East Troublesome Fire Watershed Recovery

Final Report

CTGG1 2023*2041

Prepared for:

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Colorado Watershed Restoration Program

October 2022

Prepared by:

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Final Report
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Background

On Oct. 14, 2020, the East Troublesome Fire (ETF) was reported northeast of Kremmling on the Arapaho National Forest. With high winds and low humidity in the following weeks, the fire's final acreage reached 193,812 acres by the time it was fully contained on Nov. 30. See **Figure 1** for a general location of the ETF burn scar. Grand County and Northern Water at once began collaborating with partners on watershed restoration and planning of projects to mitigate threats to life and property due to post-fire flood, sediment, and debris.

East Troublesome Fire October 22, 2020

Initial restoration efforts were primarily focused on implementing projects through the USDA Natural Resources Conservation Service (NRCS) Emergency Watershed Protection (EWP) Program. However, the EWP Program is restricted to private lands, and can only be used on federal lands in specific special scenarios where federal lands are immediately upstream and directly connected to protection of private lands. As approximately 90% of the ETF burn scar is within federal lands, Northern Water, in coordination with Grand County, contracted with the United States Forest Service (USFS) under a Participating Agreement (PA) and the Bureau of Land Management (BLM) under a cooperation agreement to provide restoration activities on USFS and BLM lands.

Three grants have been issued by CWCB to Northern Water for ETF Watershed Restoration Activities as summarized below. This Final Report is specific to CWCB grant 2023*2041 which is supplying matching funds to the USFS and BLM agreements for mulch treatment on federal land. **Figure 2** shows the general area receiving mulch treatment under this grant.

CWCB ETF Grants Summary

CWCB contracted with Northern Water for three grants, all related to the ETF Watershed Restoration Efforts. Both 2021*3428 and 2022*2360 are primarily focused of funding the local match requirement for EWP projects. Of those, 2021*3428 has already been fully disbursed and closed out.

CWCB ETF Grant Summary

CONTRACT NO.	MAX CWCB AWARD	MAX FEDERAL MATCH	PRIMARY FOCUS
CTGG1 2021*3428	$4,150,000	$16,000,000	EWP Local Match
CTGG1 2022*2360	$4,663,524	$17,454,000	EWP Local Match
CTGG1 2023*2041	$4,300,000	$12,895,685	USFS/BLM Match

