Planning Against Uncertainty on the Colorado River

Hunter Causey, P.E. Senior Water Resources Engineer



Big Thompson Project Lifts a River Over the Divide, and Makes the River Furnish the Power

Mission Statement: To lead in the protection, conservation, use, and development of the water resources of the Colorado River basin for the welfare of the District, and to safeguard for Colorado all waters of the Colorado River to which the state is entitled



Minding the Source for More Than 80 Years

- Created by the General Assembly in 1937
- Represents water interests of 15 western Colorado counties
- Area encompassing 28% of Colorado
- 80% of the water but only 10% of the population
- Board representation from each county
- Funded through a 0.252 mill levy & water activity enterprise





Minding the source for more than 80 years







1922 Compact









The Colorado River: On Paper



The Colorado River: Actual Use



The Colorado River: Actual Water Availability



Lake Powell: We Have a Long-term Problem







Colorado Has Warmed by 2°F in 30 Years



METDATA/gridMETP(Wetofglo/anon) felocale Water finatch?NOAA NCEI average (https://app.climateengine.org/)

What is Compact Curtailment and How Would it Impact Western Colorado Communities ?





Depletions from the Colorado River Basin





Upper Basin Drought Contingency Planning



CRSP Reservoir Reoperations



Cloud Seeding & Phreatophyte Removal



Demand Management



DCP: Goals and Benefits for the Upper Basin



Non-Equalized Storage Account in Lake Powell, Free of Charge



Decreases Risk of Losing Power Production at Glen Canyon Dam



Increases Ability to Maintain Compact Compliance



Colorado's Demand Management Plan

The Colorado River District is Advocating for:

- Protection of West Slope Communities
- > Must be Voluntary, Temporary and Compensated
- > <u>Water from All Sectors of Water User Community</u>
- Water Pro-rata from East and West Slope
- West Slope Agriculture Cannot be the Sacrifice Zone
- > Consistent with Prior Appropriation System, No Injury to Others
- Conserved Water Must Remain in Upper Basin Control

Agricultural Water Rights Must Remain in Local Ownership
Colorado River District
Protecting Western Colorado Water Since 1937

2019 Snowpack and Runoff







Surface Water Equivalent Rank (period of record)









■ >500%

130-150%

110-130%

100-110%

90-100%

April 4, 2019





Water Supply Forecast







Lake Powell End of Month Elevations Historic and Projected based on March 2019 Modeling







STATE CONSTRUCTION PERMIT UPDATE

COLORADO DISCHARGE PERMIT SYSTEM – GENERAL PERMIT FOR STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITIES COR-400000

Jennifer Keyes, CPESC

Wright Water Engineers, Inc.

jkeyes@wrigthwater.com

April 2019

CDPS GENERAL PERMIT COR-400000

- ► Effective April 1, 2019
- Existing permits will be given new permit certification- no need to reapply
 - Owner and operator will not be co-permittees
 - After April 1, 2019, for newly obtained coverage owner and operator will be co-permittees.
- New permit applications after April 1, 2019 must be submitted via the Colorado Environmental Online Services electronic platform (CEOS)
- CEOS Website <u>https://www.colorado.gov/pacific/cdphe/ceos</u>



https://www.colorado.gov/pacific/cdphe/cor400000-stormwater-discharge



CEOS

Back to air pollution permits | Back to hazardous waste permits | Back to water quality | Back to Tier II

CEOS login

The Colorado Environmental Online Services, CEOS, is the gateway for environmental permitting and finance needs. The platform allows you to manage permits, compliance reports, financing and more, including:

- Submitting an application.
- Monitoring submittal progress.
- Receiving notifications and alerts.
- Updating current requests with revisions as needed.

https://ceos.colorado.gov/CO/CEOS/Public/Client/ CO_CIMPLE/Doc/CEOS_Online_Tutorial.mp4

Pa	ssword
	Login
	Need more help?
	Online Tutorial
	Create a new account
	Forgot your login user name or password?

OWNER AND OPERATOR

Owner - The party that has overall control of the activities and that has funded the implementation of the construction plans and specifications. This is the party with ownership of, a long term lease of, or easements on the property on which the construction activity is occurring (e.g., the developer).

Operator - The party that has operational control over day-to-day activities at a project site which are necessary to ensure compliance with the permit. This party is authorized to direct individuals at a site to carry out activities required by the permit.(e.g. the general contractor)





Source: https://www.financialexpress.com/industry/builders-rush-to-buy-land-in-weak-market/166050/

TYPES OF CHANGES

- Terminology and Definitions
- On-Site Control Practices Effluent Limitations
- SWMP Additional Requirements
- Inspections
- ► Misc.



https://environmentalrecords.colorado.gov/HPRMWebDrawer/RecordView/1260093

GUIDANCE

COR400000 Stormwater Discharge

Back to water quality permits | Back to water construction general permits

The general permit for stormwater discharges associated with construction activity (COR400000) has been issued.

Construction Stormwater Permittees - Welcome to CEOS letter.

COR400000 Active Certifications

Certifications have been issued and are available in the electronic records drawer.

Please use the Colorado Environmental Online Services (CEOS) to apply for new permits, modify or terminate existing permits and change permit contacts.

CEOS Login

CEOS Help Guide <u>(Condensed version)</u>. CEOS Help Guide <u>(Full version)</u>. CEOS Frequently Asked Questions <u>(FAQ)</u>.

Frequently Asked Questions (FAQ) - Renewal Overview

https://www.colorado.gov/pacific/cdphe/cor400000-stormwater-discharge

TERMINOLOGY AND DEFINITIONS

- Best Management Practices (BMPs) changed to Control Measures – broader definition
- SWMP Administrator changed to Qualified Stormwater Manager
- Updated definitions See receiving waters, common plan of development and others





COMMON PLAN OF DEVELOPMENT

From permit –

Contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules, but remain related. The division determined that "contiguous" means construction activities located in close proximity to each other (within a ¼ mile). Construction activities are considered to be "related" if they share the same development plan, builder or contractor, equipment, storage areas, etc.







CONSTRUCTION ACTIVITY

From permit -

Construction does not include routine maintenance to maintain the original line and grade, hydraulic capacity, or original purpose of the facility. Activities to conduct repairs that are not part of routine maintenance or for replacement are construction activities and are not routine maintenance. Repaying activities where underlying and/or surrounding soil is exposed as part of the repaying operation are considered construction activities.






RECEIVING WATERS

From permit -

Any classified or unclassified surface water segment (including tributaries) in the State of Colorado into which stormwater associated with construction activities discharges. This definition includes all water courses, even if they are usually dry, such as borrow ditches, arroyos, and other unnamed waterways.





ON-SITE PRACTICES- EFFLUENT LIMITATIONS

- Minimize amount of soil exposedespecially on steep slopes
- Preserve topsoil unless infeasible
- Minimize soil compaction
- Maintain pre-existing vegetation or equivalent control measures for areas within 50 horizontal feet of receiving waters.



ON-SITE PRACTICES- EFFLUENT LIMITATIONS

- ► Bulk storage (≥55 gal) of fuel and liquid chemicals must have secondary containment
- Control measures for concrete washout waste must be implemented and may not contribute pollutants to stormwater runoff or receiving water and may not be located in an area where shallow groundwater may be present



ON-SITE PRACTICES- EFFLUENT LIMITATIONS

- Stormwater runoff from disturbed areas for which permanent or temporary stabilization has not been implemented must flow through at least one control measure to minimize sediment. This can be accomplished through filtering, settling, or straining.
- Vehicle Tracking Controls must be implemented
- Basins discharging water must withdraw water from or near surface. i.e. skimmer, rise pipe, etc. unless infeasible





EFFLUENT LIMITATIONS - STABILIZATION

- Temporary stabilization methods must be implemented where ground disturbing activities have permanently or temporarily ceased for more than 14 calendar days.
- SWMP needs to document if constraints necessitating an alternative schedule, provide a alternate schedule, and identify areas on the site maps.
- Implement final stabilization within 14 days of ceasing construction activities



SWMP UPDATES

- Methods for determining pre-existing vegetative cover must be explained
- Potential pollutants list has been updated
- Low Risk Discharge Guidance must be described if in use
- Electronic copies of SWMP and inspection records may be kept on site in lieu of hard copies



SWMP UPDATES

Map Updates

- All stream crossings and associated control measures must be described
- Must include flow arrows



INSPECTIONS

- Inspection frequency may be every 7 days or every 14 days with post storm inspections
 - Can petition for alternative schedule
- Inspections must identify inadequate controls versus routine maintenance



INSPECTIONS

<u>Control measure requiring routine maintenance</u> - Any control measure that is still operating in accordance with its design and the requirements of the permit, but requires maintenance to prevent a breach of the control measure



Inadequate control measure – Any control measure that is not designed or implemented in accordance with the requirements of the permit and/or any CM that is not implemented to operate in accordance with its design.



INADEQUATE CONTROL MEASURES



Too much drainage area for the installed control. The sediment control log was inadequate as a stand alone control measure.



Too much sediment is draining to the end of the treatment train.

CONTROL MEASURE NOT INSTALLED PER O DETAIL





CONTROL MEASURE NOT INSTALLED PER O DETAIL

0



• ROUTINE MAINTENANCE







QUALIFIED STORMWATER MANAGER

From permit -

Qualified Stormwater Manager - An individual knowledgeable in the principles and practices of erosion and sediment control and pollution prevention, and with the skills to assess conditions at construction sites that could impact stormwater quality and to assess the effectiveness of stormwater controls implemented to meet the requirements of this permit.



MISCELLANEOUS

- SWMP does not need to be complete for permit application but does need to be complete prior to construction
- Right of entry of state inspectors
- SWMP availability
- Revising the SWMP
- Emergency Activities 14 days after construction



MISCELLANEOUS

The plan must include a documented use agreement between the permittee and the owner or operator of any control measures located outside of the permitted area, that are utilized by the permittee's construction site for compliance with the Construction Stormwater Permit, but not under the direct control of the permittee.



