within a simulation.* The computed forecast error, not to exceed input maximums, is referenced in other rules including the calculation of a forecasted Otowi flow volume. These rules have been turned off for recent URGWOM applications." B-10.

B.4.0 *SetCompactCreditsAdjustment* [Rio Grande Compact Article VI]

"[…] Rules in this policy group are also used to adjust the amounts in the New Mexico and Colorado Credit accounts at Elephant Butte Reservoir based on the end-of-year Compact calculations. […] A rule is also included to zero out the Compact credits if Elephant Butte spills." B-13.

B.5.0 *RelinquishedCredits* [Rio Grande Compact Article VII] AND *AllocationsForEmergencyDroughtWater* [Emergency Drought Water Agreement of 2016, Section 2]

"The rules in this policy group are used to compute relinquished Compact credits and set allocations for subsequent storage of Emergency Drought water at El Vado Reservoir. This potential policy can be turned on or off with a switch in the model." B-16.

B.5.1. SetRelinquishedCompactCredits

"This rule records an amount of relinquished Compact credits. If a switch has been set by the model user, Compact credits will be relinquished on an input date for the relinquishment to occur. If a threshold Compact credit is exceeded, Compact credits will be relinquished to reduce the credit to a target lower Compact credit." B-16.

B.5.2. UpdateEmergencyDroughtStorageAllocations

"This rule includes three assignment statements to track the allocations for storage of Emergency Drought water for MRGCD, ESA, and use by municipalities where the allocations are increased for a proportion of any relinquished Compact credits. Note that the allocations include water still in storage and the allocations do not decrease until the water is released from storage. Also, the allocations for municipalities are tracked but URGWOM is not set up to model the storage or use of this water for municipalities."

B.6.0 *ArticleVIIStatus* [Rio Grande Compact Article VII, Credits – RGC Article 6]

"The rules in this policy group are used to compute the usable storage at Elephant Butte and Caballo Reservoir and set a switch that designates whether the stipulations or Article VII of the Compact are in effect." B-18.

B.6.1. ComputeUsableStorage

"This rule computes the 'usable storage' to be referenced by the SetCompactArticleVIISwitch rule when identifying whether the stipulations of Article VII of the Compact are in effect. Usable storage is computed as the total storage at Elephant Butte and Caballo Reservoirs minus any credit water for New Mexico and Colorado and minus San Juan-Chama Project water including water in the Albuquerque, Santa Fe City, Reclamation, and Combined accounts. Note that . . . any tracked Compact debt as negative account storage is not considered in the calculation and any year-to-date evaporative losses to the Compact accounts is not subtracted[.] Also, the usable storage is immediately adjusted for any relinquished credit (i.e. the transfer of water from the NMCredit account to Rio Grande storage as a result of relinquished credits)." B-18.

B.6.2. SetCompactArticleVIISwitch

"This rule sets a switch that identifies whether the policy stipulated in Article VII of the Rio Grande Compact applies which depends on whether the usable storage as determined with the CompactVIIUsableStorage Rule is less than a minimum storage of 400,000 acre-ft." B-19.

B.7.0 BeginningOfYear SetCarryover OR AllocationBackToCommonPool

"San Juan-Chama Project water allocated to contractors at Heron Reservoir must be moved out of Heron Reservoir before December 31 unless waivers are issued allowing the contractor to store the water into the following year. The rules in this policy group are used to either set the carryover for the contractor accounts at Heron if waivers are issued or revert the remaining water in storage back to the common pool for San Juan-Chama Project water if the water is not moved by the end of the year. (Note that the account methods on other reservoirs are already set to always carryover account storage to the following year.)" B-20. {cpm note: legal Q here w.r.t. "federal benefit" interpretation; see comments in outline, incl. re: 1983 Solicitor Opinion giving rise to that interpretation}

B.7.1. SetCarryoverForContractorWaiverWater

[Record of Decision for the Upper Rio Grande Basin Water Operations Review Final Environmental Impact Statement (FEIS) 2007, pg 4] [Upper Rio Grande Basin Water Operations Review Final Environmental Impact Statement (FEIS), Volume 2, Appendix I, Section 4, paragraph 2]

"On January 1 during a simulation, the Carry Over slot on all the San Juan-Chama storage accounts is set for each contractor to carryover storage into the subsequent year if waivers have been granted for that contractor." B-20.

B.7.2. SetCommonPoolAllocationFromContractorWaterNotUsedAndLost

[San Juan Chama Authorization – Public Law 87-483, 1962, Section 8(d)]

"On January 1 during a simulation, some contractor water may be lost if it is not moved by the end of the calendar year. If waivers are not in effect for those contractors, the water is reverted back to the common pool for San Juan-Chama Project water and this rule sets the resulting allocation to the FederalSanJuan storage account at Heron Reservoir on January 1st." B-21. Note: This provision has been interpreted as preventing carryover storage, but the plain text doesn't say that outright.

B.8.0 *SetAllocationsToSJCContractors* [San Juan Chama Authorization, 1962, PL 87-483, Section 11]

"Inflows of San Juan-Chama Project water through the Azotea tunnel to Heron Reservoir is tracked in a common pool account called FederalSanJuan in URGWOM. That water is then allocated to the contractors

for San Juan-Chama Project water each year. An initial allocation is made on January 1st with an additional allocation made after the runoff if needed to potential allocate more water to each contractor up to the max allocation for a year and the total firm yield for all contractors. The two rules in the policy group are used to make the allocations on January 1 and again on an input follow-up date (e.g. July 1) if necessary. Note that the Cochiti Rec Pool gets a full allocation regardless of the available water in storage and thus will not be shorted if necessary for other contractors." B-21.

B.8.1. SetSanJuanContractorAllocations

"This rule is used to allocate available water in the federal pool at Heron Reservoir to contractors for San Juan-Chama Project water on January 1 of each year. *A full allocation is first made to the Cochiti Rec Pool account. Allocations are then made proportionally, using the remaining supply, to each contractor up to the full annual allocation for the contractor.*" B-22.

B.8.2. SetAdditionalSanJuanContractorAllocationsIfNeeded

"This rule is used to allocate water in the federal pool at Heron Reservoir to contractors for San Juan-Chama Project water at a follow-up date after January 1st if needed to allocate more water up to the annual allocation. Additional allocations would be made if the full allocations for the year could not be made on January 1st due to a limited supply in the common pool for San Juan-Chama Project water at Heron Reservoir. Additional allocations are made on a date input by the model user (e.g. July 1st such that additional water is allocated after the runoff and after the additional inflows for the year from the Azotea tunnel have reach heron Reservoir)." B-23.

B.9.0 SetReclamationLeases

"Reclamation leases of San Juan-Chama Project water are modeled as transfers from accounts for contractors for San Juan-Chama Project water to Reclamation storage accounts. URGWOM is set up to model potential transfers from each account at each reservoir once a year. Leases of waiver water at Heron Reservoir are tracked separately from leases of current year allocations such that Reclamation water at Heron Reservoir can be appropriately treated as waiver water or current year allocation water." B-24.

B.9.1. SetAllLeases

"This rule is used to set all the accounting supplies for transfers from storage accounts for contractors for San Juan-Chama Project water to the Reclamation storage accounts for all leases . . . ." B-25.

B.10.0 SetAlbuquerqueDiversion [ABCWUA CONTRACT]

"Diversions by Albuquerque are set with the rules in the policy group. The rules include a check for a preemptive cutoff where Albuquerque would switch to groundwater before[:]

-curtailment and cutoff restrictions under the permit go into effect,

-flood control operations at Abiquiu Dam prevent the delivery of San Juan-Chama Project water, OR

-high flows out of Cochiti Dam prevent safe operation of the diversion structure.

"Note that the model user can set switches in the model to allow for diversions of all native water to occur while Abiquiu is in flood control operations with a debt tracked to be paid back later with San Juan-Chama Project water, and another switch is included that would allow for all San Juan-Chama Project water to be diverted when native flows are too low such that full diversions can continue."

B.10.1. SetPreemptiveAlbuquerqueCutoffSwitch

"This rule sets a switch to i*dentify whether conditions are satisfied for a preemptive cutoff of Albuquerque surface water diversions* (Albuquerque would switch to groundwater to meet their demand). **Preemptive cutoff criteria include** [:]

-a low river flow at which Albuquerque would shutdown before the permit criteria result in a curtailment to diversions,

-a high Cochiti outflow at which operating the diversion would be unsafe and impractical, AND

-an Abiquiu high outflow at which Abiquiu operations are being conducted for flood control operations and Albuquerque's San Juan-Chama Project water would not be released.

"Note that the model user can set switches to allow for diversions to continue when Abiquiu is in flood control operations with all Rio Grande water or for diversions to continue with a curtailment or cutoff of native water with additional San Juan-Chama Project water used." B-25 – B-26.

B.10.2. ComputeAlbuquerqueRGDiversionPerPermit

"This rule records a Albuquerque diversion amount for native Rio Grande water based on the permit that reflects any potential curtailment or cutoff to diversions as a function of river flows. This value reflects the <u>native portion of the total diversion</u>." B-27.

B.10.3. RecordAlbuquerqueSJCDiversion

"This rule sets an initial value for the diversion of San Juan-Chama Project water at the Albuquerque surface water diversion. The amount is generally set to a standard demand (e.g. 65

cfs) but may be set to zero if the preemptive cutoff switch has been set or Abiquiu is in flood control operations where San Juan-Chama Project water cannot be delivered to the diversion. This rule includes checks to assure Albuquerque San Juan-Chama Project water is available to deliver to meet the computed demand." B-28.

B.10.4. RecordAlbuquerqueRGDiversion

"This rule sets an initial value for the native Rio Grande water to be diverted at the Albuquerque surface water diversion. The amount is generally set to half the diversion as allowed for the return flow credit. If the preemptive cutoff switch has been set, the Rio Grande diversion is set to zero. The amount will be set to the total diversion, or twice the typical San Juan-Chama Project diversion, IF the model user has set a switch to allow for all native diversion during Abiquiu flood control operations with a debt to be paid back later."

B.10.5. SetAlbuquerqueDiversion

"This rule sets the total Albuquerque diversion as the sum of the initial computed diversion of native Rio Grande water and the final amount of San Juan-Chama Project water delivered to the diversion." B-29.

B.10.6. ComputeAbiquiuSJCDeliveriesToAlbuquerqueDiversion

"This rule sets an initial computed delivery of San Juan-Chama Project water from Abiquiu Reservoir to the Albuquerque surface water diversion to be referenced when setting the total Abiquiu outflow and for setting the accounting supply for the delivery. The diversion supply is also set in this rule based on the delivery made at the previous timestep, which can be done here due to the modeled 1-day lag between Abiquiu and the surface water diversion." B-30.

B.10.7. SetMinBypassAtAngosturaForAlbuquerqueSJC

"This rule sets a minimum bypass at the Angostura diversion to assure any San Juan-Chama Project water for the Albuquerque diversion does not get diverted at Angostura." B-30.

B.11.0 SetBuckmanDIversion

"Diversions by the City of Santa Fe and County of Santa Fe at the Buckman Direct Diversion are set with the rules in this policy group. *Current coded policy is based on an average diversion rate over time that reflect usage of their allocated San Juan-Chama Project water and allows for diversions of native water too based on any water rights in place for native water.* Water diverted and immediately returned as required for their mixing operation at the diversion are included." B-31.

B.11.1. SetBuckmanDirectDiversion

"This rule sets the diversion for the BuckmanDirectDiversion water user object for both the City of Santa Fe and County of Santa Fe diversions of San Juan-Chama Project water and native Rio Grande water based on the native rights that may be in place. **The diversion is set to** [:]

-an amount of San Juan-Chama Project water than can be delivered (or the full request for the City of Santa Fe if an exchange for San Juan-Chama Project water at Elephant Butte is to be modeled),

-native water used for the mixing operation at the diversion that is immediately returned, and

-native water based on input water rights with checks for curtailment or cutoff restrictions per the permit.

"A fractional return is computed for the native water that is diverted for the mixing operation and immediately returned. The diversion accounting supplies are also set in this rule based on the final deliveries from Abiquiu Reservoir as set at the previous timestep." B-31.