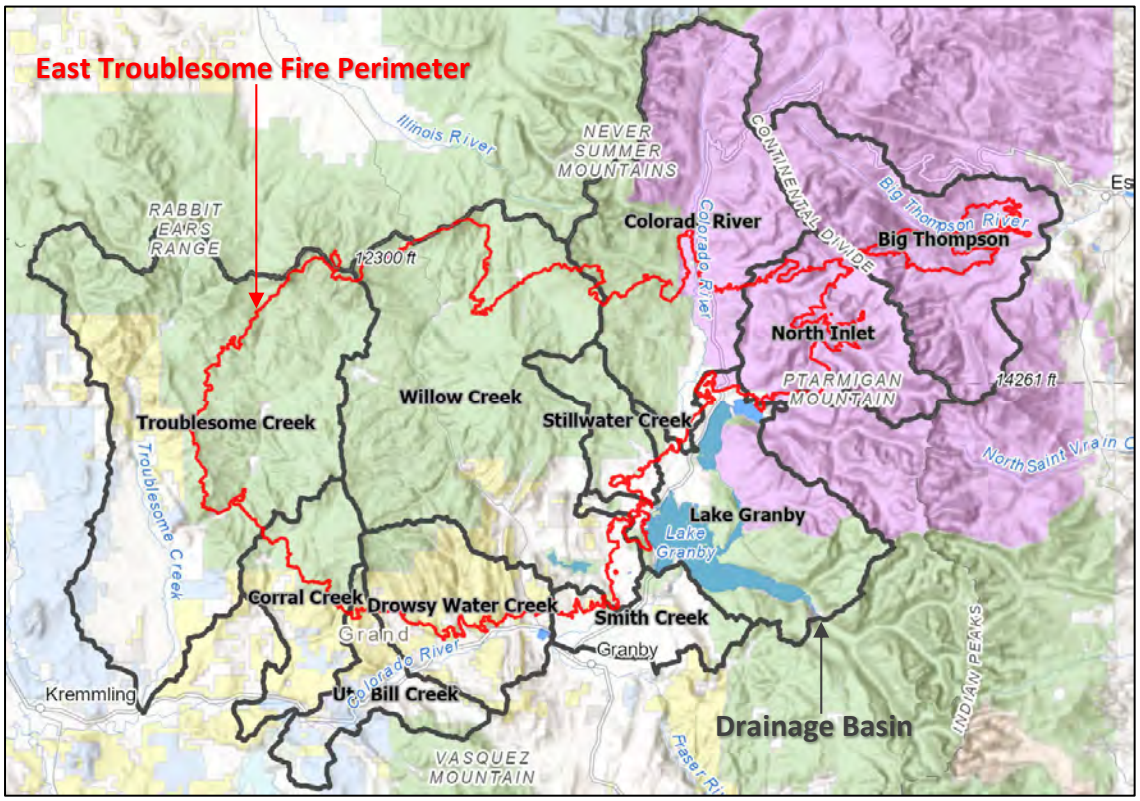

Figure 1 – East Troublesome Fire Location Map

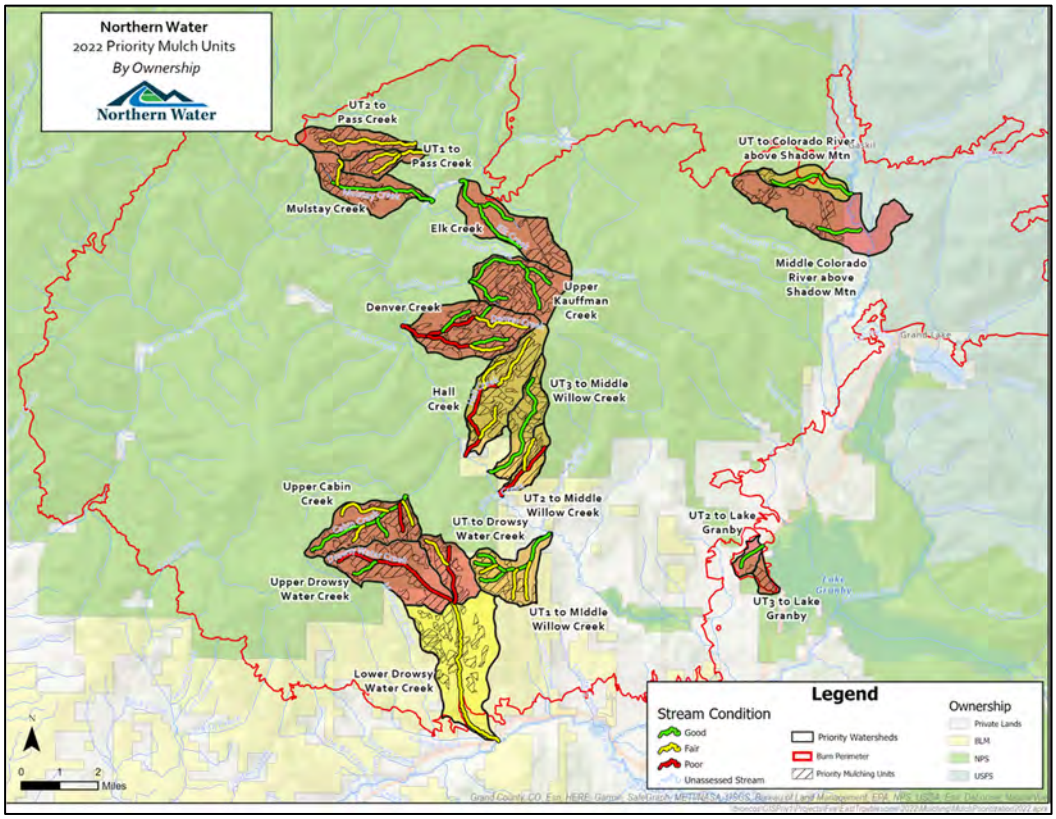

Figure 2 – General Location of Mulch Treatment on Federal Lands

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Task 1 – Aerial Mulching

Purpose: This task supplied match funds to be used on aerial mulching on USFS and BLM lands. At the time of grant application, the USFS had $17 million of funding earmarked for ETF work, but only $6.19 million was committed through the Participating Agreement. Additionally, while BLM had shown a desire to fund mulching on its land, zero funds were currently committed through the Cooperating Agreement.

Helicopter Loading at Mulch Staging Area

The Drowsy Water Creek Watershed, which spans both USFS and BLM lands, had been identified by Grand County as a special area of concern and it was therefore a priority area to receive mulch as soon as possible. Northern Water and Grand County staff were concerned BLM funding would not come in time to allow treatment in the 2022 season. Therefore, the grant application described that CWCB funds would primarily be used on this watershed unless BLM funds arrived in time, in which case CWCB funds would be used on other lands either through mulching or point source treatments as described in Task 2.

Result: A collaborative effort to prioritize impacted watersheds within the ETF burn area was undertaken by multiple stakeholders in March and April of 2022. Partners to this prioritization effort were Northern Water, USFS, BLM, NRCS, and Grand County. Supporting this effort with analysis and technical input were JW Associates and Matrix Design Group. The aim of this work was to identify values at risk from post-fire sediment and debris flows and how those values could be protected through the utilization of aerial mulch treatments or point projects. This effort is summarized below but a complete description of the prioritization methods and recommendations can be found in **Attachment B.**

Hiking towards mulched areas for on the ground validation

Only highest and high composite hazard ranked watersheds were categorized into priority and non-priority for aerial mulching with the noted exception of Lower Drowsy Water Creek which was included as a priority watershed to protect life and property. Priority focus was applied to lower elevation watersheds near significant values at risk that are more likely to receive high intensity rainstorms associated with summer monsoons.

The final ranking of aerial mulch priority watersheds identified 9,177 acres with an estimated cost of over $18 million dollars. This was ultimately narrowed down to 7,493 acres based on field validation and budgetary considerations and the final project cost came in at $17,459,914.40.

To fund this amount, the USFS increased their funding from $6.19 million to $10.19 million and BLM did end up funding aerial mulching efforts on its land. CWCB funds filled in for the remaining $4,564,229.40 through full disbursement of this grant (both Task 1 and Task 2 dollars), as well as $264,229.40 reallocated from 2022*2360's Task 2.

Actual Expenses

VENDOR	EXPENSES
WESTERN STATES	$17,459,914.40

FUNDING SOURCE	AMOUNT
USFS	$10,190,000.00
BLM	$2,705,685.00
CTGG1 2023*2041	$4,300,000.00
CTGG1 2022*2360	$264,229.40

Deliverable: A map showing the areas mulched under this task is provided in **Attachment A.**

Task 2 – Point/Linear Project Construction

Purpose: This task was to supply funds for point and linear type projects which were anticipated to occur in 2023. At the time of this grant application, it was predicted that grant 2022*2360 would not need a sizable portion of funds for EWP match and could instead be reallocated to fund a large portion of the federal land mulching. If that occurred, it would leave funds under this grant to be used in 2023 under this Task 2.

Results: As EWP and federal land projects developed throughout 2022, there was a greater need than expected for point and linear projects occurring under the EWP program which will end up using most of the 2022*2360 grant. Therefore, funds under this Task 2 were disbursed under Task 1 to help fund aerial mulching on federal land.

Deliverable: Not Applicable

Conclusions and Discussion

Recent Colorado fires have proven how important watersheds are to water providers and the population they serve. One specific challenge to affected entities in trying to provide post-fire watershed recovery efforts, is that the various land ownership breakdown of a watershed presents a difficult path to recovery as water providers do not have direct control of their watersheds. The land ownership challenge is increased when there are also multiple federal entities that are landowners as each federal entity has their own budgetary restrictions and can have differing opinions on best, or even allowed, treatments.

Northern Water and Grand County have partnered with NRCS, USFS, and BLM to bring federal dollars and with CWCB to bring state dollars to watershed restoration efforts. While the federal sources of funds have strict geographic constraints within the ETF burn scar, the flexibility of CWCB funds to be used on all lands within the ETF burn scar has been an invaluable asset as projects go from conceptual to planning to design and implementation. For example, with this specific grant BLM funding was uncertain but Northern Water was able to still plan and design for the high priority BLM Drowsy Creek on BLM land because we knew CWCB funds could be used there if BLM funds did not materialize, or, as the case happened to be, CWCB funds were able to be moved to USFS lands on the next priority area when BLM funding did become available.