MISCELLANEOUS

- Non-compliance notification
 - Same as previous permit for any discharges that endangering health or environment regardless of cause, unanticipated bypass or upset which exceeds any effluent limitations in the permit there is a required verbal 24 hour report with a follow-up written report within 5 days.
 - New requirement that at least annually a report must document all instances of non-compliance.







CDPHE GUIDANCE

On February 12, 2019, CDPHE posted several guidance documents including:

- Stormwater checklist
- Control measure template
- Inspection Form Guidance
- Comparison form of language from COR-030000 vs COR-400000

https://www.colorado.gov/pacific/cdphe/cor400000-stormwater-discharge

QUESTIONS?

Jennifer Keyes Wright Water Engineers, Inc. 2490 West 26th Avenue, Suite 100A Denver, Colorado 80211 jkeyes@wrightwater.com (303) 480-1700



s sikk

The Evolution of the Stream Management Plan

Holly Loff Executive Director Eagle River Watershed Council Kelly Romero-Heaney Water Resources Manager City of Steamboat Springs







- 1. Why we are creating our Plans
- 2. Our different processes for creating them
- 3. The Outcomes/Deliverables
- 4. Lessons Learned



Eagle River Watershed Council

Eagle River Community Water Plan

Steamboat Springs

Figure 18: Importance of City Services, 2017

Please rate the importance of each of the following services in Steamboat Springs.

	Essential			Ver	tant			
	Drinking water			24	24% 94%			
	Ambulance or emergency medical services			30%	94%			
Importance of	Fire services	66%			27%	93%		
Vomno Divor	Snow removal	56%			36%	92%		
rampa River	Management of the health of the Yampa River	49%		39%		88%		
nealth	Sewer services	46%		41%		87%		
management	Crime prevention	45%		40%		86%		
	Police services	54%		31%		85%		
	Preservation of natural areas/open space		47%		%	84%		
	Overall customer service by Steamboat Springs city employees (police, receptionists, planners, etc.)	27%	5	54%		81%		
	City parks	25%		55%		80%		
Importance of	Land use, planning and zoning 33% 46				% 80%			
Yampa River	Management of recreation activities on the Yampa River	29%	47	7%	76%			
recreation	Street repair	24%	52	%	76%			
management	Storm drainage	22% 53		%		75%		
	Bus or transit services	29%		45%		74%		
	Economic development efforts	22% 50			72%	72%		
	Public information/communication services	19%	.9% 52%		71%			
r	City recreation facilities	21%	47%		68%			
it	Municipal court	21%	46%		68%			
	City recreation programs 19% 44% 63%							
	16%	46%	6	52 %				
	16%	44%	6	0%				
	20%	39%	59	%				
	Street lighting	16%	41%	57	57%			
	Animal control 12% 44% 56% Code enforcement (weeds, signs, buildings, etc.) 15% 39% 54%							

Figure 16: Quality of City Services, 2017

Please rate the quality of each of the following services in Steamboat Springs.

		Ex	cellent			Good				
Fire services	50%			43%			93%			
Sewer services		33%		60%			93%			
- Drinking water		52%			39%					
Ambulance or emergency medical services	49%			Г	42	%	91%			
Bus or transit services	4	42%		49%			90%			
City parks	32%		5	55%						
- Snow removal	46%		6 40%			86%				
City recreation programs	26%			54%	l% 80%					
Street cleaning	19%		6	0 %		7	9%			
Storm drainage	18%		6	1%		7	9%			
Police services	23%	53%		53%		76%				
Crime prevention	23%	53		3%		76%	%			lr
all customer service by Steamboat Springs city employees	20% 54%		4%	6 74%)	
Preservation of natural areas/open space	18%	53%			71%					
Financial support of non-profit organizations	18%	53%			71%				r	
Street lighting	12%		57%			69%				
Municipal court	17% 52%			69%						
City recreation facilities	20%	48%		6	68%		(Juality	of	
Management of recreation activities on the Yampa River	12%		52%		64	%	Ya	mna F	Rive	r
Management of the health of the Yampa River	13%	50%			64	%	ma	nader	mor	nt.
Traffic enforcement	12%	50%			62%		IIIC	inagei	nei	IL.
Public information/communication services	12%	× 46%			58%					
- Animal control	13%	40	%	5	3%					
Code enforcement (weeds, signs, buildings, etc.)	8%	42%		51	.%					
Street repair	8%	43%		50	%					
Economic development efforts	8%	37%		45%						
Land use, planning and zoning	6%	33%	39	%						

all



Yampa River Health Assessment & Streamflow Management Plan

Yampa River

2012 Drought

Photo by John Russell, Steamboat Pilot and Today



Yampa River Health Assessment & Streamflow Management Plan

2016 - 303d Impaired Waterbody List

Yampa Segment 2b (Yampa River from Oak Creek to Elkhead Creek)





- Balance all uses
- Protect river health
- Anticipate changes



Eagle River Community Water Plan

Stream Management





Yampa River Health Assessment & Streamflow Management Plan



Yampa River study reach through Steamboat Springs.

Yampa River Health Assessme Streamflow Management Plan

Develop a long -term strategy for improving health and resiliency of the Yampa River in the face of changing future climatic conditions and water use demands.

Objectives

- Identify target flows to support river health and community needs
- Prioritize actions and projects to achieve measurable progress toward targets
- Outcomes
- Data-driven analysis and recommendations
- Stakeholder and community buy-in
- Actionable implementation plan



Stakeholder Involvement





Friends of the Yampa event



Advisory Committee meeting

River Health Assess(Feht Stream Method)



Assessment Results

Yampa River Stream Health Report Card:

Reach Summaries

	1.15		
4	Α	Reference standard	
	В	Highly functional	
ĺ.	С	Functional	THE THE THE
	D	Functionally impaired	
5 Y 3	F	Nonfunctional	

			Assesssment Reach						
Scale	Variable	Subvariable	1	2	3	4	5		
thed		Total volume	Α	Α	Α	Α	Α		
	Flow	Peak flow	В	Α-	Α	Α	Α		
	regime	Base flow	Α-	Α-	Α-	Α-	Α-		
		Rate of change	В	B+	A-	Α	A-		
	Sodimont	Land sources	Α-	Α-	В	B-	B-		
	seument	Channel sources	Α-	Α-	Α-	Α-	A-		
ters	regime	Continuity	C+	B-	B+	В	В		
Vat		Temperature	D	D	D	D	D		
-	Water quality	Nutrients	C+	В	В	В	В		
		Chemical Condition	В	В	B+	B+	B+		
		Buffer capacity	В	C+	C+	D	C+		
	Landscape	Terrestrial connectivity	B-	В	C-	D	B-		
		Aquatic connectivity	В	B+	C+	С	В		
n	Floodplain	High Frequency	D+	C+	D	D	C+		
	connectivity	Medium Frequency	C-	В	D	D	B-		
oaria	Riparian	Riparian Condition	B-	B-	с	D	B-		
Rip	Condition								
	Organic	Wood	B-	В	В	C	B-		
	material	Detritus	B-	В	В	B-	B-		
		Planform	D	B-	C	D	C+		
	Morphology	Dimension	C	B-	C+	D+	B-		
		Profile	C+	В	C+	C	В		
ε	Stability	Resistance	B-	B-	В	B-	В		
Strea		Equilibrium	C+	B-	В	B-	В		
		Resilience	D+	B-	D-	D	C		
	Physical	Macrohabitat	<u> </u>	C+	C	C	B-		
	structure	Microhabitat	C+	B-	В	B-	В		
	Trophic	Trophic structure	С	B-	C+	С	B-		
Overall River Health			с	B-	C+	С	B-		

Natural flow regime primary driver of Yampa River's goo condition

Undeveloped areas upper watershed contribute to good health in Steamboat reach



Photo credit: Karolina Borkowski



Water Temperature Exceeds State Stand





Loss of Native Riparian Vegetation



Water Temperature Management

≊USGS

USGS 09239500 YAMPA RIVER AT STEAMBOAT SPRINGS, CO




Water Temperature Management



Streamflow and Water Temperature

Key Findings:

- Flow rates needed to prevent exceedances are very high
- Exposing river to abnormally high flows may produce unintended consequences
- Channel modifications unlikely to alter water temperatures
- Small releases that keep flows above 100 cfs appear somewhat effective
- Increasing river shading can make water management activities more effective



Simulated Water Temperature on Yampa River above Wastewater Treatment Plant Outfall

Water Temperature Management





What will it take to preserve and restore the health of the Yampa River?



Child Labor





ReTree - Yampa River Riparian Revegetation Program







Streamflow and Water Temperature





Available Tools

- Water Right Sale
- Water Right Donation
- Long-Term Lease
- Short-Term Lease
- Water Conservation Programs
- Structural
- Alternative Use Solutions (split-season uses)
- Creative Combinations

Yampa River Water Fund

Yampa River Health Assessment & Streamflow Management Plan

The Nature Conservancy









Project management and fiscal oversight

hydrological

Technical expertise, water resource engineering services, field data collection, and quantitative analysis



Stakeholder outreach, coordination, and meeting facilitation





Eagle River Community Water Plan











Eagle River Community Water Plan

<u>FUNDING</u>

Total Cost: \$389,945

CWCB Colorado Watershed Restoration Grant: \$181,445 Colorado Basin Roundtable: \$75,000 Stakeholders: \$106,500 In-Kind: \$27,000













- Could inform land use and water planning
- A tool for collaborative water planning

Eagle River Community Water Plan



Thank you Steamboat Springs

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UPDATE ON THE COLORADO WATER PLAN

By Kevin Houck, P.E., CFM Colorado Water Conservation Board

CASFM West Slope Seminar April 5, 2019

A Land of Extremes



GISTEMP Anomaly (including seasonal cycle)





"Our iconic mountains, rivers, minerals, plains, communities, forests, snow, wildlife, and wilderness have drawn people by the millions to our

centennial state. Our population has ballooned from 1 million in 1930 to over 5 million today, and could nearly double by 2050. Sustaining this growth

requires water. While we grow at this pace, how do we preserve what we love about our state?"