B.11.2. ComputeDeliveriesToBuckmanDirectDiversion

"This rule records deliveries of City of Santa Fe and Santa Fe County water for the Buckman Direct Diversion. These recorded amounts are then referenced when setting the total outflow from Abiquiu Reservoir and for setting the accounting supplies for the final deliveries after the total Abiquiu outflow has been set.

B.12.0 SetDebts LetterWater PastAlbLoanToMRGCD EBExchange

[Navajo Irrigation–San Juan–Chama Diversion, N.M.: Hearings on S. 72 Before the Subomm. on irrigation and reclamation of the S. Comm. on Interior and Insular Affairs, 86th Cong., at 94 (1959) [hereinafter Hearings on S. 72]]

"URGWOM is set up to allow surface water diversions to continue for Albuquerque and the city of Santa Fe during flood control operations when their San Juan-Chama Project water cannot be delivered. A debt is tracked for each during these times to be paid back later with a transfer at Elephant Butte Reservoir. {cpm note: FLEX}

"Contractors for San Juan-Chama Project water may cause depletions in the basin due to groundwater pumping or some other water use and then pay back the river for the impacts with deliveries of San Juan-Chama Project water from storage. Debts caused by groundwater pumping or such other water uses are not modeled in URGWOM and thus must be input by the model user. The inputs also include a split for the amount of the payback that should go to MRGCD and the portion that should be paid back to the Compact deliveries.

-"**The payback to MRGCD** may occur as a transfer to the MRGCD San Juan-Chama account at El Vado Reservoir or a release to contribute to meeting the MRGCD irrigation demand.

-"**The pay back to the Compact** is set as a delivery in the winter to Elephant Butte Reservoir after irrigation diversions have ceased.

"This policy group also contains a rule to allow for model users to set up an MRGCD debt to payback ABCWUA for a past loan. The debt is tracked in RiverWare until paid back with the delivery from MRGCD's San Juan-Chama account at El Vado Reservoir to the Albuquerque account at Abiquiu Reservoir."

B.12.1. SetDebtForDiversionsDuringFloodOps

"This rule sets the exchange borrow supply for the debts incurred by the Albuquerque or the City of Santa Fe as a result of diverting water at their surface water diversions while Abiquiu Dam is in flood control operations and San Juan-Chama Project water is not being delivered. The debt for Albuquerque is set to half the Rio Grande diversion due to the return flow credit for the other half of the diversion. The Santa Fe debt is set to the amount taken that would have otherwise been San Juan-Chama Project water." B-33 – B-34.

B.12.2. SetDebtForPastAlbuquerqueLoanToMRGCD

"This rule sets the exchange Borrow slot for any input debt from a past loan by Albuquerque to MRGCD. The debt is then tracked and paid back as MRGCD makes deliveries of their San Juan-Chama Project water at El Vado Reservoir to the Albuquerque account at Abiquiu Reservoir." B-34.

B.12.3. SetLetterWaterPaybacksDebts

"This rule sets the exchange Borrow slots for all the exchanges set up to track the debts for contactors for San Juan-Chama Project water to be paid back with letter water deliveries. **Each contractor has three exchanges for tracking a debt to be paid back** as [:]

-a transfer to the MRGCD account at El Vado Reservoir,

-a release from Abiquiu Reservoir to contribute to the MRGCD irrigation demand, and

-to be released from Abiquiu Reservoir to pay back the Compact.

"The Borrow slots are set based on model user inputs for the total debt, the portions to be paid back to MRGCD versus the Compact, and which means to use to pay back MRGCD." B-34.

B.13.0 Compute LetterWaterDeliveries ReleasesForMRGCDemand

"The rules in the policy group are used to compute letter water delivery amounts for paybacks to MRGCD as[:]

-transfers at El Vado,

-deliveries to payback MRGCD by contributing to the MRGCD demand at Cochiti, and

-deliveries to Elephant Butte to payback the Compact.

"Rules are also used to *identify the MRGCD demand at Abiquiu and El Vado for eventually later identifying the needed release from storage for MRGCD*. These rules are all included together because the releases MRGCD demand for identify releases from storage is reduced for any letter water deliveries from Abiquiu already computed that contribute to the demand." B-35.

B.13.1. ComputeLetterWaterPaybackToMRGCDatElVado

"This rule records computed transfers for contractors to make letter water deliveries to MRGCD as transfers from account storage at El Vado Reservoir to the MRGCD San Juan-Chama account at El Vado. The deliveries are set to zero unless the switch has been set to make paybacks as transfers at El Vado and the date is on or after the input date to make such a transfer. The recorded value is set to the tracked debt with a check against the available supply for the source contractor." B-35.

B.13.2. ComputeAbiquiuMRGCDDemand

"This rule uses hypothetical simulation to *determine the required release from Abiquiu Dam to meet the MRGCD demand at Cochiti Lake.* A computed value is determined first and then a final value is set with the SetAbiquiuMRGCDDemand rule. T*he separate steps are included to potentially allow for some alternate approaches to be used in regards to better matching the needed flow at Abiquiu*. The final set value is then referenced later to determine the release needed from El Vado Reservoir and to ultimately set any potential releases from storage to meet the MRGCD demand. If the demand at Cochiti is zero, the demand at Abiquiu is set to zero without a call to hypothetical simulation." B-36.

B.13.3. SetAbiquiuMRGCDDemand

"This rule sets the MRGCD demand for the next timestep based on the computed demand. This separate rule allows for an adjustment to the computed demand to be implemented to potentially better match the need at Abiquiu Dam. With the adjustment in URGWOM to use a one-day physical lag that matches the one-day accounting lag between Abiquiu and Cochiti, this additional rule may not be needed any more." B-37.

B.13.4. ComputeLetterWaterPaybackToMRGCDOutOfAbiquiu

"This rule records computed letter water deliveries set to contribute to meeting the MRGCD demand at Cochiti. The contributions to the demand are split evenly between contractors that need to make deliveries limited to the remaining payback debt for each contractor OR the available supply at Abiquiu for the source contractor. If any contractors cannot make their portion of an evenly split delivery, other contractors will delivery more if possible." B-37.

B.13.5. ComputeLetterWaterPaybacksToCompact

"The daily letter water deliveries to pay back the Compact are recorded with this rule for each contractor based on the total payback amount for the year for the contractor, the portion to be paid back to the Compact, and the unit delivery schedule for the paybacks to the Compact. Note that *deliveries are restricted to the available water in storage at Abiquiu for the contractor*, *and if water is not available, the payback is NOT adjusted later to make up for the discrepancy, but this should be avoided with water moved from Heron to Abiquiu and made available for the paybacks as needed.*" B-38.

B.13.6. SetElVadoMRGCDDemand

"The MRGCD demand at El Vado for determining needed releases from storage is computed with this rule. The amount is determined using hypothetical simulation between El Vado and Abiquiu for meeting the MRGCD demand at Abiquiu after subtracting off contributions from any letter water deliveries out of Abiquiu to the MRGCD demand." B-38.

B.14.0 SJCDeliveriesToElephantButte

"URGWOM is set up to allow surface water diversions to continue for Albuquerque and the city of Santa Fe during flood control operations when their San Juan-Chama Project water cannot be delivered. The rule in this policy group is used to set the deliveries to Elephant Butte to payback any accrued debt or to be delivered for temporary storage when upstream space is not available." B-39.

B.14.1. ComputeContractorDeliveriesToElephantButte

"This rule records values for Albuquerque and Santa Fe City deliveries to Elephant Butte if there is no space at El Vado or Abiquiu to ultimately avoid losing allocated water at Heron Reservoir or to assure enough water is available for the contractor at Elephant Butte to pay back a debt accrued due to surface water diversions of all native water during flood control operations." B-39.

B.15.0 15. HeronRGBypass

[Colorado River Storage Project Act (enacted Apr. 11, 1956)]

"The rule in this policy group is used to compute the release of native Rio Grande water from Heron Reservoir. Space at Heron Reservoir is designated for San Juan-Chama Project water and the native inflow from Willow Creek is bypassed, but operations actually entail evacuating native water periodically as storage starts to accumulate. This is the realistic approach that is represented in the ruleset as it is not practical for damtenders to bypass the exact inflow every day." B-40. {cpm note: FLEX} Note: All the law says is that a single off stream dam should be constructed to store SJC water only. The specific way the rule works in terms of estimating an annual volume target doesn't appear to be required by law.

B.15.1. ComputeHeronRGRelease

"This rule computes an outflow of Rio Grande water from Heron Dam. The referenced function sets the outflow with three parts. Any unregulated outflow is included, and a separate calculation is included for targeting an end -of-year storage of 350 acre-ft such that the native storage will be zero to start the next calendar year after the end-of-year 350 acre-ft accounting adjustment for impacts of Rio Grande water on evaporation. The third part of the calculation is the primary component that sets the release to evacuate Rio Grande water after a threshold amount of Rio Grande storage has been exceeded to then reduce the storage to a lower storage over an input number of days." B-40.

B.16.0 Compute PandPStorageAndInflow

[Agreement – Procedures for the Storage and Release of Indian Water Entitlements of the Six Middle Rio Grande Pueblos] *and* [An Act Authorizing the Secretary of Interior to Execute an Agreement with the Middle Rio Grande Conservancy District Providing for Conservation, Irrigation, Drainage, and Flood Control for the Pueblo Lands in the Rio Grande Valley, Pub. L. No. 70-169, ch. 3219, 45 Stat. 312 (1928)] *and OtowiForecast*

"The rules in this policy group are used to compute the P&P storage requirement and set the inflow of native water to P&P storage. The approach matches the actual approach used by the BIA and Reclamation with an Otowi forecast computed in URGWOM based on input inflows. The rules allow for P&P water to be stored prior to March 1 if model parameters are set accordingly." B-41.

B.16.1. ComputeOtowiForecast

"This rule is used to compute a forecasted flow at Otowi for the period from March through July. The Otowi forecast is used later to identify the type of year when setting flow targets and is also referenced as the forecast in the model computation for the P&P storage requirement. Note that an Otowi forecast is determined based on set model inputs." B-41.

B.16.2. ComputePandPStorageRequirement

"This rule computes a P&P storage requirement at El Vado Reservoir on March 1, April 1, May 1, and also on the rulebased simulation start timestep if it is after March 1. The storage requirement is calculated based on the procedures actually used by the BIA in coordination with Reclamation as the amount of water that would be needed to meet the P&P Demand in the Middle Valley during the irrigation season with consideration for natural flows from the mainstem. Note that the resulting calculated storage requirement may be reset if the model user has also input a minimum storage requirement." B-42.

B.16.3. ResetPandPStorageRequirementToMinIfInputAndHigher

"URGWOM is set up such that a model user can override a computed P&P storage requirement to assure the storage requirement is greater than or equal to a user input minimum. This flexibility is particularly valuable for AOP modeling where a exact storage requirement may already be known that should be used as a minimum as an override to a potentially lower computed value computed in URGWOM. The separate final storage requirement is recorded and then used for setting P&P storage." B-43. {Note: FLEX}

B.16.4. TallyPandPWaterStoredInArticleVII

"This rule records a tally of the P&P water stored while Article VII is in effect. This tally is then referenced when determining whether unused P&P water each year should be

-evacuated from El Vado Reservoir OR

-transferred to Rio Grande storage at El Vado.

"The tally adds water stored while Article VII was in effect, subtracts water then evacuated at the end of the year that was stored while Article VII was in effect, and subtracts releases in excess of the amount needed to meet the P&P demand between May and October, which is water not needed and being evacuated as water stored while Article VII was in effect." B-44.

B.16.5. UnneededPandPWaterTransferredBackToRioGrande

"This rule sets the *transfer of unused P&P water to the Rio Grande account at El Vado Reservoir*. Note that any water stored while Article VII was in effect will be evacuated before excess water stored while Article VII was not in effect is transferred to the Rio Grande account. Water may be transferred to the Rio Grande account at the end of the year or during the irrigation season if the P&P storage exceeds the final storage requirement." B-44.