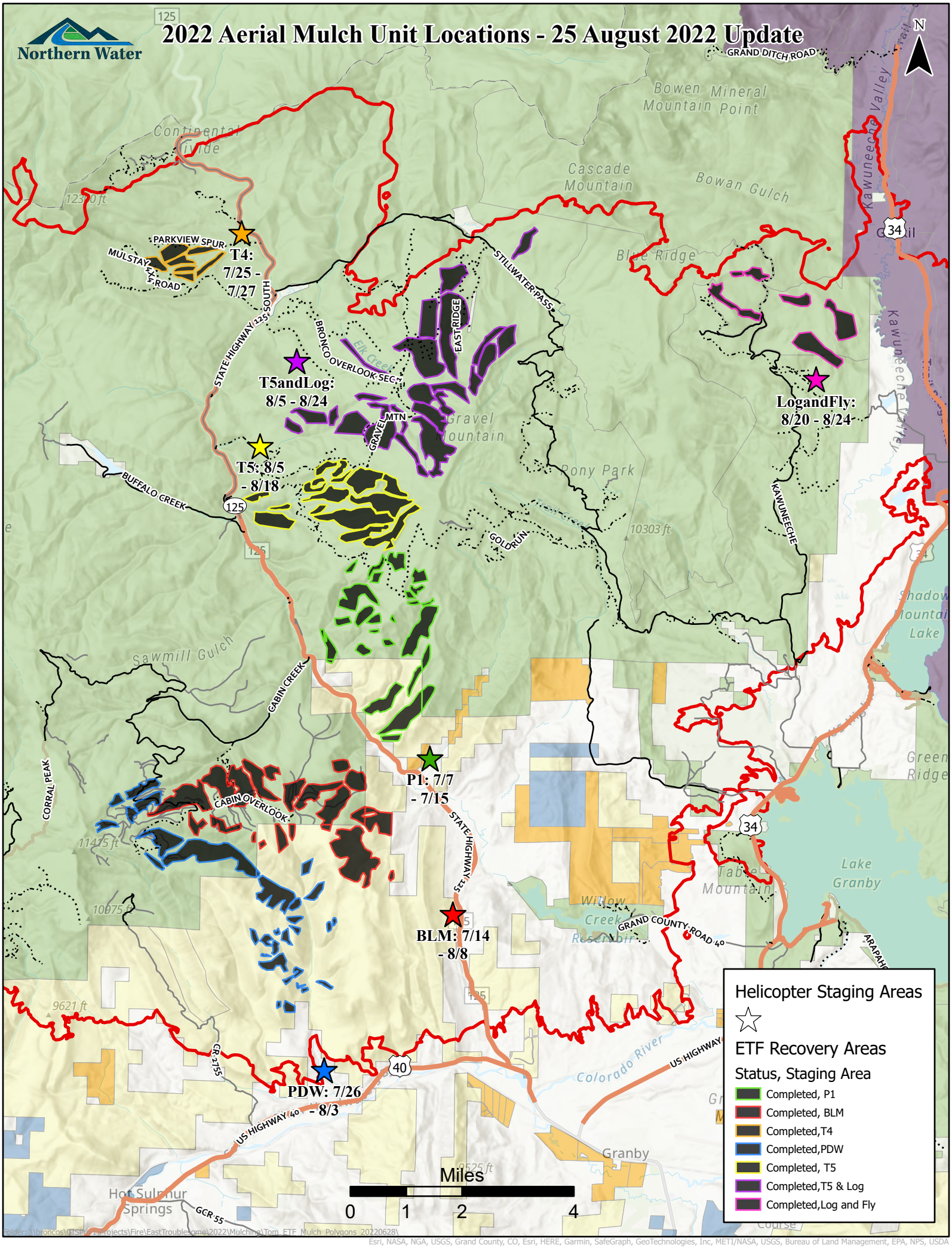
All mulching activities for the ETF burn scar, both under this grant and the EWP program are complete and neither Northern Water nor Grand County have plans for mulching in future years. All combined, through the EWP program in 2021 and through USFS and BLM work in 2022, $7.26 million from CWCB was leveraged with $20.99 million of federal dollars to implement a total of $28.25 million of aerial mulching on 12,130 acres. Assuming a full disbursement of CWCB funds under its three ETF grants ($13.11 million), the $7.26 million towards aerial mulching will be approximately 55% of CWCB grant funds.

A video recap of this project can be found here:
https://youtu.be/uY1aRoy8Bkk

Using a portion of CWCB grant funds that were originally identified as EWP match for Area A, a fourth Task was created under 2022*2360 for the purpose of conducting a mulch efficacy study through Colorado State University and USFS Rocky Mountain Research Station. This study will be able to better inform future post-fire mulching projects by looking across a range of scales in nested mulched and unmulched watersheds. The findings and implications of this work are intended to be informative for watersheds statewide.

Attachment A

Aerial Mulching Map


Northern Water
2022 Aerial Mulch Unit Locations - 25 August 2022 Update
N
GRAND DITCH ROAD
Bowen Mineral Mountain Point
Continental Divide
Cascade Mountain
Bowan Gulch
Blue Ridge
Kawuneeche Valley Trail
PARKVIEW SPUR
MULSTAY FLAT ROAD
T4: 7/25 - 7/27
STILLWATER PASS
STATE HIGHWAY 125 SOUTH
BRONCO OVERLOOK SECT
EAST RIDGE
Elk Creek
T5andLog: 8/5 - 8/24
GRAVEL MTN
Gravel Mountain
LogandFly: 8/20 - 8/24
Pony Park
T5: 8/5 - 8/18
BUFFALO CREEK
GOLD RUN
10303 ft
KAWUNEECHE
Shadow Mountain Lake
Sawmill Gulch
GABIN CREEK
CORRAL PEAK
CABIN OVERLOOK
P1: 7/7 - 7/15
STATE HIGHWAY 125
11415 ft
10075 ft
Green Ridge
Lake Granby
Willow Creek Reservoir
GRAND COUNTY ROAD 40
BLM: 7/14 - 8/8
ARAPAHO
9621 ft
CR 275
PDW: 7/26 - 8/3
US HIGHWAY 40
Colorado River
US HIGHWAY
Granby
Hot Sulphur Springs
GCR 55
Miles
0 1 2 4
Helicopter Staging Areas
ETF Recovery Areas
Status, Staging Area
Completed, P1
Completed, BLM
Completed,T4
Completed,PDW
Completed, T5
Completed,T5 & Log
Completed,Log and Fly
Esri, NASA, NGA, USGS, Grand County, CO, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA

