Enhancing Watershed Resiliency in the Pike National Forest Through the Implementation of Multi-Year and Multi-Faceted Watershed Health Improvement Projects

Final Report

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RMFI
ROCKY MOUNTAIN FIELD INSTITUTE

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Introduction

Rocky Mountain Field Institute (RMFI) is a 501(c)(3) environmental stewardship nonprofit with over 40 years of experience conserving, protecting, and improving natural areas in southern Colorado and the Pikes Peak region. In 2019 RMFI was awarded funding from the Colorado Water Conservation Board's (CWCB) Watershed Restoration Program to support a multi-year, multi-faceted watershed health improvement program in key areas of the Pike National Forest. Watersheds are critical components of ecosystem health and function. Water from Colorado's forests support a variety of uses including public drinking water, agriculture, industrial uses (including mining), recreation, and habitat for aquatic life. Forests exert a strong influence on the quantity and quality of water within watersheds by protecting soil and preventing erosion, enhancing soil moisture storage and groundwater recharge, reducing flooding, filtering contaminants and maintaining the plant communities that also contribute to this process. Forest plant communities have a direct and significant effect on both the production and quality of stream health and fresh water supply. Properly functioning riparian corridors and stream channels are essential in managing pre- and post-wildfire behavior and storm events. They act as a buffer to fire extremes and manage flood and debris flows and kinetic energy release. However, wetland, riparian, and stream health conditions vary considerably across the nation.

In the U.S. Forest Service (USFS) Rocky Mountain Region (Region 2), insect and disease, livestock grazing, transportation, recreation, mining, conifer encroachment, and urban encroachment account for many of the historical and ongoing concerns. As a result, the most common water quality problems on national forests are increases in nutrients, stream water temperatures, and sediment loads (turbidity and bedload). Restoring functionality within these systems helps improve their resiliency to catastrophic events including fire and flooding, resulting in increased ecological diversity, improved stream health, and water quality. The increasing size, severity, and frequency of wildland fires and their impact on water resources compels land managers and resource managers to take a proactive, adaptive management approach to watershed management. Land managers and hydrologists with the Pike National Forest identified a number of locations on the Forest that required adaptive management and treatment to protect critical watersheds. As part of this effort, RMFI played an important role in the implementation of a variety of treatment strategies including stream bank stabilization, trail and restoration treatments, forest thinning, and erosion control treatments. These activities, collectively, function as an interrelated set of actions to help protect water quality, improve habitat conditions, minimize erosion, and enhance watershed health and function.

Background

The multi-year, multi-faceted project was guided by a tremendous amount of research and collaborative initiatives. RMFI played a key role in many of these initiatives, and leaned on our 40-year history of environmental stewardship to assist with collaborative efforts in planning and implementation of the project. Prior to project implementation, RMFI completed similar restoration efforts along the Pikes Peak Highway corridor, erosion mitigation and restoration efforts in the Bear Creek Watershed to help protect the threatened Greenback Cutthroat trout, and conducted post-fire restoration work in the Waldo Canyon and Black Forest burn scars, including hillslope stabilization, erosion control, and riparian restoration projects. Our past experience with watershed restoration and protection proved to be incredibly valuable during implementation of the Enhancing Watershed Resiliency project. As the scope of the project covered multiple years and multiple work sites, a number of different documents and reports were used to guide our actions. A primary document used to guide our actions is a U.S. Forest Service project proposal titled "Investments in Wetland, Riparian, and Stream Health: Taking a Proactive Approach to Land Management." Not only does this document provide overall strategies for managing and improving resiliency of riparian areas and watersheds, it also details specific management activities for a number of locations on the Pikes Peak Ranger District, including the Waldo Canyon and Hayman Fire burn areas, the Bear Creek Watershed, Upper Monument Creek, and the Trout Creek landscape. Specific activities outlined in the document implemented during this project include the removal of encroaching coniferous vegetation to reduce fuel loading and increase watershed resiliency, soil stabilization measures on hillslopes lacking sufficient ground cover to hold back sediment, and trail improvements to mitigate erosion and run-off.

