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Rio Grande Basin Study, NGO Sectoral Committee

Environmental Flow Hypotheses Process

Paul Tashjian, Mark Briggs, Tricia Snyder, Enrique Prunes, Brian Richter and the NGO sectoral Committee

Talk Outline

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Rio Grande in New Mexico Basin Study

Non-governmental Organizations priorities

Environmental Flow Quantification Process

Lessons learned

Many Thanks to the Bureau of Land Management, the Turner Foundation, The Water Foundation and the Thornburg Foundation for generous support!!

Rio Grande Basin Study

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A planning effort to develop climate resilient strategies for the Rio Grande in New Mexico.

WaterSMART project led by the USBOR and MRGCD.

Divided into “sectoral” committees: Agriculture, Community Organizations, Local Governments, NGO, Tribal.

Water needs of all sectors will be modeled and analyzed to help develop strategies for resiliency.

The NGO Sectoral Committee is defining environmental flow needs for the Basin as a primary mission.

Started with an assessment of our values

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Healthy and thriving communities

Environmental/ ecological health

Economic use

Governance/ management

Primary Questions

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"How much water does the river ecosystem need?" in 6 reaches of the Upper Rio Grande in New Mexico.

What are the primary ecologic water deficits? (based on current and projected future conditions)

What activities lessen these deficits?

Within current constraints

Future outside-the-box ideas

Rio Chama Environmental Flow Hypothesis

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ADAPTED ECO-FLOW RECOMMENDATIONS

IDEALIZED RIO CHAMA NON-CONSUMPTIVE FLOW REGIME TO MEET ECOLOGICAL OBJECTIVES

(Annual total flow ~ 400,000 AF)

FLOWS				ECOLOGICAL OBJECTIVES	
Magnitude (cfs)	Recurrence Interva (yrs)	Duration (days)	Season	Canyon ("Wild" Reach)	Lower Reach ("Scenic" Reach, or Monastary Reach)
6000*	10	2 (peak)	Spring	Redistribution of tributary debris-flow sediments	Floodplain and low terrace inundation
(63,000 AF)		(21 total)	(April-June)	Mobilization of bed and bank material	Accelerate lateral migration and point-bar formation in alluvial reaches
				New bar formation and fossilized bar dissection	Creation of off-channel habitat for amphibian and avian species
				Inundation of limited floodplain segments	Recruitment of large woody debris
4000	5	2 (peak)	Spring	Redistribution of tributary debris flow sediments	Floodplain inundation
(30,000AF)		21 (total)	(April-June)	Mobilization of bed and bank material	Accelerate lateral migration and point bar formation in alluvial reaches
				New bar formation and fossilized bar dissection	Riparian plant recruitment
				Creation of fish spawning habitat	Maintenance of off-channel habitat for amphibian and avian species
				Inundation of limited floodplain segments	Recruitment of large woody debris
2500**	2	2 (peak)	Spring	Bed material mobilization & gravel flushing	Bed material mobilization and gravel flushing
(18,000 AF)		21 (total)	(April-June)	Maintenance of in-channel habitats	Riparian vegetation maintenance
700-1000***	na	3/event	Summer	Monsoon-season riffle flushing for macro-invertebrates	Monsoon season riffle flushing for macro-invertebrates
			(May-Oct)		
150****	na	60-90	Fall	Spawning redd inundation	In-channel habitat maintenance
			(Oct-Dec)		
100	na	90	Winter	Redd maintenance	In-channel habitat maintenance
			(Jan-March)	Pool habitat for fish over-wintering	Pool habitat for fish over-wintering

Environmental Flow Hypotheses Process

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Based on structure of Rio Chama e-flow hypothesis.
Hypotheses tied to USGS gage within reach.

Utilize all available resources: hydrologic information, geomorphic information, ecologic information, expert opinions and recreational observations.

Sectoral Committee 6 reach teams develop initial hypotheses (summer 2023- spring 2024).
Compile citations and Identify uncertainties.

Mark Briggs (contractor/ hydrologist) is compiling hypotheses and citations and placing into a draft report (June 2024)

Peer review workshop (summer 2024).
Draft document circulated for comments to attendees, species experts and reach.

E-flow document finalized: early fall of 2024.

Implementation: Testing strategies to fill environmental flow gaps.