Attachment B

Mulch Prioritization Methods and Recommendations Memo and Maps

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MEMORANDUM

To: Robert Skorkowsky, U.S Forest Service
Jamie Dahlkemper, US Bureau of Land Management
Ed Moyer, Grand County Colorado
Todd Boldt, US Natural Resource Conservation Service
From: Curtis Hartenstine, Northern Water
Date: May 4, 2022
Subject: ETF 2022 Aerial Mulching

Introduction

A collaborative effort to prioritize impacted watersheds within the East Troublesome Fire (ETF) burn area was undertaken by multiple stakeholders in March/April 2022. Partners to this prioritization effort are Northern Water, US Forest Service, US Bureau of Land Management, US Natural Resource Conservation Service and Grand County. Supporting this effort are analysis and input from JW Associates and Matrix Design Group. The objective of this work was to identify values at risk from post-fire sediment and debris flows and how those values could be protected through the utilization of aerial mulch treatments and/or point projects.

Wood mulch has been shown to reduce peak flows and increase soil moisture which speeds revegetation. By reducing overland flow from bare soils, the total sediment load and peak flows to unstable stream reaches is also reduced. Unstable stream reaches are particularly vulnerable to further erosion. Large peak flows and sediments coming from the hillslope can amplify in-stream erosion and lead to massive bank failures ultimately contributing to debris flows. This is a concern not only for natural resources but also for property and lives. Mulch reduces the energy and volume of flows coming into these reaches and thereby reduces the sediment yield from those unstable streams and stream banks, lessening the risk of debris flows. It is also important to note that protection of the hillslopes in these areas would also make any long-term stream restoration and stability point projects more effective.

Point projects to stabilize stream systems and hillslopes and protect other values at risk are also being planned in the ETF burn area. These projects have not yet been identified but will become the focus of the recovery effort planning in May. Watersheds and systems that may benefit from point projects were considered in the aerial mulch prioritization exercise so that the most effective treatment would be implemented in each watershed. In this assessment, point treatments have not been thoroughly evaluated. Where point treatments have been suggested, significant further analysis is required before a specific kind of treatment would be recommended.

Methods

The JW Associates Composite Hazard Ranking combines the ranking of four hazard components. The components are: Wildfire Hazard from the dNBR burn severity data; Hillslope Erosion Hazard from the Colorado Forest Restoration Institute Gross Hillslope Erosion model, modeled with the dNBR burn severity data; USGS Debris Flow Hazard as likelihood of debris flow occurrence following a rain event of 6mm in

15 min peak intensity, modeled with the dNBR burn severity data; and Roads Composite Hazard incorporating three road density pieces: total roads in the watershed, roads within 100m of streams, and road/stream crossings. The Composite score was then adjusted for the areas treated with mulch in 2021, reducing the relative score of a watershed by a factor of the percent moderate and high burn severity treated in 2021.

Focusing on the highest- and high-risk watersheds, Matrix Design Group evaluated the major rivers and tributaries within those watersheds for stream stability. Utilizing post-fire LiDAR data, a relative elevation model was created to understand stream stability, connectivity to the floodplain, gradient, and other geomorphological features. Those segments identified as less stable were generally considered candidates for point treatments. Where stream systems are unstable, instream processes become significant sources of sediment production from watersheds.

Qualitative data on pre/post-fire conditions of stream stability, revegetation and other landscape characteristics, known values at risk, and operational considerations were also considered in the decision-making process. To maximize effectiveness and provide efficiency in the treatment application, all mulch polygons within a selected watershed will be treated. All selected polygons will undergo field validation to determine revegetation status and how well the watershed has recovered; those with substantial revegetation and natural recovery will be omitted from treatment.

Recommendation

Given the current understanding of funding availability, only highest and high composite hazard ranked watersheds were categorized into priority and non-priority for aerial mulching with the noted exception of Lower Drowsy Water Creek which was included as a priority watershed to protect life and property. Priority focus was applied to lower elevation watersheds near significant values at risk that are more likely to receive high intensity rainstorms associated with summer monsoons.

Those watersheds exhibiting high natural recovery (e.g., Troublesome, Trail Creek drainages), and those farthest from significant values at risk (e.g., Willow Creek Headwaters) were not assigned priority at this time. High altitude areas do revegetate well after fire because they receive more moisture in the form of snow which results in increased soil moisture later in the spring. Areas transitioning to alpine are also more open so they do not burn as hot and may not exhibit significant soil destabilization. In the ETF burned area north-facing slopes have been observed to have areas of higher burn severity, likely due to more dense forest cover before the fire. Where there are large areas of north-facing slopes that have identified high burn severity and are connected to streams, those areas would be higher priority for treatment.

A summary of the ranked watersheds recommended for aerial mulch, acreage and estimated costs are included in **Table 1. Ranked Aerial Mulch Priority Watersheds**.

Table 1. Ranked Aerial Mulch Priority Watersheds

Watershed Name	BLM Treatment Unit (acres)	BLM Unit Estimated Cost*	USFS Treatment Unit (acres)	USFS Unit Estimated Cost*
Upper Drowsy Water Creek	224	$450,240.00	646	$1,298,460.00
UT to Drowsy Water Creek	263	$528,630.00	82	$164,820.00
Lower Drowsy Water Creek	742	$1,491,420.00	0	$0.00
UT2 to Lake Granby	0	$0.00	25	$50,250.00
UT3 to Lake Granby	0	$0.00	113	$227,130.00
UT1 to Middle Willow Creek	500	$1,005,000.00	1	$2,010.00
UT2 to Middle Willow Creek	209	$420,090.00	75	$150,750.00
UT3 to Middle Willow Creek	176	$353,760.00	335	$673,350.00
Upper Cabin Creek	0	$0.00	616	$1,238,160.00
Hall Creek	4	$8,040.00	848	$1,704,480.00
Denver Creek	0	$0.00	1,177	$2,365,770.00
UT to Colorado River above Shadow Mtn	0	$0.00	46	$92,460.00
Middle Colorado River above Shadow Mtn	0	$0.00	432	$868,320.00
Upper Kauffman Creek	0	$0.00	1,061	$2,132,610.00
Elk Creek	0	$0.00	516	$1,037,160.00
UT2 to Pass Creek	0	$0.00	381	$765,810.00
UT1 to Pass Creek	0	$0.00	234	$470,340.00
Mulstay Creek	0	$0.00	471	$946,710.00
TOTAL	**2,118**	**$4,257,180**	**7,059**	**$14,188,590**
			TOTAL ACRES	**9,177**
			TOTAL ESTIMATED COST	**$18,445,770.00**

***Estimated costs are calculated using an estimated rate of $2,010.00/acre for aerial mulch application.**

Priority Aerial Mulch Watersheds

Upper Drowsy Water Creek, UT to Drowsy Water Creek, and Lower Drowsy Water Creek

Recommendation: Aerial Mulch

The stream conditions are currently poor and fair. Grand County has expressed the desire to mulch as much as they can in Drowsy Water due to health and safety issues. There are a number of large potential polygons that are on north-facing slopes and are connected to the stream. Lower Drowsy Water Creek has a moderate composite hazard ranking, but given the overall condition of the watershed and the risks to life and property, it is recommended to mulch units within the lower watershed as well.