Another guiding document RMFI relied on was the Environmental Impact Statement for the Upper Monument Creek Landscape Restoration Project developed by the USFS. While this document was specific to the Upper Monument Creek landscape, and was invaluable during our management activities in the area, many of the guiding principles it outlined were applicable to a number of the other project locations RMFI worked on.

RMFI has been an active participant and leader of the Bear Creek Roundtable, a collaboration of about two dozen agencies and organizations dedicated to protecting the threatened greenback cutthroat trout and its habitat in Bear Creek. RMFI has been a key partner in the discussions surrounding Bear Creek, and has worked for many years to help improve the watershed and protect the fish. RMFI relied heavily on our experiences with Bear Creek, as well as the guiding documents that were produced as a result of this collaborative approach, including the USFS Bear Creek Watershed Assessment and the Environmental Assessment Decision for the Bear Creek Watershed Restoration Project.

The overarching goal of this project was to enhance watershed resiliency in key areas of the Pike National Forest. Specific watershed health improvement projects included: conducting landscape restoration to facilitate improved water quality; wildfire resiliency; native vegetation rehabilitation; invasive species control; erosion control techniques and mitigation; trail design, reconstruction, and maintenance; improvements trail drainage and sustainability; providing

educational opportunities; aquatic and terrestrial wildlife habitat improvements; and assessment and monitoring.

RMFI worked closely with the U.S. Forest Service to identify key project locations each year of the project period. Over the course of the 3-year grant period, RMFI completed watershed health improvement activities at 9 unique locations. Please see below a Site Summary for each project site at which work was completed under this grant:

Rainbow Gulch Trail – Rampart Reservoir

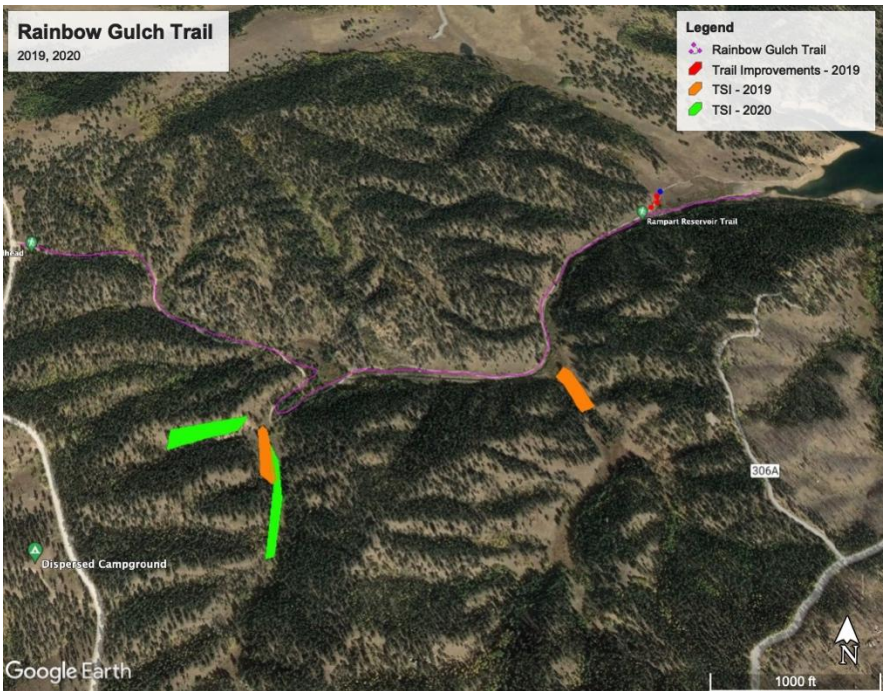

Figure 1: RMFI completed work near Rainbow Gulch Trail in 2019 (orange polygons) and 2020 (green polygons).

Rainbow Gulch Trail is a popular multi-use trail just east of Woodland Park, Colorado. The trail, popular with hikers, bikers, and anglers provides access from Rampart Range Road to Rampart Reservoir. Rampart Reservoir serves as one of the primary drinking water sources for residents of El Paso County, and is a critical piece of infrastructure for the surrounding area. The U.S. Forest Service deemed the Rainbow Gulch area as a priority for watershed health and fire mitigation work. In 2019 and 2020, RMFI completed trail improvements to the trail to mitigate erosion and sedimentation in the reservoir, as well as completed timber stand improvement and fire mitigation work in key drainages along the corridor. Goals for this work included removing aggressive conifer encroachment into important aspen stands and to reduce fuel loads.