6 Reaches and Index Gages

Chama Headwaters: La Puente Gage

Chama Below El Vado: Below El Vado Gage

Chama Below Abiquiu: Below Abiquiu Gage

Rio Grande CO Stateline to Chama Confluence: Taos Junction Bridge Gage

Rio Grande Chama confluence to Cochiti Reservoir: Otowi Gage

Middle Rio Grande: Albuquerque Gage, San Acacia Floodway Gage

Indicator Species that represent key parts of the native hydrogaph

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Study Reach	Indicator Species
Questa to Velarde	Brown Trout, Cottonwood, Southwestern Willow Flycatcher, River Otter, American Dipper
Chama Headwaters	Cottonwood, Stonefly, Brown Trout
Chama below El Vado to Abiquiu	Cottonwood, Stonefly, Brown Trout
Chama – Abiquiu to confluence	SWFL, Stonefly, Brown Trout, Cottonwood
White Rock Canyon	Summer Tanager, Rio Grande Chub/ Rio Grande Sucker, River Otter, Coyote Willow
Middle Rio Grande	Rio Grande Silvery Minnow, Cottonwood, Southwestern Willow Flycatcher, Sandhill Crane

MRG: Indicator Species and Hydrograph

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Cottonwood

Large spring pulse/ disturbance event: recurrence?

Low flows for survival/ charging shallow groundwater

Rio Grande Silvery Minnow

Spring pulse; medium and low, at least every 2 and 5 years

Low flows for survival

Southwestern Willow Flycatcher

Spring pulse for wet floodplain soils

Low flows

Sandhill Crane

Fall and winter low flows for roost habitat- not too high

Flow Target Minimal Magnitude (cfs) Albuquerque Gage	recurrence	Minimum Duration of Flow Target (days)	Season/ timing	Ecologic Objectives (include all supporting citations, interviews etc.) Indicator species: Cottonwood, RGSM, SWFL, wetland species	Evidence of Transformation	Potential opportunities and limitations to implement environmental flow hypothesis
7,000 to 12,000 cfs Occasional high volume disturbance	15-20 yr recurrence Need to tie down	10 days at or above peak; recessional tail of 500 cfs/ day Use BEMP numbers for	April 15- June 15	Regeneration of cottonwood (BEMP; Bhattacharjee et al 2006) Breakdown of organic material on floodplain RGSM spawn SWFL moist soils	Dying, older cottonwood trees; no younger recruits on floodplain; mistletoe infestation October RGSM population numbers are below a threshold.	Limitations: Flood control; 2023 maximum flood capacity for MRG = 6000 cfs; Los Lunas levees. Opportunities: High flow impact could be received
5000 Wet year flow event	5 yr recurrence	5 days at or above peak; recessional tail of 500 cfs/ day	April 15- June 15	Isleta Reach: Inundation of older floodplain allowing for decomposition of organic material; disturbance of bar and island habitat with new recruits	No cottonwood recruitment on bars and islands; October RGSM population numbers are below a threshold.	Opportunity: Use upstream reservoirs to store snow melt run off and re-regulate to improve peak and
2500 Average year flow event	2 yr recurrence	2 days at or above peak; recessional tail of 300 cfs/ day	April 15- June 15	RGSM recruitment, songbird nesting on bars and islands (SWFL etc)	October RGSM population numbers are below a threshold.	Opportunity: Use upstream reservoirs to store snow melt run off and re-regulate to improve peak and
1200 flow event	2 yr recurrence	At least 3 events	July 1- Oct 1	Wetted songbird habitat (insect base), freshening events for RGSM survivability		
200 cfs Minimum base flow		Minimum mean daily flow	Irrigation season low flows (April 1- Sep 30)	shallow riparian aquifer- water for cottonwood, (BEMP numbers) RGSM survival (Dudley and Platania), SWFL wetted soils, wetland plant survivability	RGSM CPUE numbers below threshold Cottonwood: young trees dying on bars and islands; older trees stressed on older	Opportunities: Dynamic leasing programs from agriculture, USBOR SJC water leases Limitations: water supply, drought
300 cfs Minimum base flow not to exceed 1200 cfs Nov 1 through Feb		Minimum mean daily flow	Fall-Winter low flows (Oct 1- March 31)	RGSM survival, migratory bird habitat (crane roosting, duck habitat etc.) Charge the shallow groundwater- riparian health Nov 1 through Feb 28 limit for crane roost habitat		

Middle Rio Grande Reach: Summary of e-flow needs for the Rio Grande Silvery Minnow (*Hybognathus amarus*)