B.16.6. SetInflowToPandPStorage

"This rule sets the transfer from Rio Grande storage to P&P storage at El Vado Reservoir for storing inflows for meeting the P&P storage requirement regardless of whether Article VII of the Compact is in effect. Daily inflows are stored as needed up until the storage requirement is met with available inflows above the minimum El Vado release and above the amount needed for the total Middle Rio Grande irrigation demand. Note that the referenced storage requirement allows for water to be stored up to the minimum possible requirement prior to March 1 if parameters are set accordingly in the model." B-46 – B-47.

B.17.0 Compute CallForPandPRelease

*[*Procedures for the Storage and Release of Indian Water Entitlements of the Six Middle Rio Grande Pueblos, 1981]

"The rules in this policy group i*ncrementally complete the computations for ultimately computing the call for releases from P&P storage at El Vado Reservoir.* The rules are configured to record the steps in the computation such that the incremental calculations can be reviewed from any model run. *The call effectively represents the amount of additional water that needs to be released from El Vado Dam to meet a daily demand schedule after considering inflows from the mainstem and native flows above El Vado Reservoir.*" B-47.

B.17.1. ComputeFlowFromMainstemForPandPCallCalc

"This rule records a value for the flow from the mainstem realized at Otowi for identifying the potential additional water needed to meet the daily P&P irrigation demand at Otowi." B-48.

B.17.2. RioChamaNaturalFlowNeedForPandPOtowi

"This rule records a value for the flow needed from the Rio Chama in addition to the flow provided from the mainstem as needed to meet the daily P&P irrigation demand at Otowi." B-48.

B.17.3. RioChamaNaturalFlowNeedForPandPElVado

"This rule records a value for the flow needed at El Vado in addition to the flow provided from the mainstem as needed to meet the daily P&P irrigation demand at Otowi. Model loss coefficients for the reaches between El Vado and Otowi from the previous timestep are used to identify the flow needed at El Vado from the flow needed at Otowi." B-49.

B.17.4. ComputeCallForPandPReleaseElVado

"This rule sets a call for releases of P&P water from storage. The primary purpose of the rule is to set the release as needed to meet the P&P demand at Otowi, but releases are also set to evacuate unused P&P storage that was stored while Article VII was in effect." B-49.

B.18.0 StorageOfEmergencyDroughtWaterAccounts

[Emergency Drought Water Agreement of 2016]

"The rule in this policy group is used to set the accounting supplies for transferring Rio Grande water to Emergency Drought water accounts based on tracked allocations for storage. Inflows above the amount needed for P&P storage and the amount needed to meet the MRGCD demand are stored when Article VII is in effect. Storage of Emergency Drought water is split between MRGCD and ESA based on the available space for each." B-50.

B.18.1. SetInflowToEmergencyDroughtWaterAccounts

"This rule computes the transfer of native Rio Grande inflows to Emergency Drought water storage for MRGCD and ESA. Available inflows not needed for P&P storage and also above the amount needed for meeting the MRGCD demand are stored as Emergency Drought water when Article VII is in effect. Storage of available inflows are split between Emergency Drought water storage for MRGCD and ESA based on the ratio of the available space for the individual use to the total space for both MRGCD and ESA Emergency Drought water where the space reflects the remaining unfilled allocation for storage of Emergency Drought water." B-50.

B.19.0 SetMiddleValleyTargetFlows

[Biological and Conference Opinions on the Effects of Actions Associated with the Programmatic Biological Assessment of Bureau of Reclamation's Water and River Maintenance Operations, Army Corps of Engineers' Flood Control Operation, and Related Non-Federal Actions on the Middle Rio Grande, New Mexico] ***CochitiDevitationsTargets [***WildEarth Guardians v. United States Army Corps of Engineers, memorandum opinion and order, June 6, 2018, Robert C Brack, District Judge]

B.19.1. Hydrology Year Type

"This rule is used to set a trigger for the current timestep to 1, 2, or 3 to identify whether the year is classified as Dry, Normal, or Wet, respectively. *The result is used later when downstream target flows are determined. These year classifications are established as needed for defining flow targets per the* ***Biological Opinion***. Note that the year classification is checked at the first day of each month through May 1st, and the year classification as of May 1st is maintained for the remainder of the calendar year." B-51.

B.19.2. SetMinTargetsAtStart

"This rule is used to identify the downstream target flows at Central, Isleta, San Acacia, and San Marcial at the Start Timestep based on the hydrology year type and with consideration for the input adjustment factor." B-52.

B.19.3. MinIsletaSanAcaciaSanMarcialFlowTargets

"This rule is used to set the downstream flow targets at Isleta, San Acacia, and San Marcial based on the hydrology year type and *with consideration for the input adjustment factor*. (*The target for Central is set separately to prevent priority conflicts with the potential alternate policy for resetting Central targets for recruitment or overbank flows as a result of* **Cochiti deviations**.) Targets are actually set into the future based on the travel time from Abiquiu Dam to the target location. Targets are set to zero after the year-to-date Otowi flow volume has exceeded the input threshold volume for conserving supplemental leased San Juan-Chama Project water and if there is no Emergency Drought water available (i.e. there is no storage in the SupplementalESA account at El Vado Reservoir). Policy for this proposed action of conserving supplemental leased San Juan-Chama Project in wetter years may be turned off by inputting a very high threshold Otowi flow volume." B-53.

B.19.4. MinCentralFlow Target

"This rule is used to set the downstream flow target at Central based on the hydrology year type and with consideration for the input adjustment factor. (*The target for Central is set separately to prevent conflicts with the potential alternate policy for resetting Central targets for recruitment or overbank flows as a result of Cochiti deviations.*) The target is actually set into the future based on the travel time from Abiquiu Dam to Central. The target may be set to zero after the year-to-date Otowi flow volume has exceeded the input threshold volume for conserving supplemental leased San Juan-Chama Project water and if there is no Emergency Drought water available (i.e. there is no storage in the SupplementalESA account at El Vado Reservoir). Policy for this proposed action of conserving supplemental leased San Juan-Chama Project in wetter years may be turned off by inputting a very high threshold Otowi flow volume. Note that the rule for resetting the Central targets for Cochiti deviations is higher priority and targets will be subsequently be changed for deviations if deviations are implemented." B-54.

B.19.5. ResetIsletaSanAcaciaSanMarcialTargetsForStepDown

"*Targets may be reset in URGWOM for* discretionary operations *as conducted under the Biological Opinion (Service, 2003) which entail* using supplemental water to manage the recession after the runoff and control the rate of drying after river rewetting for minnow salvage. Policy for representing discretionary operations entails implementing a longer step down in targets at the end of the runoff and shorter step downs in targets thereafter following each river rewetting event. Note that a step down in targets as needed after the continuous flow requirement if the runoff ends before the continuous flow requirement is over would be represented separately and would need to be included in the input target table." B-55.

See also Fig. B-10, Flow Chart Depicting Logic for Establishing Step Downs in Targets.

B.19.6. RecordPeakInflowAndDateForDeviationsRules

"This rule records a date and magnitude for the estimated peak inflow to Cochiti Lake. The values are then referenced later when setting operations for Cochiti deviations to target storage before the peak with releases of temporary storage then made to augment the peak flow for better providing recruitment or overbank flows in the Middle Rio Grande for ESA interests." B-56.

B.19.7. ResetCentralTargetForCochitiDeviations and SetConservationSpaceAtCochiti

"This rule is used to reset the downstream flow targets at Central to provide either a 'recruitment' hydrograph or an 'overbank' hydrograph if Cochiti deviations are implemented.The targets for the entire hydograph are set on the determined date, or input date, to begin storage at Cochiti Lake for deviations. The computed date is based on an input number of days prior to the estimated date of the peak inflow to Cochiti. The available conservation space at Cochiti is also then set for the corresponding operation based on a lookup table if a value was not input. If deviations are not being modeled, the amount of conservation space is set to a separate input amount – which may likely be zero. Deviations are not implemented if the current timestep is after the last year that deviations are implemented as input. The rule also includes assignments to a trigger slot to record which operation was conducted." B-59.

B.19.8. EndTargetsForOverbankOrRecruitment

"This rule is used to reset targets at Central set for Cochiti deviations back to the original table targets if conservation storage at Cochiti Lake drops below a threshold low volume. This adjustment is required to prevent supplemental leased San Juan-Chama Project water or Emergency Drought water from being used to provide recruitment or overbank flows after conservation storage is no longer available from Cochiti deviations." B-60.

B.20.0 EstimatedCochitiInflowAvailableForMiddleValleyDemands

"The rules in this policy group are used to develop an estimated inflow to Cochiti Lake available for Middle Rio Grande demands. The calculation is completed in separate steps with the results recorded to series slots that allows for model users to compare the estimates to the resulting modeled flows for each step. **The inflow to Cochiti is then used to reset MRGCD diversions if needed for that flow to prevent supplemental water for targets from being diverted**." B-61.

B.20.1. EstimateElVadoRGOutflow

"Rule Explanation: This rule estimates the outflow from El Vado Dam that will be available for meeting the MRGCD demand plus any additional inflows that are bypassed if Article VII is in effect. The computation includes bypassed inflows, any release of P&P water, and any release from available storage to meet the MRGCD demand." B-61.

"Rule Logic: The value for the EstimatedElVadoRGOutflow series slot in the MRGCD data object for the current timestep is set to the result of the ComputeEstimateElVadoRGOutflow function. That function computes an initial potential outflow as the MRGCD demand at El Vado restricted if needed to the available bypassed inflow plus available water in storage released to meet the demand. Bypassed inflows are set to the value for the Local Inflow series slot on the ElVadoLocalInflow reach object for the current timestep minus the three accounting supplies for transferring inflow to the PandP, MRGCDDrought, and SupplementalESA accounts. Water available in storage to also contribute to meet the demand is equal to the previous storage in the Rio Grande account plus all pending transfers to the MRGCD San Juan-Chama account at the current timestep plus any water transferred from the PandP account back to the RioGrande account plus all Emergency Drought water in storage for MRGCD. Any pending release from the PandP account is also included.

"If Article VII is in effect as checked with the user-defined ArticleVIIInEffect function, the resulting initial potential outflow for meeting the MRGCD demand is increased to include all bypassed inflows and any release form PandP storage." B-62.

B.20.2. EstimateAbiquiuRGInflow

"This rule estimates the inflow to Abiquiu Reservoir based on the estimated outflow from El Vado Dam." B-62.

B.20.3. EstimateCochitiInflowAvailableForMiddleValleyDemands

"This rule estimates an inflow to Cochiti Lake available to meet the Middle Valley demands based on the estimated inflow to Abiquiu for the MRGCD demand plus any releases of San Juan-Chama Project water from storage at Abiquiu for the Buckman Direct Diversion, the Albuquerque diversion, as additional water released from storage for the MRGCD demand, or as letter water deliveries to payback MRGCD (Letter water to pay back the Compact is not included with amount available for Middle Valley demands)." B-63.

B.21.0 SetMiddleValleyOperations

"The rules in this policy group are used set the **Middle Valley operations** which include the operations of the LFCC pumps along with the flows through the Atrisco siphon and the returns at the Central wasteway. *Diversions at Angostura may be increased during shortage operations such that the limited supply of water is delivered to the Belen Division as efficiently as possible. Diversions may also be reset lower if necessary to prevent supplemental water for targets from being diverted when there is a shortage.* Potential shorted diversions are set separately as the policy at each diversion is dependent on whether there are any target flows below the diversion." B-62 – B-63. Note: FLEX

B.21.1. SanAcaciaSocorroMainCanalDiversionRequest

"This rule sets the diversion requested to the Socorro Main Canal at the San Acacia diversion based on an input diversion schedule minus the contributions from the Unit 7 drain in the MRGCD system. Flows from the Unit 7 drain contribute toward meeting the need at the Socorro main canal, and diversions from the river are curtailed accordingly. The diversion requested values for San Acacia are set separately from the Cochiti, Angostura, and Isleta diversions due to the unique dependency at San Acacia on the Unit 7 through flow.." B-64.