Sesame Canyon Social Trail – Bear Creek

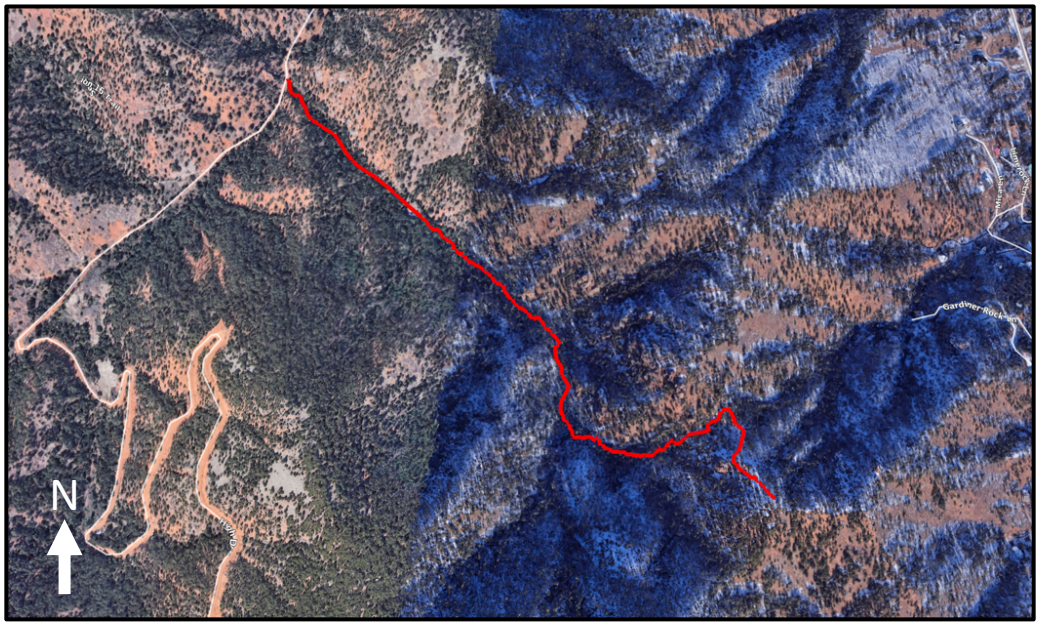

Figure 2: RMFI decommissioned the Sesame Canyon Social Trail in 2019 to reduce impacts to greenback cutthroat trout habitat. The red line shown above shows the alignment of the Sesame Canyon Trail, between where it connects with Trail 665 and High Drive.

The Sesame Canyon Social Trail was a heavily trafficked social trail in the Bear Creek Watershed. The Sesame Canyon Social Trail was steep, eroded, unsustainable, and ran straight up the fall line. The trail and its drainage are located within the Water Influence Zone for Bear Creek and deposit sediment to a tributary of Bear Creek. As part of ongoing and legally-required efforts to protect the habitat of the threatened greenback cutthroat trout, land managers made the decision to formally close the trail to the public to prevent continued use, degradation, erosion, and sedimentation. The greenback cutthroat trout (*Oncorhynchus clarkia stomais*) is Colorado's state fish. It is currently a Federally-listed threatened species under the Endangered Species Act. At present, the last remaining, naturally reproducing population of genetically pure greenback cutthroat trout inhabits just a 4-mile stretch of Bear Creek located west of Colorado Springs. It is believed there are only 750 adult species left in the wild. In 2019, RMFI closed, decommissioned, and actively restored the trail. RMFI felled trees to close the egress of the trail, constructed erosion control structures to mitigate erosion and sedimentation, and installed rock paving to stabilize the steep slopes.

Goat Camp Creek – Rampart Reservoir

Figure 3. Map detailing work sites at Goat Camp Creek in 2019 and 2020. Areas in yellow are 2019 work sites that RMFI returned to in 2020 for additional treatment. Areas in pink are new sites treated in 2020.