-Colorado's Water Plan







EXECUTIVE SUMMARY

Executive Order Values

- A productive economy that supports cities, agriculture, recreation and tourism;
- efficient and effective water infrastructure; and
- a strong natural environment including healthy watersheds, rivers, streams and wildlife



Measurable Objectives



CLOSING THE **GAP**.

GETTING TO ZERO BY 2030.

Supply-Demand Gap

Colorado's Water Plan sets a measurable objective of reducing the projected 2050 municipal and industrial gap from as much as 560,000 acre-feet to zero acre-feet by 2030.



INTEGRATING WATER-SAVING ACTIONS

and land use planning.

Conservation

Colorado's Water Plan sets a measurable objective to achieve 400,000 acre-feet of municipal and industrial water conservation by 2050.

Land use

Colorado's Water Plan sets a measurable objective that by 2025, 75 percent of Coloradans will live in communities that have incorporated water-saving actions into land-use planning.



SUSTAINING OURAG ECONOMY

ALONGSIDE GROWTH.

Agriculture

Colorado's Water Plan sets an objective that agricultural economic productivity will keep pace with growing state, national, and global needs, even if some acres go out of production.





as we conserve

Storage

Colorado's Water Plan sets a measurable objective of attaining 400,000 acre-feet of water storage in order to manage and share conserved water and the yield of IPPs by 2050. This objective equates to an 80 percent success rate for these planned projects.



PROTECTING OUR WATERSHEDS

FOR OUR WAY OF LIFE AND ECONOMY.

Watershed Health, Environment, and Recreation

Colorado's Water Plan sets a measurable objective to cover 80 percent of the locally prioritized lists of rivers with stream management plans, and 80 percent of critical watersheds with watershed protection plans, all by 2030.



Funding

Colorado's Water Plan sets an objective to sustainably fund its implementation. In order to support this objective, the State will investigate options to raise additional revenue in the amount of \$100 million annually (\$3 billion by 2050) starting in 2020.



IMPROVING PUBLIC AWARENESS AND

ENGAGEMENT ON WATER ISSUES.

Education, Outreach, and Innovation

Colorado's Water Plan sets a measurable objective to significantly improve the level of public awareness and engagement regarding water issues statewide by 2020, as determined by water awareness surveys. Colorado's Water Plan also sets a measurable objective to engage Coloradans statewide on at least five key water challenges (identified by CWCB) that should be addressed by 2030.



G. Funding

Explore New Funding Opportunities: Develop near-term funding opportunities whereby the smallest amount of funding possible has the greatest benefit to implementing Colorado's Water Plan.

	CRITICAL FUNDING ACTIONS	SECTION	PARTNERS	TYPE
0	Seek an amendment to expand the CWCB loan program's authority to fund treated water supply, reuse, conservation, environmental, and recreation projects and methods.	9.2, 6.3.2, 6.3.1	CWCB, DNR, CPW, CWPDA, CDPHE, General Assembly	Legislation
2	Explore a public-private partnership (P3) center of excellence that models how to develop P3 agreements and explores financial incentives for regionalization.	9.2	CWCB, Funding Committee, P3 experts in other sectors	Programmatic
3	Continue to encourage regional and multipurpose projects and methods that address water supply gaps by providing financial incentives, such as an interest rate reduction or extended loan repayment periods.	9.2	CWCB, Water & Power Authority	Board policy
4	Continue to provide \$1 million or more, if needed, on an annual basis to support stream management and watershed plans.	9.2	CWCB and General Assembly (Projects Bill)	Legislation
5	Develop a sustainable funding plan that integrates a guarantee repayment fund, green bonds, and additional support grants and loans for the WSRA, education, conservation, reuse, ATMs, and agricultural viability. This will include the dedication of \$50 million dollars of severance tax funds to kick-start the initiatives in the plan, and the identification of an approach to develop a new viable public source of funding.	9.2	CWCB, Funding Committee	Process



.....




Updating Colorado's Water Plan Generative Colorado's Water Plan

TABLE 11-1 CYCLICAL PLANNING PROCESS PROPOSED BY THE CWCB

Product	Year Initiated
Basin Implementation Plans	2013
Colorado's Water Plan	2013
Statewide Water Supply Initiative	2016
Basin Implementation Plans	2018
Colorado's Water Plan	2020
Statewide Water Supply Initiative	2022

ACTIONS

- The CWCB will work with other state agencies, the basin roundtables, and the people of Colorado to update Colorado's Water Plan, beginning no later than 2020.
- 2. The CWCB will develop guidelines for Basin Roundtable WSRA grants to help facilitate the implementation of the BIPs.

UPDATING THE WATER PLAN



ANALYSIS + PLANNING PHASE

BASIN INTEGRATION PHASE

> COMPREHENSIVE UPDATE PHASE



WATER PLAN SCENARIOS





- Scenarios in the Water Plan were named and developed with the IBCC.
- These represent equally plausible futures.
- Includes climate change for the first time.

RE-EVALUTING POPULATION

DRAFT Updated Statewide Population Projections



BASIN IMPLEMENTATION

PLANS













FUNDING THE BIP UPDATES



- BIP + CWP Updates/Mgmt HB1051
- IPP Database

Innovation & Outreach

Funding to provide about 65% of average BIP cost.

2015 BIP Costs	
Arkansas BRT	\$648,980
Colorado BRT	\$350,000
Gunnison BRT	\$300,000
Metro + S. Platte BRT	\$1,337,000
North Platte BRT	\$107,500
Rio Grande BRT	\$426,000
Southwest BRT	\$112,142
Yampa, White & Green BRT	\$317,066
TOTAL	\$3,598,688



Water Plan + BIPs	SWSI Contracting + Procurement	TAG Process + Analysis + Ripple Effects	Initiated BIP Updates + Engagement & Funding + Analysis/Modeling	Implementation Working Group + SWSI Update + C-9 Summit	Initiate Water Plan Update + BIP Updates + IPP Database
2015	2016	2017	2018	2019	2020

PROPOSED PLANNING TIMELINE





OCT

2018

Initiated BIP

Update Process

(per Chapter 11

of the Water Plan)

JULY 2019

> Status of the \$5.5M for the Colorado Water Plan Update known.

FUNDING WATER PLAN

Water Plan Grant Category	FY 17/18	FY 18/19	FY 19/20
WSRF Supplemental Funding	\$10M	\$2M	\$2.5M
CO Watershed Restoration Program	\$5M	\$2M	\$4M
Agricultural Transfer Methods (ATM) Grants	\$1M		\$1M
Agricultural Projects Water Plan Grants	\$1M	\$1M	\$1M
Conservation & Land Use Planning Water Plan Grants	\$1M	\$1M	\$1M
Environment/Recreation Water Plan Grants	\$1M	\$1.5M	\$1.5M
Innovation/Outreach Water Plan Grants	\$5M	\$0.5M	\$0.5M
Storage & Supply Gap Water Plan Grants	\$1M	\$3M	\$3M
Water Plan Updating Efforts	\$1M		\$5.5M
TOTAL	\$25M	\$11M	\$20M

Over 88% of this funding has gone to implementation which is in addition to WSRF dollars, other CWCB grants, CWCB loans, etc.

MAKING PROGRESS

Since 2015, significant progress has been made on over 65% of Water Plan actions even though many of the goals extend through 2050.



SUPPLY

Reduce the projected 2050 municipal and industrial gap form 560,000 acre-feet to zero by 2030.

AGRICULTURE

50,000

using

by 2030.

FUNDING

\$

Support Sustainably agricultural fund the water economic plan by raising productivity \$100 million and share in revenue annually acre-feet starting in 2020 (\$3 alternative billion by transfer 2050). methods



CONSERVATION

Achieve 400,000 acre-feet of municipal and industrial conservation of water by 2050.



LANDUSE

Ensure 75 percent of Coloradoans live in water-saving communities by 2025.



STORAGE

Attain

400.000

acre-feet

of water

manage

storage to

and share

conserved

water by

2050.



EDUCATION

Improve the level of public awareness by 2020 and engage Coloradoans on key water challenges by 2030.



WATERSHED

Cover 80

percent of

all prioritized

watersheds

Management

and rivers

with a

plan by

2030.



ADDITIONAL

Respond to and prepare for natural disasters, climate change and energy needs while protecting interstate matters.