B.21.2. LFCCPumpingRequested

"This rule sets the pumping rates from the LFCC at the Neil Cupp, North Boundary of the Bosque del Apache National Wildlife Refuge, and South Boundary sites. Policy is coded for pumping water from the LFCC to the river to manage recession after the runoff or to prevent river drying. Water that seeps into the LFCC is pumped to the river where pumping begins based on input river flow triggers. After pumping has initiated at a site, pumping will continue for a minimum of one week and until a threshold flow at San Acacia has been exceeded. Pumping will cease for the year at each site after the specific dates input for each site." B-64.

B.21.3. MRGCDWastewayCalcs

"This rule sets the MRGCD returns to the river through key wasteways and flows through siphons as represented in the URGWOM layout. Flows through some wasteway objects in URGWOM are simply set with the RiverWare method to use a percentage of the available flow, but some returns or siphon flows are set with this rule based on general policy as identified by the URGWOM Tech Team. Note that it may be important for the policy implemented with this rule to match the policy used for the Middle Valley calibration. Flows through the Central Wasteway and Atrisco siphon are set along with returns at the Peralta wasteways, the return from Atrisco Drain outfall, and the flow through the Corrales siphon." B-66.

B.21.4. ResetAngosturaDiversionForShortageOps

"This rule increases the requested diversion values for the Angostura diversion when MRGCD is in a shortage situation (i.e. no water in storage and the inflow to Cochiti is less than the MRGCD demand) and operations are being conducted to assure delivery of P&P water to the six Middle Valley pueblos. In actual operations, diversions are also increased so MRGCD can then use the limited supply as efficiently as possible. Flows to the Central wasteway and Atrisco siphon are also reset accordingly to zero and 120 cfs, respectively, for shortage operations within this rule." B-67.

B.21.5. ResetCochitiDivToPreventDiversionOfSuppWater

"This rule *resets the diversions at Cochiti to a lower amount if needed to assure supplemental water needed for targets is not diverted*. The estimated flow at Cochiti for Middle Valley demands is used to identify whether the diversions should be shorted." B-68.

B.21.6. ResetAngosturaToPreventDiversionOfSuppWater

"This rule resets the diversions at Angostura to a lower amount if needed to assure supplemental water needed for targets is not diverted. The estimated inflow to Cochiti for Middle Valley demands is used to identify whether the diversions should be shorted." B-68.

B.21.7. ResetIsletaToPreventDiversionOfSuppWater

"This rule r*esets the diversions at Isleta to a lower amount if needed to assure supplemental water needed for targets is not diverted*. The estimated inflow to Cochiti for Middle Valley demands is used to identify whether the diversions should be shorted. (Note that the Execution Constraints for this rule are not dependent on the target at Central. The rule only fires if a downstream target is greater than zero which means that remaining supplemental water could be diverted at Isleta if there are no downstream targets.)" B-69.

B.21.8. ResetSanAcaciaToPreventDiversionOfSuppWater

"This rule resets the diversions at San Acacia to a lower amount if needed to assure supplemental water needed for targets is not diverted. The estimated inflow to Cochiti for Middle Valley demands is used to identify whether the diversions should be shorted. (Note that the Execution Constraints for this rule are not dependent on the target at Central or Isleta. The rule only fires if a downstream target is greater than zero which means that remaining supplemental water could be diverted at San Acacia if there are no downstream targets.)" B-70.

B.22.0 ComputeUpstreamFlowNeedForTargets

"The rules in this policy group are used to determine the flow needed at Cochiti for the Middle Rio Grande target flows and ultimately the amount of supplemental water needed from Abiquiu and El Vado Reservoirs. A need for Emergency Drought water from El Vado is estimated and a final needed release is determined such that releases are not adjusted every day to better reflect actual operations." B-71. Note that this relates to the 2003 Biological Opinion.

B.22.1. AlternateCalcOfMinCochitiReleases TEST

"This rule was set up to TEST alternate simplified means for identify the flow needed at Cochiti Dam for downstream targets from the more computationally intensive hypothetical simulation. The approach will not be used unless a switch is set by the model user to use the alternate approach." B-71.

B.22.2. ComputeMinCochitiReleaseForCentralTarget

"This rule uses hypothetical simulation to determine the minimum total outflow from Cochiti Dam needed to meet the determined target flow at Central. The value for the next timestep is computed as needed to eventually determine the flow needed at Abiquiu at the current timestep. Inflows to Jemez Reservoir are assumed to be bypassed at Jemez Canyon Dam." B-72.

B.22.3. ComputeMinCochitiReleaseForIsletaTarget

"This rule is essentially the exact same as the ComputeMinCochitiReleaseForCentralTarget rule except the minimum release is being determined for the target flow at Isleta (Refer to Section A.22.2 for more details)." B-73.

B.22.4. ComputeMinCochitiReleaseForSanAcaciaTarget

"This rule is essentially the exact same as the ComputeMinCochitiReleaseForCentralTarget rule except the minimum release is being determined for the target flow at San Acacia (Refer to Section A.22.2 for more details)." B-73.

B.22.5. ComputeMinCochitiReleaseForSanMarcialTarget

"This rule is essentially the exact same as the ComputeMinCochitiReleaseForCentralTarget rule except the minimum release is being determined for the target flow at San Marcial (Refer to Section A.22.2 for more details)." B-73.

B.22.6. ComputeMinCochitiReleaseForAllMiddleValleyTargets

"This rule determines the maximum value from the four computed minimum releases from Cochiti Dam needed to meet the target flows at Central, Isleta, San Acacia, and San Marcial. The resulting maximum total flow needed for targets in the Middle Valley is then referenced later to identify the amount of supplemental water needed from Abiquiu Reservoir (or Cochiti Deviations). Values are set for the next timestep. **Indicators are also set to identify which targets are critical and driving the release of supplemental water.**" {Note: FLEX}

B.22.7. AbiquiuTotalFlowToMeetTarget

"This rule uses hypothetical simulation to determine the total release from Abiquiu Dam required to meet the computed minimum flow needed at Cochiti Lake for all the Middle Valley targets. The flow needed at Abiquiu is set to zero if the flow needed at Cochiti is not greater than zero, there is no supplemental water available in storage, or the estimated inflow to Cochiti Lake is high." B-74.

B.22.8. ComputeEmergencyDroughtWaterNeededFromElVadoForTargets

"The amount of Emergency Drought water needed from El Vado for targets must be estimated before the Rio Grande bypass at Abiquiu is known. *This rule is used to estimate the amount of Emergency Drought water needed as the total release needed for targets* ***minus***

-the estimated Rio Grande inflow **and minus**

…San Juan-Chama Project deliveries to the Buckman Direct Diversion, the Albuquerque diversion, …deliveries to Elephant Butte,

…letter water deliveries to payback the Compact,

…letter water deliveries to payback MRGCD, and

…releases from MRGCD storage at Abiquiu.

"The c*alculation is complicated by the potential conservation storage at Abiquiu that may be modeled*. The amount needed at Abiquiu is adjusted by the last loss coefficient betwen El Vado and Abiquiu to estimate the amount needed at El Vado." B-75.

B.22.9. SetNeededEmergencyDroughtWaterReleaseFromElVadoForTargets

"This rule sets a final value for the needed minimum release of Emergency Drought water from El Vado for targets with reference to the computed need. The actual release is not adjusted unless a specific threshold change in the need is exceeded and the release of supplemental water is not adjusted until after an input minimum of days since the last adjustment. The calculations are included to better represent actual operations that do not entail adjusting the release each day by a few cfs in attempt to exactly meet a target flow." B-76.

B.23.0 ReleaseOfEmergencyDroughtWater

[Emergency Drought Agreement, 2016]

"The rules in this policy group are used to compute releases of Emergency Drought water as contributions to meeting the MRGCD demand and deliveries to meet target flows in the Middle Rio Grande with checks against the available supply and checks against input limited annual release volumes." B-77.

B.23.1. ComputeSupplementalESARelease

"This rule *computes a daily release of Emergency Drought water from El Vado Reservoir for ESA needs* as the determined need restricted to not exceed the input daily maximum, the maximum release volume for a year, or the available Emergency Drought water supply for ESA at El Vado Reservoir." B-77.

B.23.2. ComputeMRGCDDroughtRelease

"This rule computes a daily release of Emergency Drought water from El Vado Reservoir for MRGCD **to meet the remaining need for the MRGCD** demand above native inflows that are bypassed at El Vado and any release of P&P water. Emergency Drought water is used before Rio Grande project water in storage and before MRGCD's San Juan-Chama Project water." B-78.

B.24.0 EstimateElVadoRGRelease

"The rules in the policy group record an estimated magnitude and date for the peak inflow to El Vado Reservoir and compute the release of Rio Grande water from El Vado. The magnitude and date of the peak are referenced for policy for filling El Vado Reservoir if Article VII is not in effect. If Article VII is in effect, inflows are bypassed. Native water will also be

s released from storage as available and as needed to meet the MRGCD demand with consideration for contributions from P&P releases and deliveries of MRGCD Emergency Drought water." B-79 – B-80.

B.24.1. RecordEstimatedElVadoPeakInflowAndDate

"This rule records a date and magnitude for the estimated peak inflow to El Vado Reservoir for each year in a model run. The values are then referenced later when setting the release of native water from El Vado Reservoir during filling if Article VII of the Compact is not in effect." B-80.

B.24.2. EstimateElVadoRGRelease

"Explanation: This rule computes a daily release of Rio Grande water from El Vado Reservoir.

"If Article VII is in effect, inflows are bypassed as not needed for P&P storage and storage to meet Emergency Drought Water allocations for MRGCD and ESA. Inflows will also be stored if needed to offset a negative storage.

"If Article VII is not in effect, the outflow is set to the computed amount for filling. The outflow from the Rio Grande account is checked to assure the MRGCD demand is met with releases from available storage if needed and against the Minimum Rio Grande outflow for ultimately assuring Rio Chama acequia diversions demands are met. The total outflow of native water includes any computed release of P&P water or Emergency Drought water for MRGCD or ESA." B-80.

"Rule Logic: The value for the RGOutflow series slot in the ElVadoData data object for the current timestep is set using the ElVadoRGRelease function.

"The predefined MaxItem function is first used to identify the maximum of

1) the release of native water set as a function of Article VII status,

2) the release needed to meet the MRGCD demand, and

3) the minimum Rio Grande outflow.

"1). . . An IF THEN ELSE statement is used to check the user-defined ArticleVIIinEffect function.

"If Article VII is in effect, the bypassed inflow is set to the result from the CurrentRGInflow function minus the accounting supplies for transfers to the MRGCDDrought, SupplementalESA, and PandP accounts. The bypassed inflow is also adjusted if the previous Rio Grande storage is negative to allow for the Rio Grande storage to return to zero.

"If Article VII is not in effect, the release is set to the result of the user-defined ElVadoOutflowForFilling function (That function mimics a calibrated procedure developed by Warren Sharp that was tested extensively by Warren in an Excel file (20100608_PotentialElVadoOps2010.xls) and was refined to serve as a **guide for how El Vado Reservoir could be filled to best assure the reservoir is filled with available inflows while minimizing the chance that the downstream channel capacity is exceeded**). {Note: FLEX}

"2) The release needed to meet the MRGCD demand is set to the value in the MRGCDDemand series slot in the ElVadoData data object for the current timestep minus the value in the PandPReleaseFromElVado series slot in the ComputedDeliveries data object as checked with the user-defined ElVadoMRGCDDemand function minus the value in the MRGCDDroughtReleaseFromElVado series slot in the ComputedDeliveries data object for the current timestep checked against the previous storage in the RioGrande account at ElVado using the predefined Min function.

"3) The minimum Rio Grande outflow from El Vado is checked with the MinRGOutflow function. Values in the PandPReleaseFromElVado, MRGCDroughtReleaseFromElVado, and SupplementalESAReleaseFromElVadoForTargets series slots in the ComputedDeliveries data object are then added to compute the total Rio Grande outflow." B-81.