Goat Camp Creek is located west of Monument, Colorado, northeast of Rampart Reservoir. Goat Camp Creek is an important component of the Fountain Creek Watershed, and treatment along the creek was deemed a priority by U.S. Forest Service personnel. RMFI began watershed health improvement work at Goat Camp Creek in 2019, and returned in 2020 to complete the project. Priorities at Goat Camp Creek included fire mitigation and improving wildlife habitat, addressing significant conifer encroachment into riparian zones. Crews felled conifers with 10" diameter at breast height (DBH) and under, and girdled conifers with DBH between 10" and 20" (Figure 2 – 4). Felled trees were limbed so that the trunk would contact the ground. Any trees felled on the outer edge of the drainage were left attached to the stump to keep wildlife, particularly elk out of the area (Figure 5). Willow tips and aspen bark are important food sources for elk and, with unfettered access, have been known to decimate entire willow and aspen stands.

Cascade Creek – Pikes Peak Highway

Figure 4. Map of 2020 timber stand improvement work in Cascade Creek, Tributary 1 along Pikes Peak Highway.

Cascade Creek is an important tributary that flows from the lower slopes of Pikes Peak and merges with Fountain Creek in the town of Cascade, Colorado. Cascade Creek and its numerous tributaries flow directly adjacent to the Pikes Peak Highway, a major attraction in the area and the only direct road access to the summit of Pikes Peak. U.S. Forest Service personnel identified a section of the creek that was at particular risk of severe wildfire and posed a serious threat to the riparian area and the Pikes Peak Highway. In 2020, RMFI treated this riparian area, felling conifers and creating burn piles to be burned at a later date. The objective of this action was to enhance riparian vegetation to reduce fuels, increase structural diversity, and to break canopy continuity where uniform canopy cover exists.

Harris Park – Bailey, CO

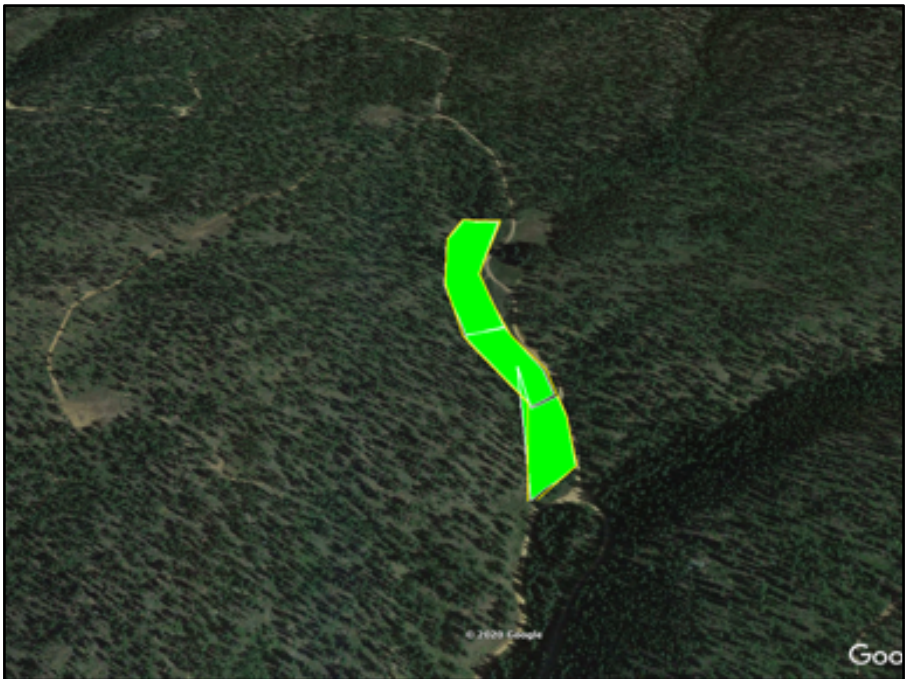

Figure 5. Map of 2020 timber stand improvement work at Harris Park.