Peak Discharge	Recurrence Interval	Duration and (Timing)	Average Flow and Variance	Reasoning and Source Information
High Spring Pulse Flow (associated with strong propagation)				
6,992 ft^3s^{-1} (198 m^3s^{-1})	tbd	10 days (May – June)	$\mu =$ $\sigma^2 =$	Discharge capable of inundating significant floodplain habitat, which is critical for strong spawning response (Magaña 2012)
Medium Spring Pulse Flow (associated with intermediate propagation)				
5910 ft^3s^{-1} (134 m^3s^{-1})	tbd	10 days (May – June)	$\mu =$ $\sigma^2 =$	Discharge mid-way between May 24, 2005 peak discharge (per Magaña 2012) and discharge needed to begin inundating floodplain habitat (per Slaugh 2003).
Low Spring Pulse Flow (associated with weak propagation)				
2470 ft^3s^{-1} (134 m^3s^{-1})	tbd	10 days (May – June)	$\mu =$ $\sigma^2 =$	Flow identified by Slaugh (2003) as minimum needed to inundate floodplain habitat near Las Lunas[1]
Monsoon Flush Flow				
Not Well Understood	Not Well Understood	Not Well Understood	Not Well Understood	Not Well Understood
Spring-Summer Low Flow				
240ft^3s^{-1} (4.2 m^3s^{-1})	Minimum flow	183 days (April 1 – Sept 30)	$\mu = 250\ ft^3s^{-1}\ (7.1\ m^3s^{-1})$ $\sigma^2 =$	Based on median flow for RGSM monitoring years (2010-2020) w lowest minnow numbers during monitoring period (Best and Bullard 2020)
Fall-Winter Low Flow				
400ft^3s^{-1} (2.5 m^3s^{-1})	Minimum flow	182 days (Oct 1 – Mar 31)	$\mu = 80\ ft^3s^{-1}\ (2.3\ m^3s^{-1})$ $\sigma^2 =$	Based on lowest flow during RGSM monitoring period 2010-2020 that sustained the minnow (Best and Bullard 2020)

Middle Rio Grande Reach: Summary of e-flow needs for the Rio Grande Cottonwoo (*Populus deltoides* ssp. *wislizeni*))

Peak Discharge	Recurrence Interval	Duration and (Timing)	Average Flow and Variance	Reasoning and Source Information
High Spring Pulse Flow (associated with strong propagation)				
9850ft^{3}s^{-1}	~ 15 year	One week (May 21-June 10)	μ = σ^2 =	Based on riparian ecology and geomorphology expert assessment of disturbance magnitude for cottonwood recruitment in the Middle Rio Grande.
Medium Spring Pulse Flow (associated with intermediate propagation)				
3,630 ft^{3}s^{-1} (m^{3}s^{-1})	5 year	One week (May 21-June 10)	μ = σ^2 =	Discharge that occurred during height of cottonwood seed fall in 2016 that produced strong cottonwood recruitment
Low Spring Pulse Flow (associated with weak propagation)				
2,470 ft^{3}s^{-1} (70 m^{3}s^{-1})	2 year	One week (May 21-June 10)	μ = σ^2 =	Flow identified by Slaugh (2003) as minimum needed to inundate floodplain habitat near Las Lunas
Monsoon Flush Flow				
Not Well Understood	Not Well Understood	Not Well Understood	Not Well Understood	Not Well Understood
Spring-Summer Low Flow				
240ft^{3}s^{-1} (7.2 m^{3}s^{-1})	Minimum flow	183 days (April 1 – Sept 30)	μ = σ^2 =	Based on median flow for RGSM monitoring years (2010-2020) w lowest minnow numbers during this period (Best and Bullard 2020)
Fall-Winter Low Flow				
350 cfs	Minimum flow	182 days Oct 1- March 31	μ = σ^2 =	Based on riparian ecology and hydrology expert assessment of low flow needs for charging riparian groundwater levels in the Middle Rio Grande

Table X. Synthesis of e-flow prescriptions for Middle Rio Grande Study Reach.

Peak One-Day Discharge	Average 10-Day Dischg Around Peak	Duration and (Timing)	Avg Rate of Recession	Reasoning and Source Information
High Spring Pulse Flow (associated with strong propagation)				
9,850 ft^3sec^{-1} (279 m^3sec^{-1})	9,270 ft^3sec^{-1} (262 m^3sec^{-1})	10 days (May - June)	828 ft^3sec^{-1} per day (23 m^3sec^{-1} per day)	Based on riparian ecology and geomorphology expert assessment of magnitude required to establish multi-age, patchy cw forests on sig portion of MRG bottomland envir.
Medium Spring Pulse Flow (associated with intermediate propagation)				
5,910 ft^3sec^{-1} (167 m^3sec^{-1})	5,330 ft^3sec^{-1} (151 m^3sec^{-1})	10 days (May- June)	470 ft^3sec^{-1} per day (13 m^3sec^{-1} per day)	Discharge that occurred during seven spring flow events in recent period that sparked intermediate cw recruitment (1993-95, 1997, 2005, 2017, 2019, and 2023) that overlap w years of strong RGSM spawning.
Low Spring Pulse Flow (associated with weak propagation)				
2470 ft^3sec^{-1} (57 m^3sec^{-1})	1,655 ft^3sec^{-1} (47 m^3sec^{-1})	10 days (May- June)	140 ft^3sec^{-1} per day (4 m^3sec^{-1} per day)	Discharge that occurred during four spring flow events in recent period that sparked low cw recruitment (1999, 2001, 2008, 2010) that overlap w years of low RGSM spawning.
Monsoon Flush Flow				
-	-	-	-	-
-	**Average Discharge for Entire Period**	**Duration and Timing**	**Minimum Threshold Discharge**	**Reasoning and Source Information**
Spring-Summer Low Flow				
	240 ft^3sec^{-1} (6.8 m^3sec^{-1})	183 days April 1 – Sept 30	170 ft^3sec^{-1} (4.8 m^3sec^{-1})	Based on RGSM monitoring data and expert opinion of average flow needs during spring-summer months
Fall-Winter Low Flow				
-	400 ft^3sec^{-1} (11 m^3sec^{-1})	182 days Oct 1 – March 31	300 ft^3sec^{-1} (8.5 m^3sec^{-1})	Based on RGSM monitoring data and expert opinion of average flow needs during spring-summer months