FACT SHEETS



NOR AN AND Municipal and Self-Supplied Industrial Demand Methodology Municipal Demand Adjustments Scenario Planning Scarano päivning relier on several lay driving forces to multiple, plausable futures (or "severative"), traditional "predict-and glant" approaches develop a single future. Under Planning Scenarios Municipal demands for the SWSI Update Musergal deviands for the Woll Update will be calculated uning methodologies senilar to 1953 2010 but will utilize Planning Scenarios and will use imhanced input data. Ethaniced input imblade data from 1951 reporting data, Water Ethiciancy Rans, and Balm Implementation Plans. Baseline estimates of 2050 population will be based on Colorado State Demograpi Office economic modeling. Additional adjustments accounting for ristitutical and geographic variability will be made per scenario-specific considerations. Projected Population Growth Through 2050 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1000.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1001.00 1000.00 100 The back equation for estimating municipal demand considers popula and per-capita water use (de) gallons per capita per day or goods Demand = Population * gpcd For the SWSI Update, five scenario-Gap Analysis ectric, county-laws population rimates for 2050 will be developed ong with scenario-specific per-capita Future per-capita water use rates will be adjusted to reflect conditions described in each scenario and will conside economic conditions, climate, regulations and enclosiony, and oracle values. Initial adjustments to future good rates are shown in the table follow. water use rates. Datinets Weak Cooperative Adaptive Hot as usual Economy Growth Intervation Growth 520 Low 520, adjuned High, High Current Current, In-Detween Hot and dry Hot, and dry Initial adjustments to future good rates based on drivers such as water efficiency adoption rates, future residential indoor good, outdoor une, non-residential indoor use, and non-resense water. 1. 1 1 10. Potential Impacts of Climate Change Natural flow water supply time series --> 2 Quantity future Apply climate Adjurchiture good rates and delivery Calculate future impacts to outdoor water use municipal water demands 373WS AT FACT SHEET Estimates of current water supply information are necessary to understand the amount of water that is physically and legally available to meet current demands, and any additional water tapplies that may be available to meet future demands. senses or u-ent correr centrario, uno any additional valore ingoles that may be available to travel forwards. Carrent water supply information consists privarily of estimates of "statural flow" at lwy locations as well as supplies available in sensories in concentration acrossists. The status flow's the association allowed the effect of may, and series as the flowalizon of the Colonado Decision Support System (CDS) surface water allocation models used to the Status (D) dupter efficient. orado's Water Plan included "Water Supply" as a key driver in each of its planning scenarios. Future water supplie persisched to be impacted by climate change in the Cooperative Growth. Adaptive Innovation, and Het Growth are projected to be planning scenarios. Impacts to Water Supplies from Climate Change CWCB has undertaken several studies and investigations on the impact of climate projections on the Astare of water use in Colorado. Not notably was the development of the Colorado Climate Plan (CCP), which focume on observed climate trend wom war motory was the development of the Colondo Christien Flan (CCF), which focus on observed Cristian Face (CC), which focus on observed Cristian Face (CC), which focus on observed Cristian Face (CC) and the Colondo Christian Face (Cristian Face))) and face (Cristian Face) (Cristi Colorado's Water Plan incorporates the impact of climate change and identifies two future potential climate projections for the lanning scenarios. The projections reflect "Host and Gry" conditions and conditions that are in between Current conditions and he Hot and Dry conditions ("In-between"). The climate projections are assigned to the planning scenarios as fallows: High and low vates of population 10,000,000 een an Unual Current. Current Current Trend of all Trend of all modeling in-factween results athe Growth In-between Hot and Dry Hot and Dry Hot and Dry Increasing Consumption Integration Recurrence (CR) The effort associated with processing the projected ciname data and devencaling the information for use at the New Dariest lead was compared through the Calculate have lead a addition (Sala). Was at 2008d. If project, this effort data was an other section of the Calculate have lead and the Calculate and the Calculate and read-calculate projects. These filter have been additioned and the Calculate and the Calculate and calculate and calculate projects. Nature filter have been additioned to the Calculate and percent of the simulations predict droughts tended to increase.

JANUARY 2018 | WATER MANYLY NETHODOLOGY FACT SHEET



REASING ANY THE

TANKS AT

Visit, www.cwcb.state.co.us to learn more.

Colorado Basin Implementation Plan

- Assess internal needs & identify projects to meet them
- Negotiate how to meet state needs

Source and further information:

Angie Fowler, P.E. SGM 970-384-9027 angief@sgm-inc.com





6 BIP Themes

- Protect and Restore Healthy Streams, Rivers, Lakes and Riparian Areas
- Sustain Agriculture
- Secure Safe Drinking Water
- Develop Local Water Conscious Land Use Strategies
- Assure Dependable Basin Administration
- Encourage a High Level of Basinwide Conservation

Status of Basinwide Top Projects

- Protect Existing and Future West Slope Uses
 - Water Banking Workgroup
 - Demand Management Workgroups (CBRT)
 - GVWUA Conserved Consumptive Use Pilot Program
 - City of Aspen ATM Pilot Project Planned
 - Risk Study (Phases 1 3)
- Colorado River Cooperative Agreement
 - Learning By Doing underway in Grand County
 - Several activities and cooperative projects underway
- Grand Valley Roller Dam
 - Master Plan 1 & 2 (Completed)
 - Upper Canyon Canal Lining Project (Completed)
 - Electrical & Controls Upgrades (Phase 1 Completed; Phase 2 designed)
- Colorado Basin Stream Management Plan (Integrated Water Management)
 - Developed a IWMP Framework (consistency)
 - Middle Colorado Watershed Council IWMP underway
- Protect the Shoshone Hydroelectric Plant Call
 - On-going dialogue regarding importance of protecting water rights

OUESTIONS? https://www.colorado.gov/cowaterplan



High Hazard Dam Release -Floodplain Impacts Ranking Tool and Database

CASFM Western Slope, Glenwood Springs Community Center

April 5, 2019



COLORADO Division of Water Resources Department of Natural Resources

Jackie Blumberg, Colorado Dam Safety

Goals of Discussion

- Talk about flooding hazard related to dam operations (not dam failure)
- Demonstrate the tool
- Discuss application to reduce risk to communities, uses for additional CRS Credits



COLORADO Division of Water Resources Department of Natural Resources

1,800ish Program Dams



Hazard Classification

Based on an evaluation of consequences of dam failure absent of flooding conditions

Assumes the reservoir is at the high water line.

Hazard Classification	Description	
High	Loss of human life is expected in the event of a failure	
Significant	Significant damage is expected, but no loss of human life	
Low	No significant damage and no loss of human life	
No Public Hazard (NPH)	No loss of human life and damage only to dam owner's property	

Dam Failure



Dam Safety and Community Rating System



OMB No. 1660-0022 Expires: March 31, 2020

National Flood Insurance Program Community Rating System

Coordinator's Manual

FIA-15/2017



COLOR Division of V Department of Na



Dam Safety and CRS

CRS Coordinators Manual, Section 630 (Dam Safety)

Credit is for state and local dam safety programs that:

- Help make information available,
- Improve communication, and
- Develop warning and response plans for dam failures

The credit is keyed to addressing the areas at risk from the failure of a high-hazard potential dam.



COLORADO Division of Water Resources

Inundation Map

- Show the areas that would be flood if a dam failure occurs ("inundation zone")
- Travel time for wave front arrival and flood peaks at critical locations
- Vary in information, resolution, and quality



Inundation Mapping Primer

Same location (Frying Pan River 4.5 miles below Ruedi dam •

 map scales are different)





Inundation Mapping Primer

Location	100-year Peak Flow	Routed Dam Failure Peak Flow
Frying Pan River 4.5 miles below Ruedi	3,310 cfs (USGS)	828,200 cfs
Mam Make Market Ma		

Why so Iarge?

- Dam is fully breached in one-hour or less
- Large volume; short time



Inundation Mapping Primer



e Rd

Ruedi Inundation Mapping **Frying Pan** River 4.5miles below the dam



Normal Operation





Oroville Dam



Parking lot and access road flooded when emergency spillway was used

Helicopters dump rocks Lake Oroville Main

spillway

Concrete wall

Trucks dump rocks, concrete is poured in eroded holes

> Path of water down emergency spillway

Oroville

Dam





What Did We Learn?

- Colorado in 2013 and Oroville in 2017 show dams operating as designed but still cause flooding downstream
- Emergency Action Plans have maps for dam failure inundation – <u>not the same as</u> operations release flooding scenarios



How Did We Apply What We Learned?

- Created a High Hazard Dam Release Floodplain Impacts database
 - Dam Information
 - Spillway data
 - Outlet data
 - Population at risk
 - Compares spillway and outlet flows to FEMA 100-year flows
 - Share the database




Database



Colorado Division of Water Resources

High Hazard Dam Release - Downstream Floodplain Impacts Study

Revision Date: 6/23/2017

	Dam Info	Spillways	Outlet Works		Streamflow Statistics at Dam	Initial Banking	Secondary Ranking	FEMA	Hydraulic Analysis
	Expand >	Expand >	Expand >	Expand >	Expand >	Expand >	Expand >	Expand >	Expand >
Dam Name	Dam ID NID ID kmz	Controlled Capacity	Outlet Capacity	Total Max. Controlled Discharge	Dam and/or Main Channel Drainage Area	Initial Ranking by Dam Not Total Considered	Secondary Ranking by Dam Not Total Considered	FIS Profile	Hydraulic Analysis Basformad hyr
		(cfs)	(cfs)	(cfs)	(mi ²)				renomed of
GREEN MOUNTAIN	360106 CO01658 Google Earth	25,000	1530.0	26530.0	582.28	35	27	FIS Profile	2
IOHN MARTIN	670215 CO01283 Google Earth		13780.0	13780.0	18482.30	152	80	N/A	
MAPLE GROVE	070219 CO00203 Google Earth	13365	102.0	13467.0	10.40	2	2	FIS Profile	YW
GRANBY	510108 CO01656 Google Earth	12000	435.0	12435.0	312.08	72	100	N/A	
CHATFIELD	080324 CO01281 Google Earth		8300.0	8300.0	3020.77	5	4	FIS Profile	YW
CHERRY CREEK	080116 CO01280 Google Earth		8100.0	8100.0	385.67	12	12	FIS Profile	YW
WILLIAMS FORK	510127 CO00717 Google Earth	6400	620.0	7020.0	230.07	36	49	N/A	
OLYMPUS	040134 CO01662 Google Earth		5767.0	5767.0	155.20	46	72	FIS Profile	
PUEBLO	140133 CO00299 Google Earth		5767.0	5767.0	1546.84	45	22	FIS Profile	
RINIDAD	190122 CO00050 Google Earth		5500.0	5500.0	671.86	10	10	N/A	
VICPHEE RESERVOIR	710106 CO02707 Google Earth		5000.0	5000.0	819.12	111	141	FIS Profile	
DILLON	360104 CO00875 Google Earth		4400.0	4400.0	334.09	18	44	No Profile	
	000401 CO03310 Consta Farth		4000 Q	1000 0	מר דחתר	F7	20	TIC BASELS	MA