B.25.0 HeronSJRelease [See within]

"The rules in this policy group are used to compute deliveries of San Juan-Chama Project water from Heron Reservoir to El Vado Reservoir, Abiquiu Reservoir, or the Cochiti Recreation Pool. **Deliveries to Abiquiu may be scheduled to provide rafting releases below El Vado Dam.**" {Note: FLEX}

B.25.1. RecordComputedRaftingSchedule

"If a specific rafting schedule has not been **input by the model users**, this rule records a typical schedule for rafting releases below El Vado Dam based on input values in a periodic slot and with reference to user set dates for a rafting season." B-81. {Note: FLEX}

B.25.2. RecordPotentialRaftingReleases

"This rule records a potential delivery from Heron Reservoir to Abiquiu Reservoir for individual contractors to provide rafting flows below El Vado Dam. **The determined delivery may be set when the final computed delivery is set with consideration for other factors.**" B-82. {Note: FLEX}

B.25.3. ComputeHeronSJCDeliveryToCochitiRecPool

[Public Law 88-293, to authorize the Secretary of the Interior to make water available for the permanent pool for fish and wildlife and recreation purposes at Cochiti Reservoir from the San Juan-Chama unit of the Colorado River storage project]

"This rule computes a delivery of Cochiti Rec Pool water from Heron to Cochiti Lake. Deliveries may be set under multiple conditions to assure an input minimum storage is maintained or water is moved out of Heron by the end of the year, as a rafting release, or over a typical delivery period restricted to not exeed the target content at Cochiti Lake. Note that the target content at Cochiti Lake may be set by the model user to an input Cochiti surface area or an input storage with different results due to the impacts of modeled sedimentation at Cochiti Lake." B-83.

B.25.4. ComputeHeronSJCDeliveriesToAbiquiu

[Public Law 97-140, Section 5, 1981]

"This rule computes
    -deliveries for contractor San Juan-Chama Project water
        …from Heron Reservoir
        …to allocated storage space at Abiquiu Reservoir.
"Deliveries may be set under multiple conditions to assure
    -an input minimum storage is maintained at Abiquiu Lake OR
    -water is moved out of Heron by the waiver date,
        …by the end of the year,
        …as a rafting release, OR
        …over a typical delivery period while restricted to not exceed the available allocated storage space at Abiquiu Reservoir." B-84. {Note: FLEX}

B.25.5. ComputeHeronSJCDeliveriesToElVado

[Amendatory Contract between the United States of America and the Middle Rio Grande Conservancy District, New Mexico, Section 10. Contract No. 178r-423, Ammendment No 4, Revised 5-14-64]

"Deliveries of contractor San Juan-Chama Project water from Heron Reservoir to El Vado Reservoir are set with this rule. MRGCD water is moved to fill available space, and other contractor water may be temporarily stored at El Vado if allowed based on model user inputs. Water for other contractors is moved as space is available at El Vado Reservoir and up to an estimated amount that can be evacuated before the next runoff." B-85. {Note: FLEX}

B.25.6. ComputeHeronSJRelease

"A total outflow of San Juan-Chama Project water from Heron Reservoir is computed as a sum of all the computed individual deliveries." B-87.

B.26.0 San Juan Diversions

[Upper Colorado River Basin Compact, Articles 3 and 4]

"The rules in this policy group are used for setting the San Juan diversions with consideration for the available flow in the tributaries to the San Juan River, all diversion and tunnel capacities, and **legal constraints** for the Project diversions. Diversions result in modeled flows into Heron Reservoir via the Azotea tunnel. The diversions are computed at this location in priority such that the space in Heron Reservoir can be assessed." B-88. {Note: CONSTRAINT}

B.26.1. ComputeAnnualSJDiversion

[Upper Colorado River Basin Compact, 1948, Article 4, Subsection B]

"On January 1 of each year, this rule sums the annual diversion of San Juan water over the previous year. The values are then referenced when 10-year restrictions on San Juan-Chama Project diversions." B-88.

B.26.2. San Juan Diversions

[Upper Colorado River Basin Compact, 1948, Subsection Article 3, Subsection A]

"The San Juan Diversions at the Blanco, Little Oso, and Oso diversions are determined with this rule. If an input maintenance switch is checked for a diversion, an input diversion will be referenced for the corresponding diversion. **Diversions will be limited if necessary based on**[:]

-the annual limit,

-limited diversion for a decade, OR

-the available space at Heron Reservoir.

"If the Project diversion is limited, separate calculations are used to determine the diversions. Otherwise, the diversions are set to the input diversion capacity. These rules capture detailed aspects of diversion and tunnel capacities that may ultimately affect the total Project diversion volume to Heron Reservoir via the Azotea tunnel." B-88 – B-89. {Note: CONSTRAINT}

B.27.0 Heron

"The rules in this policy group are used to ultimately *determine the total outflow from Heron Dam* and include checks against the reservoir ice coverage, whether the reservoir is spilling, and the maximum daily pool elevation change of one foot." B-90.

B.27.1. HeronSJReleaseRestrictions

"This rule checks to see if Heron Reservoir has full ice coverage or if it must spill. If so, the release of San Juan-Chama Project water is reset to 0.0 cfs. The ice coverage is computed as part of the CurrentSurfaceAreaPanAndIce evaporation method." B-90.

B.27.2. HeronOutflow

"Unless a total outflow for Heron Dam has been input for the current timestep, the value is set to the sum of the separate initial computed values for the release of native Rio Grande water and the release of San Juan-Chama Project water if the resulting total release is physically legitimate with consideration for the outlet works. If not, the release is reset to reflect the *restriction of the Heron Dam outlet works*." B-91.

B.27.3. HeronCheckDeltaStorage

"If the change to the pool elevation, resulting from the initial set outflow for the current timestep, is greater than the limited change of 1 ft, the outflow is reset to restrict the change to the pool elevation to the input value of 1 ft." Note: The other rules in this group are technical and it is unclear where this 1 ft restriction comes from.

B.28.0 SetHeronRioGrandeAccountingSupply

"The rules in this policy group are used to set the accounting supply for the final determined outflow of Rio Grande water from Heron Reservoir. Another rule is included to assure that supply got set. If the supply does not get set, a simulation will stop and allows the model user to identify the problem from that location in the simulation (The problem may not be directly related to the computation of the Rio Grande outflow)." B-93.

B.28.1. SetHeronRGAccount

"This rule sets the supply for the release from Rio Grande account at Heron Reservoir based on the determined outflow. If the Rio Grande outflow is greater than the Heron outflow, the supply is set to the Heron outflow. If the Heron outflow is greater than the sum of the Rio Grande and San Juan outflow, the reconciled release is set to the Heron outflow minus the San Juan outflow, or the minimum Rio Grande outflow if it is higher. Otherwise, the supply is set to the Rio Grande outflow." B-93.

B.28.2. CheckHeronRGOutflow

"This rule aborts the simulation if the supply for the release of Rio Grande water from the account at Heron Reservoir was not set. This rule helps with debugging because a simulation will stop if the Rio Grande supply was not set and the problem and any missing input can be identified by backtracking in the calculations from the point in the simulation that the run aborted. NOTE THAT the problem is likely not directly related to the computation of the Rio Grande outflow but most likely some earlier aspect of the rules solution. This rule just forces the run to go ahead and stop, so the problem can be fixed." B-94.

B.29.0 SetHeronSJCAccountingSupplies

"The rules in this policy group are used to set all the accounting supplies for deliveries of San Juan-Chama Project water from Heron Reservoir. Supplies are all set to the initial computed values for the deliveries **unless some operational constraint resulted in the total outflow from not being fully met.** Supplies are then set to the initial values in priority based on the order of the supplies listed in the function referenced for making the assignments. For deliveries through the single combined passthrough account, additional supplies are set to move the water back out of the downstream combined passthrough account to the corresponding contractor's storage account." B-94. {Note: CONSTRAINT}

B.29.1. SetHeronSJCAccountingSupplies

"This rule sets all the accounting supplies for deliveries of San Juan-Chama Project water from Heron Reservoir." B-94.

B.29.2. SetTransfersAtElVadoForDeliveriesViaCombinedAccount

"This rule sets the accounting supplies to transfer water back out of the Combined storage account at El Vado for contractor water moved from Heron to El Vado with the CombinedHeronToCombinedElVado passthrough accounts. This approach is used for the twelve contractors other than MRGCD, Albuquerque, Santa Fe City, Santa Fe County, and Cochiti Rec Pool." B-95.

B.30.0 UpdateWaiverBalances

"The rules in this policy group are used to track the balances of contractor waiver water in storage at Heron Reservoir. Waiver balances are zeroed out the day after the waiver date with any remaining waiver water in storage transferred to the FederalSanJuan account at Heron. Waiver balances are updated throughout the year for any leases of waiver water to Reclamation and for waiver water moved to El Vado or Abiquiu Reservoir." B-94 – B-95.

B.30.1. ZeroWaivers

"On the input waiver date (e.g. September 30th), accounting supplies are set to transfer remaining contractor waiver water still in storage at Heron Reservoir to the common pool for San Juan-Chama Project water. The separate tracked waiver balances for each contractor are also reset to zero." B-96.

B.30.2. UpdateContractorWaiverBalances

"The waiver balance for each contractor is tracked as the previous waiver balance minus any waiver water leased to Reclamation and minus any water moved to El Vado or Abiquiu. A Reclamation balance is also tracked that is increased with leases." B-97. {Note: FLEX}

B.31.0 ElVadoSJCRelease

"The rules in this policy group are used to compute deliveries of San Juan-Chama Project water from El Vado Reservoir and compute an initial total outflow of San Juan-Chama Project water from El Vado Reservoir." B-98.

B.31.1. ComputeElVadoSJCDeliveriesToAbiquiu

"Explanation: This rule computes deliveries for San Juan-Chama Project water from El Vado to Abiquiu.

-**MRGCD water** is moved to assure water is available as needed at Abiquiu Reservoir to meet the MRGCD demand, and

-**water for other contractors** is evacuated from El Vado Reservoir prior to the runoff based on input dates to move the water.

"Deliveries are also computed for the passthrough of contractor water being moved from Heron to Abiquiu Reservoir." B-98.

"Rule Logic: **Twenty-three assignment statements** are included in the rule to compute deliveries for San Juan-Chama Project water from El Vado Reservoir.

For the first assignment statement, the **MRGCDDeliveryElVadoToAbiquiu** series slot in the ComputedDeliveries data object for the current timestep is set with the user-defined ComputeElVadoMRGCDSJRelease function.

-Within that function, IF the MRGCD demand at Abiquiu as determined with the user-defined AbiquiuMRGCDDemand function is greater than 0.0 cfs or the current timestep is in the irrigation season and the available space at Abiquiu for MRGCD San Juan-Chama Project water as computed with the user-defined AvailableAccountStorage function is greater than half the allocated storage space for the MRGCD account and the previous storage in the Rio Grande and MRGCDDrought accounts is less than twice the MRGCD demand at Cochiti, MRGCD San Juan-Chama Project water is moved to Abiquiu.

-OTHERWISE, the delivery is set to 0.0 cfs. A delivery of MRGCD water to Abiquiu is set to fill the available space at Abiquiu plus meet the current MRGCD demand at El Vado with consideration for any contributions from the MRGCDDrought account and any release of RioGrande water from El Vado. The release is restricted to the available MRGCD storage at El Vado.

The **next sixteen assignment statements** *set deliveries for moving contractor water to Abiquiu – for contractors other than MRGCD* – using the user-defined SJCDeliveryFromElVadoToAbiquiu function.

-Within that function, if the account storage at El Vado is greater than zero and the current timestep is within the period to evacuate contractor water from El Vado based on the values input to the DateToFullyEvacuateTemporaryStorageAtElVado and DaysBeforeTargetDateToStartMovingWater columns for the corresponding account in the DeliverySettings table slot in the ComputedDeliveries data object,

…*a delivery rate is set* to the maximum of the same typical delivery rate used to move water out of Heron or the average rate to evacuate all the storage out of El Vado over the delivery period.

-The result is checked against the available space for the corresponding account at Abiquiu Reservoir with reference to the user-defined AvailableAccountStorage function.

The r**emaining six assignment statements** set the passthrough amounts for water being moved from Heron to Abiquiu through El Vado Reservoir." B-98 – B-99.