The Denver Water Department approached representatives of the Pike National Forest with a request to address conifer encroachment in a key drainage near Harris Park, Colorado. The drainage is an important component of the South Platte Collection System, a primary water source for the residents of Denver. Denver Water was familiar with the successes of the collaborative partnership between the U.S. Forest Service and RMFI. To continue building on this collaborative approach to proactive watershed health management, RMFI completed 10 days of watershed health and timber stand improvement work in Harris Park. Primary objectives for this drainage was the removal of conifer encroachment in the riparian zone, promoting fire resilient riparian vegetation and reducing fuels. These activities will reduce the potential impacts of severe wildfire and limit erosion impacts to the municipal water source.

Nichols Trail – Rampart Reservoir

Figure 6. Map of 2020-2021 RMFI work on Nichols Trail. The green line is the decommissioned Nichols Trail. The white line to the right is the designated Nichols Trail.

Nichols Trail is a popular trail that traverses downhill from the Rampart Reservoir Recreation Area parking lot to Nichols Reservoir. The trail provides an opportunity for a more secluded recreation experience and is the direct access trail to Nichols Reservoir. Over time, users had created an unsustainable social trail that followed the fall line from the parking lot directly down to Nichols Reservoir. The closure and restoration of this social trail was deemed a high priority by the U.S. Forest Service. The steep, fall line trail was experiencing significant erosion. Soil and sediment run-off from the trail flowed directly downhill at high velocity, eventually flowing into Nichols Reservoir, impacting water quality. RMFI completed watershed work on Nichols Trail in 2020 and 2021. RMFI closed the social trail, constructed erosion control structures including check dams and log erosion barriers, and planted native vegetation to increase slope stability and promote native vegetation regrowth. In addition, crews stabilized and rebuilt sections of the designated trail to make it more appealing to user groups and to create a more sustainable trail. RMFI also constructed a puncheon crossing through a wetland to protect the sensitive habitat.

Ensign Gulch

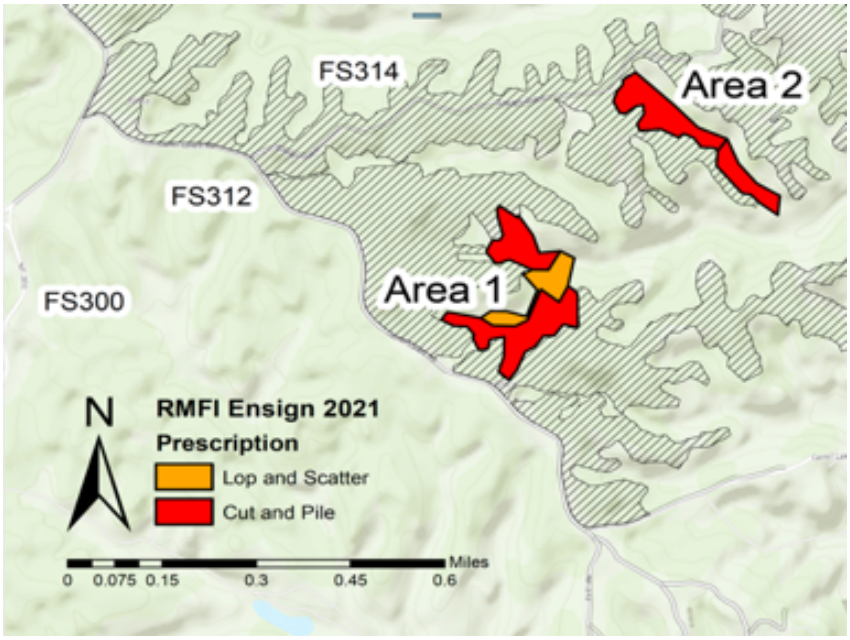

Figure 7. Map of 2021 timber stand improvement work at Ensign Gulch. The red and orange polygons represent the RMFI work area, each with specific prescriptions.

In 2020, the U.S. Forest Service hired a private contractor to perform timber stand improvement work in the drainages and riparian areas near Rampart Reservoir. The contractors were able to complete a significant amount of work on the ridges and in certain drainages. RMFI was contracted to complete timber stand improvements in the drainages that were inaccessible to the contractor's heavy machinery. The Ensign Gulch area is a key component of the watershed, and timber stand improvement work will enhance the resiliency of the riparian areas. Additionally, the treatments will mitigate the risk of high severity wildfires in the area.