- Main Categories
 - Dam Information, dam ID, google earth KMZ
 - Spillway Capacity
 - Outlet Capacity
 - Total Controlled outlet
 - Stream flow
 - Ranking
 - FEMA
 - Hydraulic Analysis

AVAILABLE BY EMAIL REQUEST TO CHIEF OF DAM SAFETY

Ruedi

- Facts
 - Dam Height 291 ft
 - Storage capacity 119,560 af
 - Spillway Capacity 5,540 cfs
 - Drainage Basin 224 sq mi
 - Outlet Capacity 2,520 cfs
 - 2-yr stream stat 1,290 cfs
 - 100-yr stream stat discharge 3,310 cfs
 - Population at risk no data
 - Ranking 128 of 416
 - FEMA no data
 - Safe channel capacity ?? cfs



Colorado Division of Water Resources High Hazard Dam Release Downstream Floodplain Impacts Study

RUEDI							
DAM ID NID ID County Stream	380136 CO01664 PITKIN FRYINGPAN RIVER		Latitude Longitude	<u>Go to Google Earth</u> 39.361 -106.818			
Dam Drainage Area, DA (mi²) 100-Yr StreamStats Discharge (Q ₁₀₀) (cfs) Total Spillway Capacity, Q _{sw} (cfs)		223.89 3100 5540	Outlet Works Total Maximu Discharge, Q _c	Capacity (cfs) ım Controlled _{ont} (cfs)	2520 2520		



Ranking Summary						
R1: DA & Total Max. Controlled Discharge	130	R4: Q ₁₀₀ &	Total Spillway Capacity	281		
R2: Q ₁₀₀ & Total Max. Controlled Discharge	46	R5: Total Max. Controlled Discharge		19		
R3: Distance To Downstream Town	268	R6: Total Spillway Capacity		137		
Composite Ranking	128	HIGH	Rankinas reported out of 416 to	tal dams		

Consequence Analysis							
Population at Risk (PAR)	N/A						
Social Vulnerability Index (SVI)	N/A						
Estimated first impacted downstream road	<u>View in Google Earth</u>						
Estimated first impacted downstream structure	<u>View in Google Earth</u>						

Garfield County High Hazard Dam Release High Risk Rankings (9)



Message

- We know the risk exists
- Colorado Dam Safety has attempted to define and rank the severity of the risk
- We now have a tool for screening level ranking
- Examples demonstrate utility of detailed evaluations
- Floodplain and Emergency managers can use this screening level information to assess their risks
- Floodplain and Emergency managers make decision on where additional detailed evaluation is needed



COLORADO Division of Water Resources Department of Natural Resources

Questions - Next Steps

Do Floodplain and Emergency Managers:

- Have authority/responsibility to further assess the risk of High Hazard Dam releases in their areas?
- Have interest to use this info to further assess the risk of High Hazard Dam releases in in their areas?



Questions?

SUNDAY SEPTEMBER 15, 2013 + DENVERPOST.COM + THE DENVER POST

** SECTION B

DENVER & THE WEST

DONATE: Contribute to flood-relief efforts. »28

FORECAST: More rain expected Sunday. 368

"Normal has changed"

Fifth person presumed dead while authorities work to get hundreds to safety



Jon Cook drives down Hygiene Road with his father, Bob, while looking over flooding of neighboring properties Saturday in Hygiene. Resident of the town helped one another salvage personal belongings from flooded homes. crag r. waker, the Denverboat



COLORADO Division of Water Resources

Department of Natural Resources

Image Source: Denver Post

Colorado Dam Safety Rules and Regulations Revision Lightning Talk

CASFM Conference Glenwood Springs Community Center, CO April 5, 2019



COLORADO Division of Water Resources Department of Natural Resources Jackie Blumberg, P.E. Colorado Dam Safety

Outline for Discussion

- REPS and Runoff
- Rulemaking Timeline
- Where to Find/How to Comment
- Questions



REPS PMP Tool

Download REPS PMP Tool from Colorado Dam Safety website:

http://water.state.co.us/damsafety/dams.asp



Colorado - New Mexico . **Regional Extreme Precipitation Study Summary Report** Volume II Deterministic Regional Probable Maximum Precipitation Estimation November 30, 2018

Data and Mapping Tools

CDSS Online Tools MAD Man Vieware

K Agricultural Water Protection Water

Helpful Links K Colorado Revised Statutes

Colorado's Water Dian

REPS MetPortal Precipitation Frequency Tool

MetPortal PF web-service: <u>https://conm-reps-gui.shinyapps.io/metportal/</u> (link is in the REPS Interim Use Guide on DWR website)



Portal CO, NM Precipitation Precuency GUI et 6.0

ate and Time of Analysis: 2018-01-25 20:52:07 Alterated. <watershed name not found in shapefile ID attribut

5 Centrald- 19 13N 107 179

Colorado - New Mexico Regional Extreme Precipitation Study . **Summary Report** Volume III **Regional Precipitation-Frequency Estimation** November 30, 2018

Mountain Basin Hydrologic Study Reports http://water.state.co.us/damsafety/dams.asp



> Surface Water > Dam Safety

Dam Safety

Dam Safety Contacts Design and Construction Education & Outreach Safety of Existing Dams

Flood Information

- Hydrography & Satellite Monitoring
- Interstate Compacts
 Rainwater Collection
- Rulemaking & Advisory Groups
- Water Rights

Dam Safety Home

Dam Safety Rulemaking

Draft 2019 Dam Safety Rules

Dam Safety Data

-

Meetings Schedule and Agenda
 Summary of Proposed Revisions to Rules.

Active Design Review Dataset

Juridictional Dam Dataset

Non-Jurisdictional Dam Dataset

Active Design Review Map

Stakeholder Meetings Presentation

The Dam Safety Program is administered by the Division's Dam Safety section (Dam Safety Section brochure). The section consists of two units; one is the Design Review and Construction Inspection Unit, and the other is the Dam Safety Engineering Unit. The program is managed by a Chief Engineer, who develops program goals and objectives and is responsible for deciding the kind and extent of engineering programs needed to accomplish the objectives, and to assure they are being met. The section carries out two principal duties of the State Engineer: to determine the safe storage level of the reservoir dams in the state (see our <u>Safety of Existing Dams</u> section); and to approve the plans and specifications for the construction and repair of Jurisdictional dams (see our <u>Design and Construction</u> section). All

New! Dam Safety Data & Resources

See below for new tools, including Potential Failure Mode Analysis Tools, Active Design Review Dataset & Map, as well as Datasets for Jurisdictional & Non-Jurisdictional Dams. Also, see Dam Safety Resources below for an updated Sample Emergency Action Plan. Additionally, inundation mapping grant documents can be located on the Emergency Preparedness Page.

Jurisdictional dams (see our <u>Design and Construction</u> section). All persons requesting access to dam files should submit their requests per our Public Access to Dam Files and Records policy.



Colorado Water Institute Colorado

Mountain Basin Hydrologic Study

Department of Civil and Environmental Engineering

Douglas D. Woolridge

Colorado State University

CWI Completion Report No.237

Jeffrey D. Niemann

December 2018

RULES



COLORADO Division of Water Resources Department of Natural Resources

Statutory Authorities CRS Title 37 Article 87

- 37-87-105-Approval of Plans for Reservoirs
 - Make and Maintain Rules and Regulations (The Rules)
 - Review and Approval Authority for; New Dams, Alteration, Modification, Repair and enlargement of existing dams
- 37-87-107- Safety Inspections-Amount of Water to be Stored
 - Inspections
 - Determination of Safe Storage Level



Dam Safety Rules Revision Timeline





Dam Safety Rules Revision Timeline





Dam Safety Rules Revision Timeline





Proposed Dam Safety Rules

Download a copy of the from Colorado Dam Safety website:

http://water.state.co.us/damsafety/dams.asp

Or Google "Colorado DWR"

		ources		Colorado.gov Co	Colorado.gov Contact Us Help Search			
L		COL Divisior Departme	ORADO n of Water Reso nt of Natural Resource	ources ces				
	Home Ground V	Vater	Surface Water	Data & Maps	Documents & Forms	Division Offices		
> Surfa	ce Water > Dam Safety							
Dar	m Safety	Dam	Safety Home					
	Dam Safety Contacts	-						
æ	Design and Construction	Safety se	n Safety Program is administ ection (Dam Safety Section	tered by the Division's Dam brochure). The section	Neud Dam Cafeby Data	Bassumme		
	Education & Outreach	consists	of two units; one is the Des	ign Review and Construction	See below for new tools, inc	uding Potential Failure		
	Safety of Existing Dams Inspection Unit, and the other is Unit. The program is managed by			e Dam Safety Engineering Chief Engineer, who develoos	Safety Engineering Engineer, who develops Map as well as Datasets for Initialiational & Non-			
Flo	od Information	program	goals and objectives and is	responsible for deciding the	Jurisdictional Dams. Also, se	e Dam Safety Resources		
Hyo	drography & Satellite nitoring	the obje	extent of engineering prog ectives, and to assure they a out two principal duties of t	rams needed to accomplish are being met. The section he State Engineer: to	below for an updated Sampl Additionally, inundation map be located on the Emergence	e Emergency Action Plan. ping grant documents can v Preparedness Page.		
Int	erstate Compacts	determi	ne the safe storage level of	the reservoir dams in the				
Rai	inwater Collection	the plan	is and specifications for the	construction; and to approve				
e Ru	lemaking & Advisory Groups	s Jurisdict	tional dams (see our <u>Design</u> Public Access to Dam Files a	and Construction section). All and Records policy.	persons requesting access to dam	files should submit their requests		
e Wa	iter Rights							
			am Safety Rulemaking Draft 2019 Dam Safety Rules Meetings Schedule and Agenc Summary of Proposed Revisio Stakeholder Meetings Presen	ta ins to Rules itation	CO-NM Regional Extrem Precipitation Study Final Reports and Tools Mountain Basin Hydrolo Advances in Flood Hydrolog	ne ogic Study		

Detential Eailune Mede Analysis

Juridictional Dam Datase

Dam Safety Engineer - Rule Makers





COLORADO Division of Water Resources Department of Natural Resources

Philosophy

- Process followed Executive Order 2012-002 Regulatory Efficiency Reviews:
- Is necessary and does not duplicate existing rules;
- Is written in plain language and is easy to understand;
- Has achieved the desired intent and whether more or less regulation is necessary;
- Can be amended to reduce any regulatory burdens while maintaining its benefits; and
- Is implemented in an efficient and effective manner, including the requirements for the issuance of any permits or licenses.