B.31.2. ComputeDeliveryForMRGCDPaybackToAlbuquerque

"This rule computes a delivery of MRGCD San Juan-Chama Project water from El Vado Reservoir to the **Albuquerque account at Abiquiu** based on inputs that reflect the debt for a past loan." {Note: transfers = FLEX}

B.31.3. ComputeElVadoSJRelease

"A total outflow of San Juan-Chama Project water from El Vado Reservoir is computed as a sum of all the computed individual deliveries." B-99.

B.32.0 ElVadoOutflow and CheckFloodControl

"The rules in this policy group are used to compute an initial total outflow from El Vado Reservoir and check the outflow against the **maximum pool elevation** and **downstream channel capacity**." B-100.

B.32.1. ElVadoOutflow

"Unless a total outflow for El Vado Dam has been input for the current timestep, the value is set to the sum of the predetermined outflows of Rio Grande and San Juan-Chama Project water, checked against the minimum outflow. That total *release is checked to see if it is physically legitimate based on the El Vado Dam outlet works*, and if not, the release is reset to reflect the restriction for the outlet works." B-100.

B.32.2. ElVadoFloodControl

"If the pool elevation at El Vado Reservoir is higher than the input maximum, the outflow is set to the release required to reduce the pool elevation to that maximum pool elevation or the maximum release from the outlet works if that outflow is lower. A check is also included to assure the minimum release is exceeded." B-101.

B.32.3. ElVadoChannelCapacity

"This rule adjusts the outflow from El Vado Dam to comply with the input downstream channel capacity if the predetermined outflow exceeds that capacity. Note that this rule fires after the ElVadoFloodControl rule, so the reservoir level will rise above the maximum pool elevation if required to keep downstream flows less than the channel capacity." B-101.

B.33.0 SetElVadoRioGrandeAccountingSupplies

"The rules in this policy group are used to set the final accounting supplies for the outflow of Rio Grande water from El Vado Reservoir and for the deliveries from P&P storage and Emergency Drought storage for MRGCD and ESA. An additional rule is included to assure the accounting supply for the outflow from the Rio Grande account gets set and stops the simulation if the supply did not get set." B-102.

B.33.1. SetAllRioGrandeAccountingSupplies

"Accounting supplies for the outflow of Rio Grande water from El Vado are set for the **release from the**[:]

-PandP,

-SupplementalESA,

-MRGCDDrought, and

-RioGrande

accounts.

"The supplies are set one-by- one with consideration for the previously set supplies restricted to a total reconciled Rio Grande outflow. **If initial computed deliveries cannot all be made with the final reconcile Rio Grande outflow, water is moved based in priority based on the order of the assignment statements**. If a higher outflow is set due to flood control operations, the additional outflow will be included with the Rio Grande account outflow set last." B-102.

B.33.2. CheckElVadoRGOutflow

"Aborts the simulation if the accounting supply for the release of Rio Grande water from the account at El Vado Reservoir was not set. This rule helps with debugging because a simulation will stop if the Rio Grande supply was not set and the problem and any missing input can be identified by backtracking in the calculations from the point in the simulation that the run aborted. NOTE THAT the problem is likely not directly related to the computation of the Rio Grande outflow but most likely due to some earlier aspect of the rules solution. This rule just forces the run to go ahead and stop, so the problem can be fixed." B-102 – B-103.

B.34.0 SetElVadoSJCAccountingSupplies

"The rules in this policy group are used to set the accounting supplies for the final deliveries of San Juan-Chama Project water from El Vado Reservoir and to transfer water conveyed in the combined passthrough accounts back to individual contractor storage accounts at Abiquiu Reservoir." B-103.

B.34.1. SetElVadoSJCAccountingSupplies

"This rule sets all the accounting supplies for deliveries of San Juan-Chama Project water from El Vado Reservoir. Accounting supplies are also set for the transfers from contractor storage accounts to the MRGCD account for letter water deliveries completed as a payback to MRGCD." B-103.

B.34.2. SetTransfersAtAbiquiuForDeliveriesViaCombinedAccount

"This rule sets the accounting supplies to transfer water back out of the Combined storage account at Abiquiu for contractor water moved from Heron to Abiquiu and from El Vado to Abiquiu with the -CombinedHeronToCombinedAbiquiu and

-CombinedElVadoToCombinedAbiquiu passthrough

accounts, respectively. This approach is used for the twelve contractors other than MRGCD, Albuquerque, Santa Fe City, Santa Fe County, and Cochiti Rec Pool." B-104.

B.35.0 ComputeRemainingIndividualAbiquiuDeliveries

[See Within]

"The rules in this policy group are used to compute[:]

-a potential inflow to conservation storage at Abiquiu Reservoir,

-an outflow of Rio Grande water, and

-deliveries of contractor San Juan-Chama Project water from Abiquiu Reservoir for MRGCD and targets.

"A total outflow of San Juan-Chama Project water from Abiquiu Reservoir is computed." B-105.

B.35.1. B.35.1. SetInflowToRGConservationStorageAtAbiquiu

[Settlement Agreement Between Rio Grande Silvery Minnow v Keys Plaintiffs, the City of Albuquerque and the Albuquerque Bernalillo County Water Utility Authority]

"Explanation: This rule sets an inflow to Rio Grande conservation storage at Abiquiu IF conservation space has been set and inflows are available for conservation storage." B-105.

"Rule Logic: The RioGrandeAbiquiuToRioGrandeConservationAbiquiu.Supply slot for the current timestep is set to minimum of the result from the user-defined ComputeRGConsInflow function and the maximum inflow input to the MaxRGConservationInflow table slot in the AbiquiuData data object as identified with the user-defined MaxRGConservationInflow function. Within the ComputeRGConsInflow function, an IF THEN ELSE statement is used to check whether an inflow to conservation storage should be computed with the IsRGConservationAllowed function. If not, the function result is 0.0 cfs. If so, the inflow available for conservation storage is computed as the available native inflow determined with the user-defined RioGrandeInflowWithPreviousRGGainLoss function plus the value in the Incidental Content slot for the corresponding reservoir object at the previous timestep or any storage adjustment and determined carryover release amount for the reservoir minus a minimum reservoir outflow determined with the user-defined MinimumRioGrandeOutflowBeforeTransferToConservationStorage function which assures Middle Valley demands are met. The resulting inflow to conservation storage is restricted to the available space determined as the minimum of the results from the user-defined EasementSpaceAvailableAsFlow and RGConsSpaceAvailableAsFlow functions. Refer to Figure B.16 for a screen capture of the RPL for the ComputeRGConsInflow function." B-105.

{cpm note: unpack}

B.35.2. ComputeAbiquiuRGRelease

"Explanation: This rule computes the preliminary value for the release

of Rio Grande water from Abiquiu Dam. The release is set to bypass inflows with any needed release from storage or adjustment from any potential storage during flood control operations and any potential non-irrigation season release of carryover storage from the irrigation season. The outflow is reduced for any inflow to conservation storage at Abiquiu Reservoir." B-106.

"Rule Logic: The value for the RGOutflow series slot in the AbiquiuData data object for the current timestep is set to the result of the user-defined AbiquiuMinRGOutflow function minus the RioGrandeAbiquiuToRioGrandeConservationAbiquiu.Supply slot value for the current timestep. The AbiquiuMinRGOutflow function computes the minimum outflow equal to the current Rio Grande inflow as determined with the user-defined CurrentRGInflow function plus the value for the Gain Loss for the Rio Grande Account at Abiquiu Reservoir for the previous timestep plus the result from the user-defined AbiquiuRGStorageAdjustment function plus the result from the RGCarryOverRelease function. The predefined Max function is used to restrict the result from this function to a minimum of the value of the MinRGOutflow function." B-107.

B.35.3. ComputeAbiquiuPassthroughToCochitiRecPool

"This rule computes the passthrough at Abiquiu of CochitiRecPool account water being delivered from Heron to Cochiti." B-107.

B.35.4. ComputeMRGCDSJCDeliveryToMiddleRioGrande

"Explanation: This rule computes a delivery of MRGCD San Juan-Chama Project from Abiquiu to meet the MRGCD demand if the storage of Rio Grande water and Emergency Drought water at El Vado Reservoir has dropped below a low threshold storage." B-107.

"Rule Logic: If a value is not input as checked with reference to the predefined IsInput function, the MRGCDSJCDeliveryToMiddleRioGrande series slot in the ComputedDeliveries data object for the current timestep is computed if the previous account storage for the RioGrande and MRGCDDrought accounts at El Vado is less than twice the MRGCD demand at Cochiti. The delivery is computed as the MRGCD demand at Abiquiu identified with reference to the AbiquiuMRGCDDemand function minus the Rio Grande outflow from Abiquiu and minus the sum of all the letter water deliveries from Abiquiu to payback MRGCD. The computed amount is restricted to the available MRGCD storage at Abiquiu Reservoir." B-108.

B.35.5. ComputeNeededSupplementalWaterFromAbiquiu

"Explanation: This rule computes the needed amount of supplemental water for targets as the total amount of water needed minus other deliveries for diversions and as letter water deliveries that will contribute towards the total need for targets." B-108.

"Rule Logic: The value for the NeededSupplementalWaterFromAbiquiu series slot in the MiddleValleyTargets data object for the current timestep is set to the value for the TotalFlowNeededAtAbiquiuForTargets series slot for the current timestep minus the values in the

-AlbuquerqueDeliveryToSurfaceWaterDiversion,

-MRGCDSJCDeliveryToMiddleRioGrandeFromAbiquiu,

-SantaFeCityDeliveryToBuckmanDiversion,

-AlbuquerqueDeliveryAbiquiuToElephantButte, and

-SantaFeCityDeliveryAbiquiuToElephantButte

series slots in the ComputedDeliveries data object for the current timestep. All computed letter water deliveries to payback MRGCD and to payback the Compact are also subtracted. The need for supplemental water is reset to zero if there is Emergency Drought water available for ESA at El Vado or conservation storage at Cochiti or Jemez Reservoir." B-108.

B.35.6. SetNeededSupplementalWaterReleaseFromAbiquiu

"This rule *sets a final value for a needed release of supplemental water from Abiquiu Reservoir. The actual release is not adjusted* UNLESS a specific threshold change in the need is exceeded and the release of supplemental water is not adjusted until after an input minimum of days since the last adjustment. *These calculations are included to better represent actual operations that do not entail adjusting the release each day by a few cfs in attempt to exactly meet a target flow.*" B-108 – B-109.

B.35.7. ComputeAbiquiuRGConservationRelease

"This rule computes a release of available conservation storage at Abiquiu to meet target flows. If the current timestep is within the period to make a release from conservation storage at Abiquiu, available conservation storage is released as the maximum of the amount needed for targets or an average flow to evacuate the water over an input delivery period." B-109.

B.35.8. ComputeAbiquiuReleaseOfReclamationLeasedWater

"This rule computes a release of leased San Juan-Chama Project water from Abiquiu Reservoir for targets based on the computed need for supplemental water minus any potential contribution from conservation storage releases." B-110.

B.35.9. ComputeAbiquiuSJRelease

"A total outflow of San Juan-Chama Project water from Abiquiu Reservoir is computed as a sum of all the computed individual deliveries." B-110.

B.36.0 Abiquiu

[See Within]

"The rules in this policy group are *used to determine the total outflow from Abiquiu Dam* **with consideration for**[:] -minimum flows,

-pre-evacuation releases,

-stepped release restrictions,

-downstream channel capacity restrictions,

-prescribed maintenance flows, and

-flood control operations."

B-111.

B.36.1. AbiquiuLockedIn

[Abiquiu Dam and Reservoir, Rio Chama, New Mexico, Water Control Manual, 1995, Section 7-05 "Flood Control"]

"This rule is used to set a trigger indicating that storage during flood control operations should be locked in as carryover storage at Abiquiu Reservoir until after the irrigation season per flood control operations. Between July and October, if the storage is greater than the input minimum storage for carryover and the flow at Embudo plus the local inflows above Abiquiu Reservoir are less than an input flow to lock in water as carryover storage, the trigger is set. The water is then released during the non-irrigation season. This rule effectively assures any water stored during flood control operations is delivered to Elephant Butte for the Compact if the flows subsequently decrease to where it would otherwise be diverted in the Middle Valley." B-111.