Promontory Picnic Area – Rampart Reservoir

Figure 8. Map of 2021 RMFI worksite at Promontory Picnic Area. The red polygons indicate restoration, stabilization, and erosion mitigation areas.

Promontory Picnic Ground is a popular access area for recreational day use at Rampart Reservoir. The picnic ground is located just past the Thunder Ridge Campground and before the access gate to the reservoir via the dam. Users were traversing multiple paths to access the reservoir from the picnic area, creating fall line trails that had become deeply incised gullies. The U.S. Forest Service installed concrete pathways to provide a designated, hardened route to the reservoir and to protect the surrounding area from user impacts. Over time, the concrete caused more erosion issues and the decision was made to remove the concrete. The U.S. Forest Service hired a private contractor to tear up the concrete and regrade the area.

RMFI continued the stabilization process by closing and restoring braided sections of trail. Crews built a retaining wall and barrier/mono-wall to designate one path for users to take to the reservoir from the main parking lot entrance and transplanted surrounding native plants to disguise the braided trail. RMFI also installed check dams and other erosion control structures in the deep, user created gullies. The erosion control treatments will limit erosion and sediment run-off into Rampart Reservoir.

Trail #666 – Bear Creek Watershed

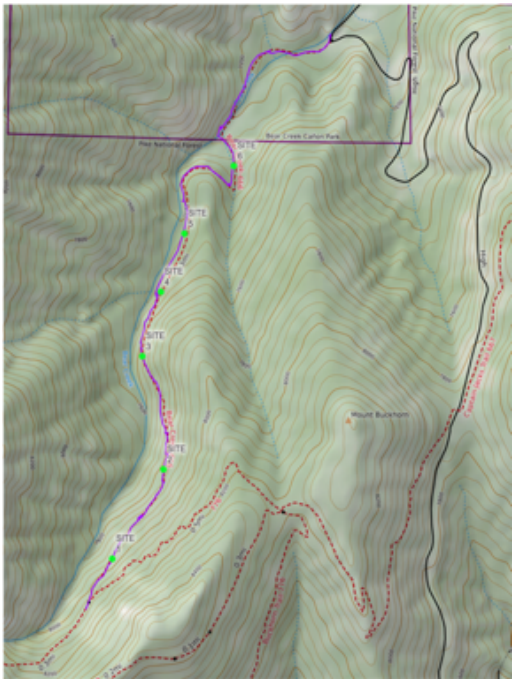

Figure 9. Map of 2021 RMFI work sites along Trail #666 in Bear Creek. The green points indicate each RMFI worksite.

The Bear Creek Watershed is a protected area due to the presence of the last genetically pure population of Greenback Cutthroat Trout (Colorado's state fish) in the entire world. The primary objective in this area was to protect the fish and its habitat by minimizing and mitigating sediment run off into the creek. RMFI focused on erosion control work along Trail #666 to the Buckhorn Connector Trail (Trail #776). Trail #666 is a steep trail that parallels Bear Creek for a short distance. The trail then travels upslope along an eroding slope of Pikes Peak granite. The popular multi-use trail contributes significant run-off into the creek. Six areas were identified for work along the trail, which included building timber retaining structures to support the critical edge of the trail, installing drains to divert water, and felling trees for use as erosion barriers on the eroding slopes. Treatments will reduce trail and hillside erosion and mitigate impacts to the creek.

Methods

The scope of the multi-year, multi-faceted project required significant planning and coordination. RMFI worked closely with our partners to identify project priorities each year. RMFI and U.S. Forest Service staff participated in numerous site visits each year to determine goals and objectives for each work site. Detailed assessment notes were recorded, including treatment prescriptions, GPS data, and photo documentation. The results of those assessments dictated the implementation approach for each site. While many of the objectives for each site were similar (conifer encroachment removal, stream bank stabilization, erosion control etc.) the unique nature of each site required individual scopes of work.

The success of this project was only made possible through the collaborative efforts of multiple agencies, organizations, and individuals. RMFI leveraged funding from the CWCB and the U.S. Forest Service to maximize project outputs and outcomes. CWCB funding supported every facet of the program including staff time for pre-project planning and coordination, collection of site notes and data, and drafting of scopes of work and project over sight. CWCB funding also supported the hiring of seasonal staff who implemented the work plans in the field as well as operational costs of the project. CWCB also supported post-project evaluation, monitoring, and reporting activities.