UT2/UT3 to Lake Granby

Recommendation: Aerial Mulch

This small area is immediately adjacent to HWY 34, Lake Granby and several parcels of private property and has a stable stream reach. The large mulch polygon extends across the northeast facing ridge of Table Mountain from the ridgetop to the highway just in front of the reservoir. If this watershed experiences a rainfall event, it will likely produce a debris flow that could impact HWY 34 as well as Lake Granby. Given the risks to access, life and property, it is recommended to mulch units within the small watershed.

UT1 to Middle Willow Creek

Recommendation: Aerial Mulch

UT1 to Middle Willow Creek received some mulch treatments in 2021. In this area, there are burned BLM lands that were not available for treatment in 2021. There is a burned and interconnected headwaters area on BLM land that was viewed in the field in 2021. JW Associates' field review concluded that the area has a high potential to exhibit significant post-fire runoff and sediment yield. The stream conditions are currently good. There are three small impoundments above Highway 125. They appear to be constructed by a landowner and are erodible soil materials. These could easily fill, overtop and fail which would cause a hazard to Highway 125.

UT2 to Middle Willow Creek

Recommendation: Aerial Mulch

UT2 to Middle Willow Creek was not visited in the field or mulched in 2021. The stream conditions are currently poor. A number of smaller watersheds in this area have experienced debris flows that have entered Willow Creek. This watershed has one large potential mulch area that is on a north facing slope and runs from the ridgetop to the stream. If this watershed experiences a rainfall event, it will likely produce a debris flow that could impact Willow Creek. The aerial imagery does not show any areas of aspen.

UT3 to Middle Willow Creek

Recommendation: Aerial Mulch

UT3 to Middle Willow Creek was not visited in the field or mulched in 2021. The stream conditions are currently good. A number of smaller watersheds in this area have experienced debris flows that have entered Willow Creek. This watershed has one large potential mulch area that is on a north facing slope

and runs from the ridgetop to the stream. If this watershed experiences a rainfall event, it will likely produce a debris flow that could impact Willow Creek.

Upper Cabin Creek

Recommendation: Aerial Mulch

Upper Cabin Creek was not visited in the field, except for the outlet, or mulched in 2021. The stream conditions are currently poor in the lower portions and good/fair in the upper portions based on Matrix Design Group's analysis. The outlet of Cabin Creek was visited in July 2021 (Figure 1). The Creek was running down the road, and debris and sediment were being transported and deposited onto the road and into Willow Creek. Upper Cabin Creek has an extensive road network which may be contributing to post-fire watershed response. The upper watershed has some concentrated areas with potential mulch polygons.

Figure 1. Cabin Creek running down the road just above Willow Creek

Hall Creek

Recommendation: Aerial Mulch

Hall Creek was not visited in the field or mulched in 2021. The stream conditions are currently poor and fair. Hall Creek has a long stream channel that is bordered by some large north-facing mulch polygons. The aerial imagery does not show many areas of aspen. Several smaller watersheds in this area have experienced debris flows that have entered Willow Creek.

Denver Creek

Recommendation: Aerial Mulch

Denver Creek was not visited in the field or mulched in 2021. The stream conditions are currently poor in the lower portions and good/fair in the upper portions based on Matrix Design Group's analysis. There are some large potential mulch polygons in Denver Creek. There are large areas on north-facing slopes that are connected to streams and do not appear to have any aspen. Some smaller polygons appear to be

more open and may be revegetating more quickly. There are several roads in Denver Creek that should be reviewed. Because the lower channel is in poor condition, it is evident that the watershed is experiencing adverse sediment yields and peak flows. US Forest Service campgrounds are at the bottom of this watershed.

UT to Colorado River above Shadow Mountain and Middle Colorado River above Shadow Mtn

Recommendation: Aerial Mulch

The polygons identified in this watershed are tributary to the North Fork of the Colorado River. Several private parcels are located lower in the watershed and the drainage is adjacent to the Supply Creek watershed, which was treated in 2021. The North Fork of the Colorado is known to carry a significant amount of sediment associated with other changes in watershed practices higher in the watershed and has been depositing these sediments in Shadow Mountain Reservoir.

Upper Kauffman Creek

Recommendation: Aerial Mulch

Upper Kauffman Creek was not visited in the field or mulched in 2021. The stream conditions are currently good. There are some large potential mulch polygons in Upper Kauffman Creek covering most of the watershed. There are large areas on north-facing slopes that are connected to streams and do not appear to have any aspen. Some smaller polygons appear to be more open and may be revegetating more quickly. There are several roads in Upper Kauffman Creek that should be reviewed. Lower Kauffman Creek is not rated as a high hazard watershed. The stream in Lower Kauffman Creek appears to be lower gradient with good riparian areas. One large area of this stream appears to have good connection to its floodplain. This looks like a depositional reach and would likely settle out some of the sediments and attenuate the peak flows from Upper Kauffman Creek.

Elk Creek

Recommendation: Aerial Mulch

Elk Creek was not visited in the field or mulched in 2021. The stream conditions are currently good in Elk Creek. There are some large potential mulch polygons in Elk Creek covering most of the upper watershed, which burned at mostly high severity. Recent research has shown that the headwaters or upper portions of a watershed are the most important contributors of sediment and erosion post-fire and should be prioritized for mitigation. Few aspen areas appear to be present in the watershed.

UT1 to Pass Creek, UT2 to Pass Creek, and Mulstay Creek

Recommendation: Aerial Mulch

UT1 and UT2 to Pass Creek and Mulstay Creek are the identified watersheds in Pass Creek with potential mulching areas. These three watersheds all cross Highway 125 just before joining Pass Creek which creates a potential health and safety hazard. These watersheds have not been visited in the field, but they have potential mulching polygons that have some large areas of north facing slopes that are connected to the streams, and few aspen areas appear to be present.