B.36.2. Abiquiu Outflow

[Abiquiu Dam and Reservoir, Rio Chama, New Mexico, Water Control Manual, 1995, Table 7-1 "Normal Regulation Schedule"]

"Unless a total outflow for Abiquiu Dam has been input for the current timestep, the value for the *outflow is set to the determined Rio Grande release plus the release of San Juan-Chama Project water*. The resulting total release is *checked to see if it is physically legitimate based on the outlet works*, and if not, the release is reset to reflect the restriction of the outlet works. Note that a **minimum flow for the Rio Chama acequias** is *set at El Vado Dam and would be bypassed at Abiquiu Dam*. Separate minimum flows are also set by the user for Abiquiu Dam." B-113.

B.36.3. AbiquiuPreEvacuation

[Abiquiu Dam and Reservoir, Rio Chama, New Mexico, Water Control Manual, 1995 7-15.c "Planned Deviation"]

"If water needs to be pre-evacuated at Abiquiu Reservoir in anticipation of forecasted inflows, the outflow from Abiquiu Dam is reset based on a computed pre-evacuation flow which includes consideration for the downstream channel capacity and stepped release restrictions. **It is very rare that criteria would be satisfied for such a pre-evacuation operation.** {Note:FLEX?}

"If water is pre-evacuated from Abiquiu Dam, the Rio Grande account storage may go negative, signifying a debt by the Rio Grande account to all other accounts at the reservoir. That debt is effectively paid back as Rio Grande water is recaptured after the pre-evacuation operation." B-113 – B-114.

See also Figure B.17. Flow Chart with Logic for Setting Abiquiu Preevacuation Releases (B-115).

B.36.4. AbiquiuSteppedRelease

"Per flood control operations, *the total outflow from Abiquiu Dam may be reset if the release needs to be stepped*. This rule determines whether a stepped release is required, and if so, computes the release based on a stepped release approach. The rule references a switch that may be set by the model user to prevent stepped release policy from causing the Rio Grande account storage to go negative.

Rio Grande storage may go negative if there is not enough native water in storage to maintain higher releases for a step down in releases. For such cases, the negative Rio Grande storage effectively represents a debt by the Rio Grande account to all other accounts that is paid back when native Rio Grande storage is recaptured after stepped releases over." B-115.

B.36.5. AbiquiuChannelCapacityRestrictions

[Abiquiu Dam and Reservoir, Rio Chama, New Mexico, Water Control Manual, 1995, Table 7-1 "Normal Regulation Schedule]

"This rule resets the outflow from Abiquiu Dam if necessary maintain a downstream flow that is less than the downstream channel capacity restrictions below the dam (1800 cfs), at Chamita (3000 cfs), and at Otowi (10,000 cfs) with consideration for downstream local inflows." B-116.

B.36.6. AbiquiuTemporaryFlowsForMaintenance

[Abiquiu Dam and Reservoir, Rio Chama, New Mexico, Water Control Manual, 1995, Section 7-15.b "Unplanned Minor Deviations]

"This rule resets the outflow from Abiquiu Dam to the input maintenance flow if the maintenance switch is set." B-117. {cpm note: what are 'temporary maintenance flows'?}

B.36.7. AbiquiuFloodControl

[Abiquiu Dam and Reservoir, Rio Chama, New Mexico, Water Control Manual, 1995, Section 7-15.a "Emergencies"]

"If there is an unregulated spill, per flood control operations, this rule resets the outflow from Abiquiu Dam to either the downstream channel capacity or the unregulated spill if it is higher." B-117.

B.36.8. AbiquiuRGCarryOver

[Abiquiu Dam and Reservoir, Rio Chama, New Mexico, Water Control Manual, 1995, Section 7-05 "Flood Control"]

"Explanation: This rule *records the value for any release of carryover storage* (during the period from November through March) and updates the recorded value for the carrover storage remaining Carryover storage results from storage during flood control operations that is not evacuated before flows decrease below a set threshold." B-118.

"Rule Logic: The rule includes an IF THEN ELSE statement to see if the current timestep is January 1 and if the result from the user-defined **IsRGConservationAllowed** function is TRUE. If not, the value for the RGCarryOverRelease time series slot in the AbiquiuData data object for the current timestep is set to the result from the user-defined RGCarryOverRelease function. If so, an interior IF THEN ELSE statement is used to see if the value for the RGCarryOverLeft time series slot in the AbiquiuData data object for the previous timestep is greater than the result from the user-defined ComputeAbiquiuRGConsInflow function converted to a volume using the predefined FlowToVolume function. If so, the value for the RGCarryOverRelease time series slot for the current timestep is set to the result from the user-defined RGCarryOverRelease function. If not, the value for the RGCarryOverRelease slot is set to 0.0 cfs.

This rule includes an additional assignment statement to set the value for the RGCarryOverLeft time series slot in the AbiquiuData data object for the current timestep to the result from the user-defined RGCarryOverLeft function." B-118.

B.37.0 SetAbiquiuAccountingSupplies

"The rules in this policy group are used to set the accounting supplies for the release from

-conservation storage,

-the Rio Grande outflow, and

-releases of San Juan-Chama Project water

from Abiquiu Reservoir." B-118.

B.37.1. SetAbiquiuRioGrandeAccountingSupply

"This rule sets the accounting supplies for the outflows from the Rio Grande and Rio Grande Conservation accounts at Abiquiu Reservoir." B-119.

B.37.2. CheckAbiquiuRGOutflow

"Aborts the simulation if the accounting supply for the release of Rio Grande water from the account at Abiquiu Reservoir w

as not set. This rule helps with debugging because a simulation will stop if the Rio Grande supply was not set and the problem and any missing input can be identified by backtracking in the calculations from the point in the simulation that the run aborted. NOTE THAT the problem is likely not directly related to the computation of the Rio Grande outflow but most likely due to some earlier aspect of the rules solution. This rule just forces the run to go ahead and stop, so the problem can be fixed." B-119.

B.37.3. SetAbiquiuSJCAccountingSupplies

"This rule sets all the accounting supplies for deliveries of San Juan-Chama Project water from Abiquiu Reservoir." B-120.

B.37.4. SetTransfersAtElephantButteForDeliveriesViaCombinedAccount

"For Albuquerque and Santa Fe City water that may have been delivered from Abiquiu Reservoir to Elephant Butte, the water is conveyed through a single thread of passthrough accounts through the Middle Rio Grande portion of URGWOM. The water is then transferred back to the contractor's storage account at Elephant Butte using this rule. The transfer is set to the release minus San Juan-Chama losses between Abiquiu Dam and Elephant Butte Reservoir." B-120.

B.38.0 CochitiAndJemezDeliveries

"The rules in this policy group are used to

-determine whether storage at Cochiti Lake and Jemez Reservoir should be locked in as carryover storage per flood control operations,

-compute potential inflows to conservation storage, and

-compute the Rio Grande and San Juan releases from each reservoir."

B.38.1. Cochiti and Jemez LockedIn

"This rule is used to set a trigger indicating that storage should be locked in at Cochiti Lake as carryover storage until after the irrigation season per flood control operations. The trigger is also set for Jemez in this rule to zero if not input." B-121.

B.38.2. SetCochitiRGConservationAccountInflow

[See Within]

"Explanation: This rule sets the accounting supply to transfer Rio Grande inflows to Cochiti Lake to conservation storage based on the defined space available for storage for **deviations operations**. Conservation storage may occur based on an input value for available space or a computed value as part of Cochiti Deviations policy. Note that conservation space for both reasons can be modeled." B-121 – B-122.

"Rule Logic: The RioGrandeCochitiToRioGrandeConservationCochiti.Supply slot value for the current timestep is set with an IF THEN ELSE statement. If the value in the FullTimeRGConservationSpaceAvailableNotRelevantToDeviations table slot in the CochitiData data object is greater than zero or the value in the ComputedRGConservationSpaceAvailable slot for the current timestep is greater than zero and the current timestep is within the period for deviations storage, the value is set as the minimum of the result from the user-defined ComputeRGConsInflow function and the maximum inflow input to the MaxRGConservationInflow table slot in the AbiquiuData data object as identified with the user-defined MaxRGConservationInflow function. Within the ComputeRGConsInflow function, an IF THEN ELSE statement is used to check whether an inflow to conservation storage should be computed with the IsRGConservationAllowed function. If not, the function result is 0.0 cfs. If so, the inflow available for conservation storage is computed as the available native inflow determined with the user-defined RioGrandeInflowWithPreviousRGGainLoss function plus the value in the Incidental Content slot for the corresponding reservoir object at the previous timestep or any storage adjustment and determined carryover release amount for the reservoir minus a minimum reservoir outflow determined with the user-defined MinimumRioGrandeOutflowBeforeTransferToConservationStorage function which assures Middle Valley demands are met. The resulting inflow to conservation storage is restricted to the available space determined as the minimum of the results from the user-defined EasementSpaceAvailableAsFlow and RGConsSpaceAvailableAsFlow functions." B-122.

B.38.3. TallyCochitiRGConservationStorageInArticleVII

"This rule sets a slot to track the amount of water stored as conservation storage at Cochiti Lake while Article VII is in effect. This may happen during Cochiti deviations where any unused amount stored while in Article VII must be evacuated while other water stored during deviations may be retained if conservation space is still established after the deviations policy." B-122.

See also: Figure B.18. Rule Policy Language for the TallyCochitiConservationStorageInArticleVII Rule ("This tally of the inflow to conservation storage while **Art. VII** is in effect is used to assure that water is evacuated if stored for Cochiti Deviations but not needed. Other water stored while Article VII is NOT in effect during Deviations may be retained if conservation space has been allocated in the model run." B-123.

B.38.4. ComputeCochitiRGRelease

"This rule computes the preliminary value for the release of Rio Grande water at Cochiti Dam. The release is set to bypass inflows with any needed release from storage or adjustment from any potential storage during flood control operations and any potential non-irrigation season release of carrover storage from the irrigation season." B-123.

B.38.5. ComputeCochitiRGConservationRelease

"This rule computes a release of native Rio Grande water in conservation storage at Cochiti Lake from Cochiti Deviations or based on an input amount of conservation storage space.

"For Deviations, releases are set to provide recruitment or overbank flows depending on which operation is targeted based on established criteria. Releases are set to provide a peak release at the same time as the peak inflow.

"Releases may also be set to assure water is evacuated from conservation storage by the end of an input Deviations period.

"Any water that may be stored based on an input amount of conservation storage space will be released as needed for targets before water from upstream sources is used (e.g. Emergency Drought water for ESA or Reclamation leased San Juan-Chama Project water).

"Water stored for Deviations not needed for targets is evacuated at the end of the deviations period down to an input amount of regular conservation space or if it was stored while **Article VII** was in effect." B-124.

B.38.6. SetJemezSJRelease

"The San Juan release from Jemez Canyon Dam is set to zero." B-125.

B.38.7. SetJemezRGConservationAccountInflow

"This rule sets an inflow to Rio Grande conservation storage at Jemez if conservation space has been set and inflows are available for conservation storage." B-125.

B.38.8. SetJemezRGRelease

"This rule computes an initial value for the release of Rio Grande water at Jemez Canyon Dam as the sum of the inflow to the reservoir plus the amount of water in the Rio Grande storage account at Jemez Reservoir. If the amount of water in the storage account is negative, the outflow is set to the inflow multiplied by an input percentage such that the Rio Grande storage will return toward zero. The bypassed inflow is reduced for any transfer to conservation storage at Jemez Reservoir. The reference to storage includes consideration for modeled sedimentation." B-126.

B.38.9. ComputeJemezRGConservationRelease

"This rule computes a release of available conservation storage at Jemez to meet target flows. If the current timestep is within the period to make a release from conservation storage at Jemez, available conservation storage is released as the maximum of the amount needed for targets or an average flow to evacuate the water over an input delivery period. Note that the release of any available conservation storage for targets is not implemented until the conservation storage at Cochiti is used." B-127.