How to Comment?

- Email questions, comments, suggestions to:
- Colorado Dam Safety email account dnr_coloradods@state.co.us
- Look up current info and any updates http://water.state.co.us/SurfaceWater/DamSafety
- Email your local Dam Safety Engineer
- Comment Period ends June 1, 2019



COLORADO Division of Water Resources Department of Natural Resources

Next Steps

- Additional Rules Workshops April (Durango, Alamosa, Craig)
- Comment Period Ends June 1
- Formal Rulemaking July 1
- Promulgated Rules October 1
- Develop Guidance Documents to Support Rules (May-August)







Questions?

Mitigation Planning & Projects

Current Water Issues on the Western Slope



Deanna Butterbaugh and Mark Thompson



COLORADO

Division of Homeland Security & Emergency Management

Department of Public Safety





Division of Homeland Security & Emergency Management

Department of Public Safety

- Hazard Mitigation Planning
 - Benefits
 - Planning process
- Hazard Mitigation Projects
 - Example project types
 - Colorado projects since 2011
 - Recent Western Slope projects
 - How to get a grant
- ✤ Questions
- References





Division of Homeland Security & Emergency Management

Department of Public Safety

Hazard Mitigation Planning



COLORADO Division of Homeland Security & Emergency Management

Department of Public Safety

Hazard Mitigation

- What is the ultimate purpose of hazard mitigation?
- What consequences are we trying to prevent?



Source: Masterson et al, 2014; Modified from Schwab, 1998; Lindell, Prater, and Perry, 2007



COLORADO Division of Homeland Security

& Emergency Management

Department of Public Safety

What Are the Benefits of an HMP?

- The planning process enables a community's comprehensive assessment of its hazards, how it would like to mitigate them, and opportunities to integrate mitigation planning with other community plans.
- An approved Local HMP has a five-year lifecycle and creates eligibility for FEMA's Hazard Mitigation Assistance (HMA) grant programs (25% local share) for each participating jurisdiction:
 - Pre-Disaster Mitigation (PDM- Annual Cycle; All natural hazards)
 - Flood Mitigation Assistance (FMA- Annual Cycle; Flood; NFIP insured structures & communities)
 - Hazard Mitigation Grant Program (HMGP- Post-Disaster; All natural hazards)
 - Projects under these programs must be tied directly to the mitigation goals and objectives in your HMP; tying them to a specific mitigation action is better
- Other tangible benefits:
 - Up to 382 points for Community Rating System Activity 510 (Floodplain Management Planning)
 - "Copy and Paste" updates of Community Wildfire Protection Plans (CWPP's) for some jurisdictions



Division of Homeland Security & Emergency Management

Mitigation Financial Benefits

Department of Public Safety

	National Benefit-Cost Ratio Per Peril *BCR numbers in this study have been rounded Overall Hazard Benefit-Cost Ratio	Federally Funded	Beyond Code Requirements 4:1
🛕 Riverine F	lood	7:1	5:1
🙆 Hurricane Surge			7:1
쓥 Wind	5:1	5:1	
\land Earthquak	3:1	4:1	
🚧 Wildland-L	Jrban Interface Fire	3:1	4:1

Source: National Institute of Building Sciences, Natural Hazard Mitigation Saves: 2017 Interim Report





Division of Homeland Security & Emergency Management

Department of Public Safety

Hazard Mitigation Projects



COLORADO Division of Homeland Security & Emergency Management Department of Public Safety

Hazard Mitigation Examples

- Reduce the future demand for, and rising costs of, disaster response and recovery.
- Retrofit a critical facility, enforce building codes, land use planning, remove a structure from a hazard area.



MITIGATION: Elevated Home by the River

MITIGATION: Defensible Space, Fuels Reduction



RESPONSE: Purchase of Police Command Vehicle



Division of Homeland Security & Emergency Management

Projects in Colorado to 2018

Department of Public Safety

Colorado Project Awards through FEMA Hazard Mitigation Assistance Program

	Wildfire Mitigation/Fuels Reduction (<i>Coming Soon:</i> <i>Post-Fire Actions</i>)	Flood Reduction/ Drainage Improvements/ Property Acquisition	Landslide/ Slope Stabilization/ Property Acquisition	Planning Grants (including Advance Assistance)	Other Projects: Generators, 5% Projects, Appraisals, Preparedness, Warning			
Obligated Projects	21	29	5	29	32			
FEMA Grant Fund	HMGP, PDM	HMGP, PDM, FMA	HMGP, PDM	HMGP, PDM	HMGP			
Project Costs	\$9,569,391.66	\$85,959,741.61	\$11,717,794.00	\$2,076,269.05	\$4,265,228.01			
Total FEMA Funding and Local Match (2011-Present) = \$113,588,424.33 (Total Projects: 116)								
Each project must be linked to the HMP's Goals & Objectives								
2017 Pending	; 2	1						
Award	~ \$2,900,000	~ \$5,300,000						
2018	1	6	1	11				
Applications	\$330,000	~38,380,000	~\$3,600,000	~\$1,100,000				

Every dollar spent on mitigation saves three to six dollars in disaster response and recovery costs!



Division of Homeland Security & Emergency Management

Department of Public Safety

Durango Crestview Ditch: PDM 2014, \$1.26M budget, \$854K cost





Western Slope Projects

Ouray County/Log Hill FPD: PDM 2015, \$163K budget, 50 homes





Division of Homeland Security & Emergency Management

Department of Public Safety

Glenwood Springs/Mountain Springs: HMGP 4145, \$28K budget & cost, Fuels reduction





Western Slope Projects

Glenwood Springs/Canyon Creek:

HMGP 4133, \$82K budget, \$73K cost, 22 homes





Division of Homeland Security & Emergency Management

Department of Public Safety

Mesa County/Orchard Mesa Detention Pond: HMGP 4145, \$1.2M budget, \$955K cost, 270 structures



Western Slope Projects

Mesa County/Bosley Wash Reservoir A: HMGP 4145, \$2.8M budget




COLORADO Division of Homeland Security & Emergency Management

How Do I Get a FEMA HMA Grant?

Department of Public Safety

- ✤ Identify an eligible project/activity that is consistent with your Mitigation Plan.
- Identify a project champion to "sell" the project and complete the application through DHSEM.
- Complete the Benefit-Cost Analysis (BCA) with a ratio of 1:1 or better.
 - BCA training offered annually at DHSEM & available online course from FEMA.
 - Some projects have pre-determined benefits.
 - Benefits include losses avoided/reduced for structures, infrastructure, economic impacts, disaster response and recovery costs, and social costs of a disaster.



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Department of Public Safety

- Hazard Mitigation Planning
 - Benefits
 - Planning process
- Hazard Mitigation Projects
 - Example project types
 - Colorado projects since 2011
 - Recent Western Slope projects
 - How to get a grant





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Department of Public Safety

Questions?



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Department of Public Safety

References

- Hazard Mitigation Assistance Guidance- [HMGP, PDM, and FMA]; FEMA; February 27, 2015
- Hazard Mitigation Assistance Guidance Addendum- [HMGP, PDM, and FMA]; FEMA; February 27, 2015
- Local Mitigation Planning Handbook; FEMA; March 2013
- Mitigation Planning and the Community Rating System- Key Topics Bulletin; FEMA; October 2018
- FEMA 551- Selecting Appropriate Mitigation Measures for Floodprone Structures; FEMA; March 2007
- * FEMA P-936- Floodproofing Non-Residential Buildings; FEMA; July 2013
- Integrating Hazard Mitigation Into Local Planning- Case Studies and Tools for Community Officials; FEMA; March 1, 2013
- Mitigation Ideas- A Resource for Reducing Risk to Natural Hazards; FEMA; January 2013

Burned Area Emergency Response

Program Overview



BAER

Jim Frazier & Sharon Grant Stanislaus National Forest July 2004

1. BAER Program

- What is the BAER Program?
- Why do we do BAER?
- Who's responsible?
- 2. BAER Process
 - Assessment/Prescription
 - Implementation
 - Monitoring
- 3. Summary
 - Review
 - Questions & Answers

BAER Overview



The BAER Program

The BAER program addresses immediate post-fire **EMERGENCY** situations with the goal of protecting life, property, and natural and cultural resources.

Skalkaho Complex Fire,

Why is BAER Necessary?

Minimize threats to human life

Bitterroot N.F.

"...because the whole Priest Grade area was burned this summer...the danger level of storm and rescue work intensified."

Moccasin Fire BLM, Tuolumne Co., CA

35¢ HER COPY Teen driver killed in mudslide

The Union Democrat

By PAUL PAYNE

Road workers were trying to close the grade, but they (the line of cars) were one of the last to get through' and Free CAPT. DAVE DECRENDEL California Dep



Why is BAER Necessary?

Minimize threats to property

- Roads
- Structures & facilities



Why is BAER Necessary?



Stabilize & prevent unacceptable degradation to natural & cultural resources

NRHP eligible guard station, Malheur N.F.

Water

Quality

Aquatic/Riparian & Wildlife Habitat

Cultural Resources





Who's Responsible for BAER?