DRAFT HYPOTHESES

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Reach	Safe channel capacity (cfs)	Spring Mag Rare Distubance flow (cfs) 10-20 year recurrence Apr-May-June	Spring Mag High flow (cfs; 5 year recurrence) April, May June	Spring Mag Average (cfs; 2 year recurrence) Apr-May-June	Monsoon Flush (cfs) 2 year with 3 events	Spring-summer Low Flow (cfs) April 1- Sep 30	Fall-winter Low Flows (cfs) Oct 1- March 31
Chama Headwaters La Puente Gage		6500	5500	3000		50	50
Chama Below ElVado Below El Vado Gage	*6000*	6,000 w/ recessional limb of xx	4,000	2500	700	100	150
Chama Below Abiquiu Below Abiquiu Gage	*1800*						
Rio Grande SL to Chama Taos Junction Bridge Gage		7000	3000	2000		250	500
Rio Grande White Rock Otowi Gage	*5000*	7500	3000	2000	?	350	550
Middle Rio Grande Albuquerque Gage San Acacia Floodway Gage	*5000*	10,000	6000	2500	1200?	250	400

DRAFT HYPOTHESES

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Reach	Safe channel capacity (cfs)	Spring Mag Rare Distubance flow (cfs) 10-20 year Apr-May-June	Spring Mag High flow (cfs; 5 year recurrence) April, May June	Spring Mag Average (cfs; 2 year recurrence) Apr-May-June	Monsoon Flush (cfs) 2 year with 3 events	Spring-summer Low Flow (cfs) April 1- Sep 30	Fall-winter Low Flows (cfs) Oct 1- March 31
Chama Headwaters La Puente Gage							
Chama Below ElVado Below El Vado Gage							
Chama Below Abiquiu Below Abiquiu Gage							
Rio Grande SL to Chama Taos Junction Bridge Gage							
Rio Grande White Rock Otowi Gage							
Middle Rio Grande Albuquerque San Acacia							

Environmental Flow Document

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I.	Study Objectives and Background
II.	Methods
III.	Environmental Flow – A Brief Primer
IV.	The Basin
V.	The River
VI.	The Indicator Species
VII.	The Six Study Reaches
	Each Reach
	Location Climate and Geology
	Surface and Ground Water Conditions, Trends and Management
	Biophysical Changes
	E-Flow Recommendations
	Constraints, opportunities and strategies
VIII.	Constraints, Challenges and Opportunities to E-Flow Recommendations
IX.	Next Steps

A Team Effort

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Steering Committee

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Reach Team Leads

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Expert input

Steve Harris, Dagmar Llewelyn, Mike Harvey, Keith Sauter, Sage Dunn, Shinya Burck, Ed MacKerrow, Cecil Rich, Mickey Porter, Joel Lusk, Kim Eichorst, Rich Wagner, Garret Hanks, Julia Bernal, Tucker Davidson, Aidan Manning, etc (still growing!)

Expert review

The larger Rio Grande expert community including you!

Lessons being learned

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Greatest strength: Team Effort; distribution of expertise. Durability moving forward!

Strength: Funding-for and finding a knowledgeable and skilled author has been essential!

Greatest challenge: Avoiding rabbit holes while trying to be as quantitative as possible.

Challenge: How do we implement adaptive management for flow hypotheses?

Primary concern: Rolling numbers out and addressing sensitivities and misconceptions.

Next Steps

Draft Report out- early June

Will solicit expert-peer review

Workshop in August

Identify data gaps; Focus on constraints and opportunities

Tribal engagement

TNC, NM Wild

Outreach

Testing and implementing strategies: adaptive management framework

THANK YOU!