B.38.10. ComputeCochitiSJCPassthroughsToMRG

"This rule computes the passthroughs at Cochiti Lake for San Juan-Chama Project water being delivered to

-the Albuquerque surface water diversion,

-MRGCD diversions,

-Reclamation leased San Juan-Chama Project water for targets, OR

-contractor deliveries to Elephant Butte."

B-127.

B.38.11. ComputeCochitiSJRelease

"This rule computes an initial value for the release of San Juan-Chama Project water from Cochiti Dam which is essentially a passthrough of all San Juan-Chama Project water except for Cochiti rec pool water." B-128.

B.39.0 CochitiAndJemezDeliveries [sic; CochitiAndJemez]

[See within, Cochiti Lake Water Control Manual]

"The rules in this policy group are used to determine the total outflow from Cochiti Dam and Jemez Canyon Dam **with consideration for**

-downstream target flows,

-downstream channel capacities,

-stepped release restrictions, and

-flood control operations.

"Policy for balanced operations between Cochiti Dam and Jemez Canyon Dam for flood control operations is also checked." B-128.

B.39.1. Cochiti Outflow

"UNLESS a total outflow for Cochiti Dam has been input for the current timestep, the value is set to bypass all inflows minus any potential transfers to conservation storage and not including water being delivered to the Cochiti Rec Pool and with any needed adjustment for incidental content and any winter release of carryover storage added." B-128.

B.39.2. JemezOutflow

"UNLESS a total outflow for Jemez Canyon Dam has been input for the current timestep, the value is set to the sum of the predetermined Rio Grande and San Juan-Chama outflows and including any release from conservation storage. T*he resulting total release is checked to see if it is physically legitimate based on the outlet works*, and if not, the release is reset to reflect the restriction for the given outlet works." B-129.

B.39.3. CentralChannelCapacityRule

"This rule uses hypothetical simulation to determine the release from Cochiti Dam to meet the input channel capacity at Central." B-130.

B.39.4. SanMarcialChannelCapacityRule

"This rule uses hypothetical simulation to determine the release from Cochiti Dam to meet the input channel capacity at San Marcial or the maximum computed inflow to Elephant Butte to prevent an Elephant Butte release greater than the channel capacity below Elephant Butte." B-130 – B-131.

B.39.5. JemezSanMarcialChannelCapacity

"This rule simply sets the value for the MaxReleaseForSanMarcialChannelCap time series slot in the JemezData data object for the current timestep equal to the value in the MaxReleaseForSanMarcialChannelCap time series slot in the CochitiData data object for the current timestep." B-131.

B.39.6. CochitiChannelCapacityRestrictions

"This rule resets the outflow from Cochiti Dam and Jemez Canyon Dam to comply with the downstream channel capacities at Central and San Marcial if necessary. An indicator slot value is also set to identify for the model user which downstream channel capacity is controlling the release: 1 – Central, 2 – San Marcial, 3 – below Elephant Butte." B-131 – B-132.

B.39.7. CochitiSteppedRelease

"The outflow from Cochiti Dam may be reset to assure increasing or decreasing releases are stepped if needed. This rule determines whether stepped releases are required, and if so, computes the release for Cochiti. The rule references a switch that may be set by the model user to prevent stepped release policy from causing the Rio Grande account storage to go negative. Rio Grande storage may go negative if there is not enough native water in storage to maintain higher releases for a step down in releases. For such cases, the negative Rio Grande storage effectively represents a debt by the Rio Grande account to all other accounts that is paid back when native Rio Grande storage is recaptured after stepped releases over." b-133.

B.39.8. JemezSteppedRelease

"The outflow from Jemez Canyon Dam may be reset to assure increasing or decreasing releases are stepped if needed. This rule determines whether stepped releases are required, and if so, computes the release for Jemez. The rule references a switch that may be set by the model user to prevent stepped release policy from causing the Rio Grande account storage to go negative. Rio Grande storage may go negative if there is not enough native water in storage to maintain higher releases for a step down in releases. For such cases, the negative Rio Grande storage effectively represents a debt by the Rio Grande account to all other accounts that is paid back when native Rio Grande storage is recaptured after stepped releases over." B-134.

B.39.9. CochitiWCMBalancedRelease

[Cochiti Lake Water Control Manual 7-05.a.4, 1996]

"Explanation: This rule resets the outflow from Cochiti Dam and Jemez Canyon Dam as necessary to balance operations and the available flood storage space at each reservoir as stipulated in the water control manuals for each dam.

"Rule Logic: If the execution constraints are satisfied, two assignments are completed with this rule. The value for the Outflow time series slot in the Cochiti storage reservoir object is set to the result from the user-defined CochitiBalancedOperation function. Within this function, an IF

THEN ELSE statement is used to see if the result from the user-defined CochitiJemezStorageDifferentialRatio function is less than zero. The result from this function is the ratio of the currently available flood storage space to the total available flood storage space at Cochiti Lake minus the ratio of the currently available flood storage space to the total available flood storage space at Jemez Reservoir. So, if that value is less than zero (the ratio at Cochiti Lake is less than the ratio at Jemez Reservoir), the outflow is increased using that ratio. Otherwise, the outflow is decreased based on the adjustment made to the release from Jemez Canyon Dam. For the second assignment, the user-defined JemezBalanceOperation function is used to set the value for the Outflow time series slot in the Jemez storage reservoir object. The same ratio is checked again, and the outflow is adjusted similarly.

"For both of the previous assignments, the result for the Outflow is checked against the physical restrictions of the outlet works for the corresponding dam using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1). Refer to Figures B.19 through A.21 for flowcharts that depict the logic used for balanced operations." B-135.

See especially Figure B.19. Flow Chart with Logic for Setting Cochiti and Jemez **Balanced Operations**, B-136 and Figure B.20. Flow Chart for Setting Jemez Flow for Channel Capacity – **Balanced Ops**, B0127.

B.39.10. CochitiFloodControl

[Cochiti Lake Water Control Manual 7-05.a.2&3, 1996]

"Explanation: If there is an unregulated spill, per flood control operations, this rule resets the outflow from Cochiti Dam to match the channel capacity at Central **if necessary and as possible** while maintaining the unregulated spill portion of the outflow." B-138.

"Rule Logic: If the execution constraints are satisfied, the value for the Outflow time series slot in the Cochiti storage reservoir object for the current timestep is reset to the result from the CochitiFCOutflow function. This function includes an IF THEN ELSE statement to see if the value for the Unregulated Spill time series slot in the Cochiti storage reservoir object for the current timestep is less than the channel capacity at Cochiti as input in the ChannelCapacities table slot in the CochitiData data object and referenced with the user -defined ChannelCapacity function. If not, the function result is set equal to the value in the Outflow time series slot in the Cochiti storage reservoir object for the current timestep (i.e. the outflow is not changed). If so, the function result is then computed using the user-defined CochitiFlowToMatchCentralChannelCapacity function.

"The CochitiFlowToMatchCentralChannelCapacity function computes the outflow to match the input channel capacity, if necessary, based on the value in the Gage Inflow time series slot in the Central stream gage object for the current timestep. An exterior IF THEN ELSE statement is used to see if the value in the Gage Inflow time series slot is greater than the channel capacity. If not, the outflow at the current timestep is adjusted based on that difference to match the channel capacity. If so, a second IF THEN ELSE statement is used to see if the computed release to match the channel capacity is less than zero as identified with the user-defined IsReleaseToMatchChannelCapacity<0 function. If so, the release is set to the value input to the Minimum column in the ChannelCapacities table slot in the CochitiData data object as referenced using the user-defined ChannelCapacity function. Otherwise, a third IF THEN ELSE statement is used to see if the computed release to match the channel capacity is greater than zero as identified with the IsReleaseToMatchChannelCapacity>0 function. If so, the outflow is set to the Outflow time series slot in the Cochiti storage reservoir object for the current timestep (i.e. the outflow is not changed). The last IF THEN ELSE statement identifies whether the outflow from just Jemez Canyon Dam to match the target is less than zero, and then the outflow from Cochiti Dam is adjusted accordingly.

"Within the rule, the result is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1)." B-138 – B-139.

B.39.11. CochitiRGCarryOver

"This rule sets a value for the release of carry over storage and sets the remaining carry over content. Flood water may be carried over until after the irrigation season. This rule computes the subsequent release and remaining carry over storage." B-139.

"Rule Logic: The value for the RGCarryOverRelease time series slot in the CochitiData data object for the current timestep is set to the result from the user-defined RGCarryOverRelease function. This function includes an exterior IF THEN ELSE statement to see if it is the carry over release season (November through March) as determined using the user-defined FloodCarryOverReleaseSeason function and if the value for the Storage in the Rio Grande account is greater than zero and if the value for the Locked In time series slot in the Cochiti storage reservoir object is equal to zero. If not, the carry over release is set to 0.0 cfs. If so, a second IF THEN ELSE statement is used to see if the result from the user-defined IfRGCarryOverRelease function is true. This function checks to see if the value for the RGCarryOverLeft time series slot in the CochitiData data object is greater than zero or the value for the Storage in the Rio Grande account at Cochiti Lake is greater than the value in the MinRGCarryOverStorage table slot in the CochitiData data object or the value in the Carryover Content time series slot in the Cochiti storage reservoir object for October 31 of the current year is greater than zero. If not, the carry over release is set to 0.0 cfs. If so, the carry over release is set to the value in the RGCarryOverRelease time series slot in the CochitiData data object for the current timestep unless it is a NaN. Then, the value is set to the result from the user-defined ConstantRGCarryOverRelease function.

"The rule includes a second assignment statement to set the value for the RGCarryOverLeft time series slot in the CochitiData data object for the current timestep to the result from the user-defined RGCarryOverLeft function. Within this function, an exterior IF THEN ELSE statement is used to see if the results from the RGCarryOverIsNaNBoolean function and the user-defined ConstantCOReleaseBoolean function are true. The former checks to see if the result from the FloodCarryOverReleaseSeason function is true and if the Storage in the Rio Grande account at the previous timestep is greater than zero and if the result from the IfRGCarryOverRelease function is true and if the value for the RGCarryOverRelease time series slot in the CochitiData data object for the current timestep is a NaN. The latter checks some of the same criteria and also to see if the value for the Locked In time series slot in the Abiquiu level power reservoir object is equal to 0.0. If those criteria are satisfied, a second IF THEN ELSE statement checks again to see if the Storage in the Rio Grande account at the previous timestep is greater than zero. If not, the function result is 0.0 acre-ft. A third IF THEN ELSE statement is then used to see if the value for the RGCarryOverLeft time series slot in the CochitiData data object for the previous timestep is greater than zero. If not, the carry over left is set to the previous Storage in the Rio Grande account minus the volume of the RGCarryOverRelease. A fourth IF THEN ELSE statement is used to see if the result from the user-defined IsRGConservationAllowed function is true. If not, the carry over left is the value in the RGCarryOverLeft time series slot in the CochitiData data object for the previous timestep minus the RGCarryOverRelease. If so, the result is the value for the RGCarryOverLeft minus the result from the user-defined ComputeAbiquiuRGConsInflow function minus the RGCarryOverRelease. If the exterior IF THEN ELSE is NOT satisfied, a second IF THEN ELSE statement is used to see if the results from the RGCarryOverNOTNaNBoolean function and the ConstantCOReleaseBoolean functions are true. If so, the Storage in the Rio Grande account is checked again to see if it is greater than zero and then, the result is the previous Storage in the Rio Grande account minus the RGCarryOverRelease. If not, an IF THEN ELSE statement is used to see if the value for the RGCarryOverRelease is a NaN. If so, the result from the user-defined ComputeIsNaNRGCarryOverLeft function is checked to see if it is less than or equal to zero or the RGCarryOverRelease is equal to zero. If so, the result is 0.0 acre-ft. If not, the function result is the result from the user-defined ComputeIsNaNRGCarryOverLeft function. Otherwise, a last IF THEN ELSE statement is used to see if the ComputeNOTIsNaNRGCarryOverLeft function is less than or equal to zero or the RGCarryOverRelease is greater than or equal to the Storage in the Rio Grande account. If so, the result is 0.0 acre-ft. If not, the carry over left is set to the result from the user-defined ComputeNOTIsNaNRGCarryOverLeft function." B-139 – B-141.

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