Forest Supervisor

- Evaluates the fire to determine if a BAER team is needed.
- Selects BAER Assessment and Implementation Team Leader
- Manages the BAER Team
- Requests BAER funding
- District Ranger
 - Briefs the Assessment Team on management issues and expectations.
 - Implements and maintains treatments
 - Monitors treatments
- Regional Forester & Watershed Staff Director, WO
 - Approves BAER report



Agency Coordination

- BAER assessment and implementation are often cooperative efforts with federal, state and local agencies
 - Natural Resources Conservation Service (NRCS)
 - National Park Service
 - Bureau of Land Management
 - U.S. Fish and Wildlife Service
 - Bureau of Indian Affairs
 - State Water Quality Control Boards
 - Local emergency service organizations (police, fire, flood control districts, public works, etc.)



The BAER Process

• The BAER process has 3 phases:

- 1. Assessment/Prescription
- 2. Implementation
- 3. Monitoring



- Forest Service Handbook (FSH 2509.13)
- Forest Service Manual (FSM 2523)
- BAER website

BAER

Program References

- <u>http://fsweb.gsc.wo.fs.fed.us/baer/</u>
- BAER guidance papers

The BAER Process

- Assessment/Prescription —
- Implementation
- Monitoring





AND M

BAER Assessment Team

- BAER teams are staffed by specially trained professionals who rapidly assess the burned area and prescribe emergency stabilization treatments.
 - Hydrologists
 - Soil scientists
 - Engineers
 - Biologists
 (wildlife/aquatic)
 - Vegetation Specialists
 - Archeologists
 - Geographic
 Information Specialists
 (GIS)



When to Assess?

Time is of the essence BAER is an **EMERGENCY!**

The BAER assessment usually begins before the wildfire has been fully contained, and must be completed within seven days after containment.

BAER Assessment Team Tasks

- Identify "Values at Risk"
- Determine if there is an emergency to life, property, and cultural and natural resources





BAER Assessment Team Tasks

Prescribe Treatments

- Treatment Categories

 -land, channels, roads & trails, major structures, hazard warnings

 Treatment Locations

 Treat only the portion of the burned area where emergency hazards exist.

 Treatment Priorities
 - -Natural recovery
 - -Administrative closures
 - -Treatment

BAER Assessment Team Tasks

Present

 assessment
 findings to
 the Forest
 Supervisor



The BAER Process

- Assessment/Prescription
- Implementation
- Monitoring







"Remember! The BAER EMERGENCY is not over until all treatments have been implemented and are functioning effectively!"

- An Implementation Team Leader and Team is selected to install treatments prescribed by the assessment team.
- The Implementation Team responsibilities are to:
 - Review and revise assessment team prescriptions and costs as needed
 - Implement treatment prescriptions
- The <u>District Ranger</u> is responsible for ensuring all treatments are implemented.

BAER Implementation Team



When to Treat?

Timing is Critical

Treatments must be installed before the first damaging storms or other events that threaten life, property, or resource values needing protection.





Land Treatments

- Mulch Application
 - Mulch is used to provide immediate soil cover to reduce rain impact and soil erosion.
 - Mulch may be applied manually or mechanically.



Land Treatments

- Seed Application
 - Purposes
 - Increase vegetative cover to reduce soil erosion and runoff
 - Replace native seed bank where it is severely reduced by fire
 - Out-compete invasive species (e.g., cheatgrass)
 - Methods
 - Manual (hand seeding)
 - Mechanical
 - Aerial (helicopter or fixed wing)
 - Ground (e.g., range drill)
 - Seed may be applied with or without mulch
 - Policy
 - Priority is to use native seed





Land Treatments

- Runoff Barrier
 Installation
 - Log erosion barriers (LEBs)
 - Fiber rolls
 - Contour tilling





Channel Treatments

- In-stream Structures
 - Small straw or log dams
 - Rip-rap
- Debris Removal
 - Clearing vegetative obstructions



Road & Trail Treatments



- Repair drainage features along roads and trails
- Patrol roads in winter



Road & Trail Treatments



PUBLIC NOTICE:

The Candy Rock Road beyond this point is closed for public safety until Spring 2002. The Darby Fire burned several locations above the road resulting in potential rockfall, mudflow and washout hazards to road users. The road is expected to be reopened prior to the fishing and swimming season in April 2002.

Thank you for your cooperation.

74/ Rob Briffith District Ranger Calaserers Ranger District 5519 Highway 4 P.O. Box 500 Histhowoy Pries, CA 95233 (209) 795-1381

PUBLIC SAFETY



Major Structures



Debris Basins
Flood Flow Deflectors

Hazard Warnings

- Automated flood warning systems
- Road and trail warning signs

WARNING

BURNED WATERSHED NEXT 3 MILES

RISK FROM FLASH FLOODS, ROCKFALL AND DEBRIS







- Media announcements
- Evacuations



The BAER Process

- Assessment/Prescription
- Implementation
- Monitoring





Mr. A. M. M. J.

What do we Monitor?



- Monitor the implementation and effectiveness of prescribed emergency stabilization treatments.
 - For example, on a helimulching project:
 - Implementation: did the straw cover meet the prescription objective (i.e., 50% cover)?
 - Effectiveness: did the straw cover mitigate erosion and sedimentation as expected?

- Up to three years of monitoring treatment effectiveness may be covered by BAER funds.
- Funds must be requested annually.



When do we

Monitor?



BAER Program

BAER Mission:

 The BAER program addresses immediate post-fire emergency situations with the goal of protecting life, property, and natural and cultural resources.

> "The **EMERGENCY** caused by the fire is not over when the flames are out!"

Why is BAER Necessary?

Post-fire hazards can KILL people and DAMAGE property and resource values.

Program Limitations:

• BAER is not an opportunity to fix historic problems, expand programs or personnel, or conduct new assessments or long-term restoration.

Questions & Answers


416 Fire Burned Area Emergency Response (BAER) Executive Summary

San Juan National Forest, Durango, Colorado February 26, 2019 Prepared by Lindsey Hansen

FIRE BACKGROUND

The 416 Fire started on June 1, 2018 approximately 13 miles north of Durango, Colorado. The majority of the fire is on the San Juan National Forest in the Hermosa Special Management Area and Hermosa Wilderness. While total containment of the 416 Fire had not occurred, a Burned Area Emergency Response (BAER) assessment was initiated in late June as the flooding and debris flow from the rains could pose significant threats to roads, trails, homes and private property within and downstream of the fire. After the initial assessment, an additional 19,738 acres for a total of 54,130 acres burned on the 416 Fire and interim BAER assessment addressed the additional acres and identified risks to public safety and infrastructure that may result.



Hermosa Creek Drainage

BAER PROCESS

The BAER assessment focuses on determining where post-fire precipitation events could increase runoff, flooding, erosion and sediment delivery, and where high-risk areas are for the spread of invasive weeds. Hydrologists, soil scientists, engineers, weed specialists, archaeologists, wildlife/fisheries biologists, and GIS analysts all contributed to the BAER assessment. In addition to contributions from the assessment team, the US Geological Survey (USGS) provides models on debris flow potential following the fire.

The BAER team identifies 'Values at Risk' (VAR) which include human life and safety, infrastructure, private property, natural resources, and cultural resources. The team develops a Soil Burn Severity (SBS) map to document the degree to which soil properties changed as a result of the fire within the burned area. Fire damaged soils have low strength, high root mortality, and increased rates of water runoff and erosion. Using the SBS map, BAER team members run models to estimate changes in stream flow and debris flow potential. The models compare pre-fire conditions to predicted post-fire conditions to determine relative changes as a result of the fire. These models are then used to determine the relative risk to different VAR's, and are used to make recommendations to address high risk areas determined to be an emergency. Modelling results are not intended for site specific actions such as sizing culverts or mitigating a specific area, but rather to identify areas of high to moderate probability of flooding or debris flow.

ANALYSIS OVERVIEW

In late September, the U.S. Forest Service Geospatial and Technology and Applications Center provided the BAER team with an initial Burned Area Reflectance Classification (BARC) map derived from satellite imagery that compares pre and post fire images. The team conducted reconnaissance and field verification surveys to adjust the BARC and create a final soil burn severity map (Figure 1).

Soil Burn Severity for the 416 Fire (Initial vs. Final)								
Soil Burn Severity	Acres by Severity on NFS Lands		Percent of Total Acres on NFS Lands		Acres of Severity on Private Lands		Percent of Total Acres on Private Lands	
High	2,559	1,480	8%	3%	12	5	2%	1%
Moderate	15,807	15,864	47%	30%	222	158	32%	22%
Low	12,190	28,929	36%	54%	377	485	54%	67%
Unburned	3,140	7,132	9%	13%	85	77	12%	10%
Grand Total	33,696	53,405	100%	100%	696	725	100%	100%

Burn Severity By Ownership as of September 27, 2018:

Additional/updated information from final assessment is reflected in blue font.

Figure 1: Final Soil Burn Severity Map (interim 1/final map on left, Initial map on right)



Physical Characteristics of the Burned Landscape

SOILS

An estimated 33% of the area within the 416 Fire perimeter had high or moderate SBS and may have developed water repellent soils as a result of the fire. Water repellent soils develop when organic material (dead plant debris) on the soil surface burns during a fire, releasing waxy substances that coat soil particles—basically "shrink-wrapping" the soil and filling in the pores that would normally allow water to soak in during rain events. When water can't infiltrate into the soil because the pores are blocked, water runs over the surface causing erosion and increased flood potential.

Soil erosion models indicate that relative to pre-fire conditions, erosion rates are expected to increase from negligible to 8 tons of soil per acre. For perspective, one acre of soil equal to the thickness of one sheet of paper is equal to one ton of sediment. The increased erosion can result in downstream sediment delivery and increased flooding affects. Increased sediment can also block culverts and other infrastructure and degrade water quality.