Priority Point Treatment Watersheds

Upper Middle Willow Creek/Lower Upper Willow Creek

Recommendation: Point Treatments

Identified mulch polygons within these areas are fragmented and relatively small compared to watershed size. Stream segment stabilities have been identified as fair/poor. Many of the channels in these watersheds are relatively small tributaries that feed directly into the Willow Creek mainstem. Due to their smaller contributing areas, these tributaries are not as high priority for mulching but they are steep and burned at moderate and high severity, and therefore the likelihood of debris flows is high. Point protection in these streams is of high importance to protect the Willow Creek mainstem from additional sediment and debris input, as well as to protect HWY 125.

Adams Creek

Recommendation: Point Treatments

Adams Creek was not visited in the field or mulched in 2021. However, the outlet was viewed in July as a debris flow entered Willow Creek and is modifying channel conditions (Figure 2). The stream conditions are currently poor. Adams Creek has some large areas of north-facing slopes that appear to have burned hot. These are connected and are located from the ridgeline to the stream in two locations. There appear to be only small areas of aspen. Adams Creek is expected to continue to deliver substantial amounts of sediment to Willow Creek. Stream channel processes are the dominate source of material to Willow Creek and point treatments are recommended to manage these sources.

Figure 2. Debris Flow from Adams Creek at Willow Creek

Upper Trail Creek and UT to Trail Creek

Recommendation: Point treatments

Trail Creek is the first tributary above Willow Creek Reservoir. In 2021, Northern Water mulched much of Lower Trail Creek and some of Middle Trail Creek. Upper Trail Creek and UT to Trail Creek watersheds

have a number of potential mulch polygons. The stream conditions are currently good based on Matrix Design Group's analysis. Trail Creek below these watersheds is relatively low gradient and mostly meandering through Middle Trail Creek. There is also a reservoir in the channel in that reach. There is good access to that portion of Trail Creek.

Upper and Lower Gold Run Creek

Recommendation: Point treatments

Some private lands in Lower Gold Run Creek were mulched in 2021. The stream conditions are currently good based on Matrix Design Group's analysis. JW Associate's field review in 2021 in Lower Gold Run Creek confirms that analysis. The channel has a recovering riparian area that is quite wide and connected with its floodplain in many locations. There is also a small impoundment in Lower Gold Run Creek. The stream in the lower portion of Upper Gold Run Creek appears to be in similar condition. These stream conditions experienced post-fire sediment yield and peak flows and remain in good condition. In addition, the polygons that were mulched in 2021 were starting to recover and some had good ground cover in many locations. A review of the aerial imagery shows large areas of aspen in these watersheds.

Bronco Creek

Recommendation: Point treatments

The stream channel stability in this watershed is ranked fair. Access via Forest Service roads is available and immediately adjacent to the Creek. Few potential mulch polygons are within this watershed.

Watersheds Requiring Further Analysis

Willow Creek Headwaters: UT3, UT4, UT5, UT6, Lost Lake

Recommendation: TBD

Middle Headwaters Willow Creek, Upper Headwaters Willow Creek

Recommendation: TBD

Troublesome Creek Headwaters: Headwaters East Fork Troublesome, UT 1 to Haystack Creek, UT 2 to East Fork Troublesome, UT1 to East Fork Troublesome

Recommendation: TBD

Hay Park Creek, UT9 Outlet East Fork Troublesome, UT 2 Wheatley Creek, UT 1 to Wheatley Creek, Upper Wheatley Creek, UT 10 to East Fork Troublesome, UT 11 to East Fork Troublesome, Paradise Gulch, UT 3 to Corral Creek