While soils in high severity burned areas may lose some productivity and vegetative recovery will be slow, over time, natural processes will result in effective revegetation of these soils. Soil loss may be greater in localized patches but these impacts are not considered significant and will not result in permanent impairment of soil productivity in the long-term (10 years).



Moderate Soil Burn Severity

<u>HYDROLOGY</u>

Prior to the fire, the surface duff and litter acted as a 'sponge' that naturally absorbed water during rainfall events and promoted infiltration into the soils. Post-fire, the loss of the surface cover in combination with newly created water repellent soils results in increased flooding, particularly downstream of areas of high and moderate soil burn severity. Relative increases in flood flows for after summer thunderstorms for selected watersheds are displayed in Figure 2.

Figure 2: Relative increases in post-fire summer thunderstorm flood flows. (interim 1/final map on left, Initial map on right)



The most damaging post-fire effects are likely to occur after high intensity storms. Minor precipitation in high and moderate soil burn severity areas is likely to produce runoff that would not have occurred previously, and moderate or major precipitation could produce extreme runoff events, particularly in steep drainages. Thunderstorms moving through the area may cause increased flow. Post-fire peak flows will vary depending on the amount of vegetative recovery and the degree that hydrophobic soil layers are broken up before the next high-intensity storm. Areas that have the highest potential for increased flows resulting from the fire includes drainages with large amounts of high and moderate burn severity. Debris flows in these areas are a risk to life and safety for forest visitors and workers, and to property including roads, trails, bridges and spring developments.

In the larger Hermosa Creek watershed, the predicted flood flows are still below spring peak flows that occur from snowmelt runoff. Existing infrastructure should be able to accommodate these increased summer flows. However, there is a chance that increased debris and logs from the burn area will collect and create debris and log dams that could subsequently dislodge and cause outburst floods. This could pose a serious risk to life and property downstream during high flow events since they carry logs, rocks, and a deluge of mud.

In the smaller watershed areas of Tripp Gulch and Dyke Canyon, runoff from post-fire rainfall events could exceed pre-fire peak flows. The channels in these canyons are smaller and there is less room for the flood waters to spread out, increasing velocity and erosion potential.

<u>GEOLOGY</u>

Debris flows from burned logs are among the most hazardous consequences of rainfall on burned hillslopes. Debris flows pose a hazard distinct from other sediment-laden flows because of their unique destructive power. Debris flows can occur with little warning and can exert great impulsive loads on objects in their paths. Even small debris flows can strip vegetation, block drainage ways, damage structures, and endanger human life. Additionally, sediment delivery from debris flows can "bulk" the volume of flood flows, creating an even greater downstream flooding hazard. The U.S. Geological Survey (USGS) used the SBS map in their modeling to predict risk of debris flows (Figure 3). Debris flows are likely in the upper Hermosa drainage, but will likely dissipate within the low gradient Hermosa Creek channel. The results of the USGS debris flow modelling effort will be available at: http://landslides.usgs.gov/hazards/postfire_debrisflow/2018.

Figure 3. USGS Combined Probability and Volume Predicted Debris Flow Potential.



IDENTIFIED VALUES AT RISK

The BAER team analyzed the fire related threats to the identified values-at-risk for potential impacts from increased stream flows, loss of water control on trails and roads, increased debris flow risk, increased sediment delivery to streams, and establishment of invasive weeds. The team used a risk matrix (Probability of Damage or Loss and the Magnitude of Consequences) to evaluate the risk level for each value identified during the BAER assessment.

Human Life and Safety

Substantial threats to life and safety exist in and below areas of high and moderate burn severity. The greatest concerns are in the southern portion of the fire due to increased debris flow potential. Debris flows can be initiated with as little as 0.25 inches of rain. Rain gages have been established in key areas to provide advanced notice of rainfall events that could cause debris flows.

USFS Roads and Trails

Roads and trails within the San Juan National Forest are currently closed and will remain closed until hazards are mitigated and crews conduct repair work. Roads within the burned area are at risk from impacts from increased water, sediment, and/or debris. Impacts include damage to the road and/or loss of access due to severe erosion of the road surface, or deposition of sediment or debris. Roads within the burned area are also likely to exacerbate the risk of flooding and erosion by collecting surface water, concentrating it and delivering it to hillslopes or stream channels. Most of the roads within the burned area have inadequate cross-drainage for anticipated post wildfire flows.

~ 50 miles of trail and 6.9 miles of road are within the fire perimeter. Trail values at risk include trail tread, water quality, and fish habitat. It is anticipated that increase in flows, sediment, and debris associated with the fire effects will cause trail rilling and erosion, trail approaches to stream crossings on steep slopes are at risk of failure, and cut slope and fill slope failures are have already and are likely to occur. In addition to the resource degradation, the trails are likely to become difficult, impassable, or dangerous for travel.

USFS Spring/Water Developments

16 Forest Service spring/water developments exist within the burn perimeter. Spring/Water developments are included in FS infrastructure and provide numerous benefits. These structures provide for water quality and sediment control by acting as a basin for runoff, sediment, and debris flows.

Native Plant Communities

Noxious weeds are the most serious ecological threat, due to the fact that large burned areas open the watersheds to the rapid spread of species adapted to colonizing disturbed soils. Noxious weeds displace native species and can disrupt ecological relationships and connections, reducing ecosystem stability. The appearance, function, economic values, and resilience of large landscapes can be substantially changed by invasive species. The BAER team recommends conducting noxious weeds surveys and treatments in areas of moderate to high burn severity that are most prone to the spread of noxious weeds (along roads and trails) and treating them early.

Riparian Areas

Most of the drainages in the 416 burn area are in steep narrow canyons. Riparian vegetation is limited. Areas where the valley floors are wider and or gentler have developed riparian areas. High to moderate severity burned riparian areas are likely to have destabilized banks and sedimentation.

Fisheries

Changes in supplies of water and sediment are commonly observed after wildfire. The increase in sediment can reduce macroinvertebrate populations, reduce spawning areas, negatively affect trout

habitat and impact native cutthroat trout species. Inter-agency coordination with the Colorado Parks and Wildlife is ongoing to mitigate potential threats to these fisheries.

Emergency Treatment Objectives:

The approved treatments on National Forest System lands can help to reduce the impacts of the fire from storm events, but treatments cannot fully mitigate the post-fire effects of the fire. The treatments listed below are those that are considered to be the most effective on National Forest System lands to minimize threats to identified values at risk.

Land Treatments

The objective of the land treatments are to:

- Promote and protect native and naturalized vegetative recovery by reducing the spread of noxious weeds.
- Promote and protect native and naturalized riparian vegetative recovery and provide for streambank stabilization and reduction in erosion.
- Site stabilization, foster recovery, and reduce values at risk to the habitat.

Treatment description:

- Invasive plant detection and treatment along the Forest Service trails and drainages, that were of high to moderate burn severity and where non-native invasive plants are absent or present in small amounts, will be necessary to prevent spread and dispersal of non-native invasive plants into newly burned and disturbed areas.
- Approximately 65 acres of mapped riparian habitat burned as high or moderate intensity. Riparian vegetation is accustomed to disturbance and thrives on flooding. However, if the increase in water yield is too great, the riparian vegetation can be lost and streambanks can become destabilized. The moderate to high severity burn areas will be surveyed and willows cuttings will be planted as appropriate and feasible to stabilize eroding banks.

Road and Trail Treatments

The objective of the road and trail treatments are to:

- Protect road and trail investments from becoming impassible and damaged due to increased post-fire runoff.
- Reduce sedimentation into streams degrading water quality.
- Improve road drainage by increasing ditch and catchment basin capacity to reduce the potential for road failure due to increased flows.

Treatment description:

- Bridge Removal Remove the South Fork Bridge from Hermosa Creek to remove the hazard of the debris dam it has created.
- Storm Proofing and road stabilization: Activity will include cleaning culverts inlets, road ditches, and ensuring water does not concentrate on the road.
- Storm Patrol and response of trail/drainage features will include sections downstream of the Clear Creek/ Hermosa confluence. Storm inspection/response will keep road culverts and trail drainage features functional by cleaning sediment and debris from in and around features between or during storms.
- Trail Stabilization Work will include the installation of drainage features (outsloping, rolling grade dips, water bars), stabilization of two drainage crossings, and snagging trees as appropriate for worker safety. This work is necessary to protect the trail asset by diverting anticipated increases in surface runoff off the trail.

Protection/Safety Treatments

The objective of the protection/safety treatments are to:

1. Protect human life and safety by raising awareness through posting hazard warning signs at recreation sites, trailheads, and when entering the burn area.

2. Protect life/safety through an area closure. Limiting public access to the burn area would minimize the potential for loss of life or injury from floods, debris flows, and hazard trees.

Treatment description:

• Treatment activities will include installation of trail closure signs.

Property/Land Treatments:

The objective of the property/land treatments are to:

- 1. Provide protection to the integrity of the spring/water development structures
- 2. Provide protection from floodwater, floatable debris, sediment, boulders, and mudflows.
- 3. Reduce sedimentation into streams degrading water quality

Treatment description:

 Treatment activities will include the removal of sediment and debris from spring and water developments

CONCLUSION

The BAER team has identified imminent threats to values at risk based on a rapid scientific and engineering assessment of the area burned by the 416 Fire. The assessment was conducted using the best available methods to analyze the potential for flooding and debris flows. Options for reducing postfire peak stream flows, soil erosion, and debris flow potential are limited due to the nature of the burn, rugged topography and slope characteristics. As a result, treatment recommendations focus on mitigation measures to minimize loss of life and damage to values at risk. These mitigations include area closures, warning signs, and public safety approaches such as installation of an early warning system to notify area residents and users of when damaging storms may be approaching.

The findings provide the information needed to prepare and protect against serious post-fire threats. Agencies and landowners are encouraged to use the findings to prepare plans and take actions to protect values at risk.