Recommendation: TBD

Composite Watershed Hazard Ranking

With 2021 Treatment

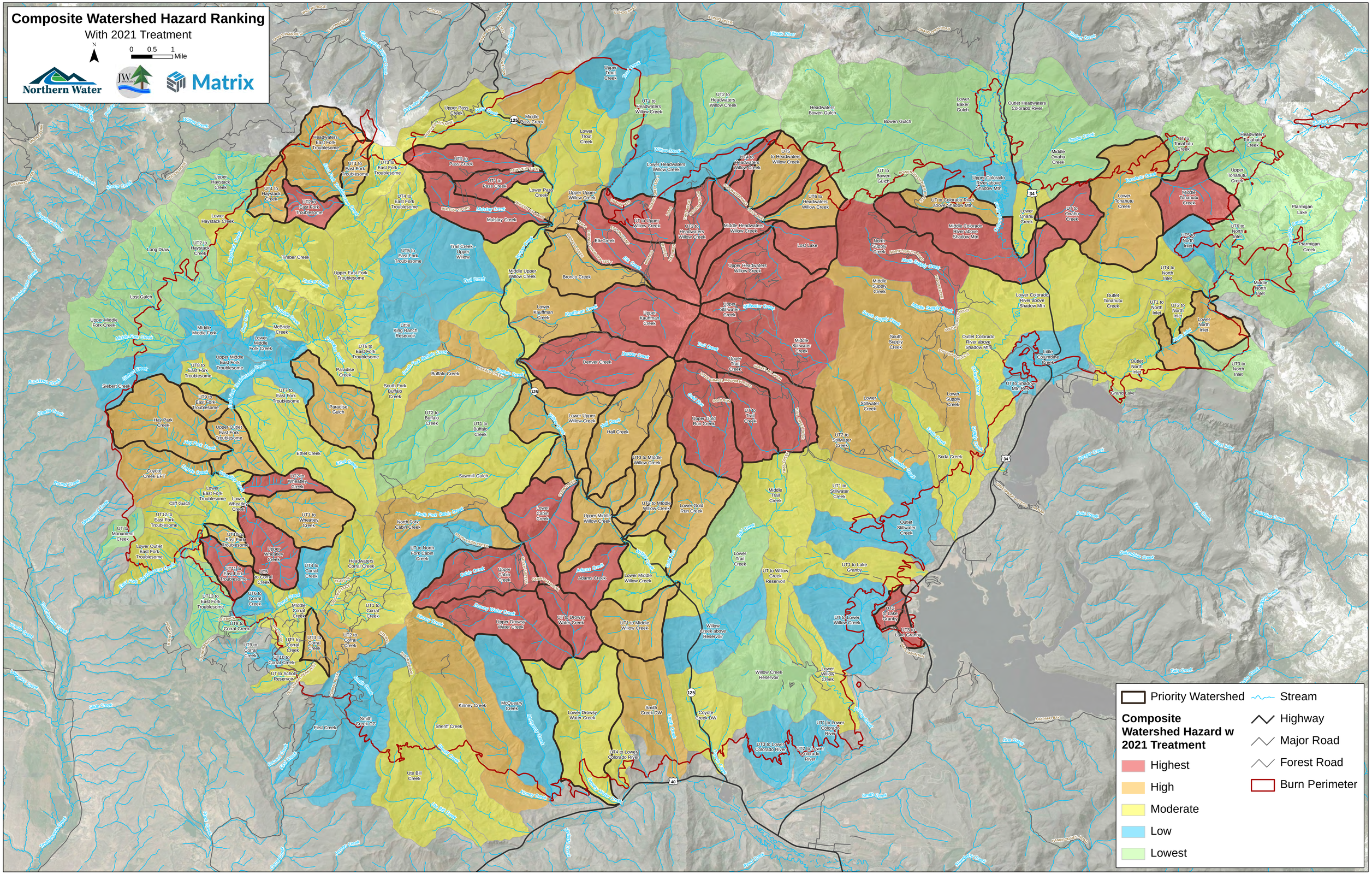
N

0 0.5 1 Mile

Northern Water

JW Associates

Matrix



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Overview

Preliminary Mulch Priority Polygon
With Stream Condition Assessment

N

0 0.5 1 Mile

Northern Water | JW | Matrix

Recommended Mulch Polygon Breakdown by Subbasin		
Subbasin Name	BLM Treatment Unit Acres	USFS Treatment Unit Acres
Adams Creek	16	460
Bronco Creek	0	297
Buffalo Creek	0	4
Denver Creek	0	1,177
Elk Creek	0	516
Hall Creek	4	848
Hay Park Creek	0	1,015
Headwaters East Fork Troublesome	0	767
Lost Lake	0	419
Lower Cabin Creek	0	446
Lower Drowsy Water Creek	742	0
Lower Gold Run Creek	60	686
Lower Kauffman Creek	0	4
Lower Upper Willow Creek	0	533
Middle Colorado River above Shadow Mtn	0	432
Middle Headwaters Willow Creek	0	663
Mulstay Creek	0	471
Paradise Gulch	0	721
Upper Cabin Creek	0	616
Upper Drowsy Water Creek	224	646
Upper Gold Run Creek	0	1,262
Upper Headwaters Willow Creek	0	809
Upper Kauffman Creek	0	1,061
Upper Middle Willow Creek	135	223
Upper Outlet East Fork Troublesome	0	267
Upper Trail Creek	0	831
Upper Wheatley Creek	0	637
UT to Colorado River above Shadow Mtn	0	46
UT to Drowsy Water Creek	263	82
UT to Trail Creek	0	671
UT to Upper Willow Creek	0	267
UT1 to East Fork Troublesome	0	161
UT1 to Haystack Creek	0	284
UT1 to Middle Willow Creek	500	1
UT1 to Pass Creek	0	234
UT1 to Wheatley Creek	0	740
UT10 to East Fork Troublesome	0	194
UT11 to East Fork Troublesome	0	305
UT2 to East Fork Troublesome	0	267
UT2 to Lake Granby	0	25
UT2 to Middle Willow Creek	209	75
UT2 to Pass Creek	0	381
UT2 to Wheatley Creek	0	233
UT3 to Corral Creek	0	196
UT3 to Headwaters Willow Creek	0	612
UT3 to Lake Granby	0	113
UT3 to Middle Willow Creek	176	335
UT4 to Headwaters Willow Creek	0	97
UT5 to Headwaters Willow Creek	0	432
UT6 to Headwaters Willow Creek	0	451
UT9 to East Fork Troublesome	0	231

Preliminary Mulch Priority Polygon (24,578 AC)

Priority Watershed

Mulch Priority Polygon in Rocky Mountain National Park (2,785 AC)

2021 Completed Mulch Polygon (5,209 AC)

Stream Condition

Good

Fair

Poor

Unassessed Stream

Ownership

BLM

NPS

USFS

Highway

Major Road

Forest Road

Burn Perimeter

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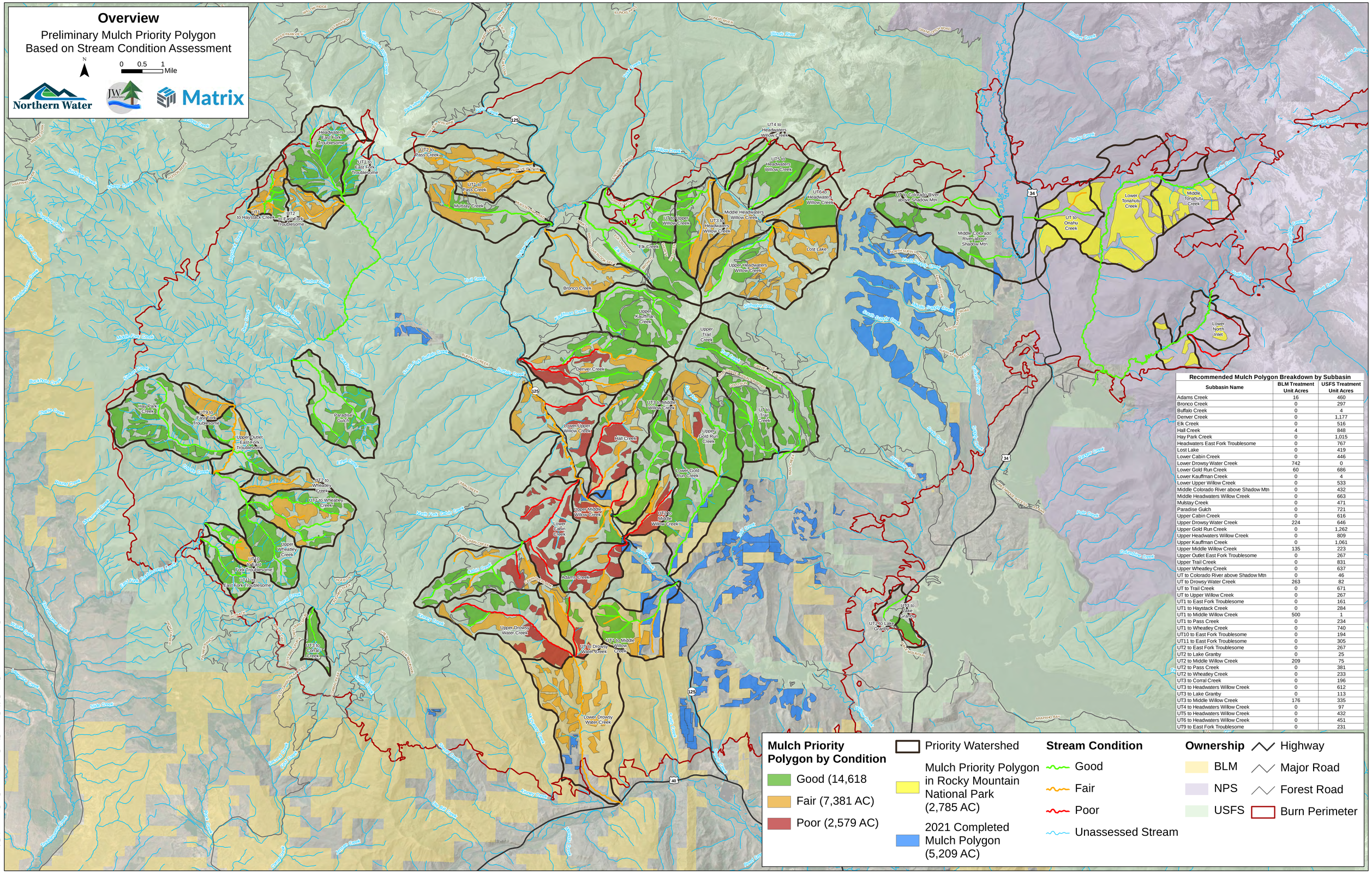
Overview

Preliminary Mulch Priority Polygon
Based on Stream Condition Assessment

N

0 0.5 1 Mile

Northern Water | JW | Matrix



Recommended Mulch Polygon Breakdown by Subbasin

Subbasin Name	BLM Treatment Unit Acres	USFS Treatment Unit Acres
Adams Creek	16	460
Bronco Creek	0	297
Buffalo Creek	0	4
Denver Creek	0	1,177
Elk Creek	0	516
Hall Creek	4	848
Hay Park Creek	0	1,015
Headwaters East Fork Troublesome	0	767
Lost Lake	0	419
Lower Cabin Creek	0	446
Lower Drowsy Water Creek	742	0
Lower Gold Run Creek	60	686
Lower Kauffman Creek	0	4
Lower Upper Willow Creek	0	533
Middle Colorado River above Shadow Mtn	0	432
Middle Headwaters Willow Creek	0	663
Mustang Creek	0	471
Paradise Gulch	0	721
Upper Cabin Creek	0	616
Upper Drowsy Water Creek	224	646
Upper Gold Run Creek	0	1,262
Upper Headwaters Willow Creek	0	809
Upper Kauffman Creek	0	1,061
Upper Middle Willow Creek	135	223
Upper Outlet East Fork Troublesome	0	267
Upper Trail Creek	0	831
Upper Wheatley Creek	0	637
UT to Colorado River above Shadow Mtn	0	46
UT to Drowsy Water Creek	263	82
UT to Trail Creek	0	671
UT to Upper Willow Creek	0	267
UT1 to East Fork Troublesome	0	161
UT1 to Haystack Creek	0	284
UT1 to Middle Willow Creek	500	1
UT1 to Pass Creek	0	234
UT1 to Wheatley Creek	0	740
UT10 to East Fork Troublesome	0	194
UT11 to East Fork Troublesome	0	305
UT2 to East Fork Troublesome	0	267
UT2 to Lake Granby	0	25
UT2 to Middle Willow Creek	209	75
UT2 to Pass Creek	0	381
UT2 to Wheatley Creek	0	233
UT3 to Corral Creek	0	196
UT3 to Headwaters Willow Creek	0	612
UT3 to Lake Granby	0	113
UT3 to Middle Willow Creek	176	335
UT4 to Headwaters Willow Creek	0	97
UT5 to Headwaters Willow Creek	0	432
UT6 to Headwaters Willow Creek	0	451
UT9 to East Fork Troublesome	0	231

Mulch Priority Polygon by Condition

- Good (14,618
- Fair (7,381 AC)
- Poor (2,579 AC)

- Priority Watershed
- Mulch Priority Polygon in Rocky Mountain National Park (2,785 AC)
- 2021 Completed Mulch Polygon (5,209 AC)

Stream Condition

- Good
- Fair
- Poor
- Unassessed Stream

Ownership

- BLM
- NPS
- USFS

- Highway
- Major Road
- Forest Road
- Burn Perimeter

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Recommended Plan

2022 Recommended Mulch Polygon

N

0 0.5 1 Mile

Northern Water | JW | Matrix

UT200 Pass Creek
UT1 to Pass Creek
Mulstay Creek
Upper Cabin Creek
Upper Drowsy Water Creek
Lower Drowsy Water Creek
Upper Kauffman Creek
Denver Creek
Elk Creek
Hall Creek
UT3 to Middle Willow Creek
UT to Drowsy Water Creek
UT to Colorado River above Shadow Mtn
Middle Colorado River above Shadow Mtn
UT2 to Lake Granby
UT3 to Lake Granby

Recommended Mulch Polygon Breakdown by Subbasin

Subbasin Name	BLM Treatment Unit Acres	USFS Treatment Unit Acres
Denver Creek	0	1,177
Elk Creek	0	516
Hall Creek	4	848
Lower Drowsy Water Creek	742	0
Middle Colorado River above Shadow Mtn	0	432
Mulstay Creek	0	471
Upper Cabin Creek	0	616
Upper Drowsy Water Creek	224	646
Upper Kauffman Creek	0	1,061
UT to Colorado River above Shadow Mtn	0	46
UT to Drowsy Water Creek	263	82
UT1 to Middle Willow Creek	500	1
UT1 to Pass Creek	0	234
UT2 to Lake Granby	0	25
UT2 to Middle Willow Creek	209	75
UT2 to Pass Creek	0	381
UT3 to Lake Granby	0	113
UT3 to Middle Willow Creek	176	335

2022 Recommended Mulch Polygon (9,177 AC)

Priority Aerial Mulch Watershed

Ownership

BLM
NPS
USFS

Highway
Major Road
Forest Road
Stream

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