RMFI employed a crew of 5-6 highly trained RFMI staff to implement project work each season. RMFI staff are trained in timber stand improvement, trail maintenance, and erosion control and active restoration techniques. RMFI staff are also trained in back country medicine and Leave No Trace. In addition, community volunteers were engaged at a select number of project locations.

Timber Stand Improvement and Fire Mitigation

Due to the significant chainsaw work required to complete the types of treatments necessary, all staff on the project were S212 chainsaw certified. Having a crew fully certified to operate chainsaws greatly increased our productivity on project work. Timber stand improvement and fire mitigation prescriptions varied across project sites. U.S. Forest Service personnel determined prescriptions for each site, and RMFI staff implemented the prescriptions. Specific treatment methods included burn pile construction, “lop and scatter”, and tree girdling. Multiple treatment methods were implemented at several of the project locations.

Burn Pile

RMFI felled conifer species up to 10” diameter at breast height (DBH). The felled trees were limbed and bucked to manageable dimensions for piling. All piles were constructed as compactly as possible. Slash was stacked parallel with the slope. Heavier material was placed on top of the slash on the uphill side of the pile to maximize stability. Maximum pile size was 10’ in diameter by 8’ in height. The minimum pile size was 7’ in diameter by 5’ in height. Piles were not constructed within stream channels or on top of downed logs, stumps, or snags. Piles were constructed a minimum of 20’ from live trees, or, outside of the dripline of any live trees. Piles were constructed a minimum of 10’ from snags.

Lop and Scatter
RMFI felled conifer species 10" DBH or less. Felled trees were "topped", removing the upper most portion of the crown of the tree, and partially limbed. Felled trees were limbed such that the trunk and bole of the tree had good connectivity with the ground to mitigate the creation of ladder fuels. All limbed slash was scattered on the forest floor, away from the base of live trees and stream channels. Slash was widely scattered to reduce heavy fuel loads in one area.

Girdling
Tree girdling is a useful technique, but is only applied in specific situations. Trees are girdled when they stand in sensitive areas. For example, a large conifer may be girdled if it grows amidst a young aspen stand. The girdled tree will continue to stand, allowing the surrounding young trees the opportunity to grow and become more resilient when the girdled tree does eventually fall. Girdling trees was also useful when the prescription called for enhancing wildlife habitat. A girdled tree will die and remain standing, providing excellent bird habitat. Finally, girdling was used when safety was a concern. In high density timber stands, strategic tree girdling may be used to mitigate the occurrence of tree hang-ups, a very hazardous situation. When prescribed, RMFI girdled trees greater than 10" DBH and less than 20" DBH.

All conifer trees greater 20" DBH or greater were retained. Retaining large conifers promotes the biodiversity of the area and increases structural diversity.

Trail Maintenance

RMFI has over 40 years of experience building and maintaining natural surface trails. While trails provide outdoor recreation opportunities and access to the outdoors for millions of people, heavy use of trails has serious impacts to surrounding natural resources, particularly if trails are not adequately maintained. Several scopes of work for the watershed health enhancement project called for trail maintenance activities near critical creeks, streams, and other riparian areas. A properly maintained trail will keep users on the established trail tread and protect the surrounding areas from impact. A key component of a trail is the critical edge. If the critical edge of a trail is compromised (often by users navigating around wet, snow covered, or otherwise obstructed portions of trail), the trail will quickly erode, and sediment and soils in and around the trail will run-off into water sources.

Over the 3-year grant period RMFI implemented a number of different trail maintenance treatments to prevent the erosion of trails and to mitigate impacts to water sources.

Grade Dips/Drains
Grade dips and drains are constructed to divert water off trail, reducing erosion and protecting the trail from incision. An incised trail can quickly become a large gully, which increases water velocity and exacerbates further erosion. Drains also mitigate standing water on the trail, which users often cut around, compromising the critical edge. The strategic placement of drains has a tremendous effect, improving the overall quality of a trail and greatly reducing impacts to natural resources and water sources.

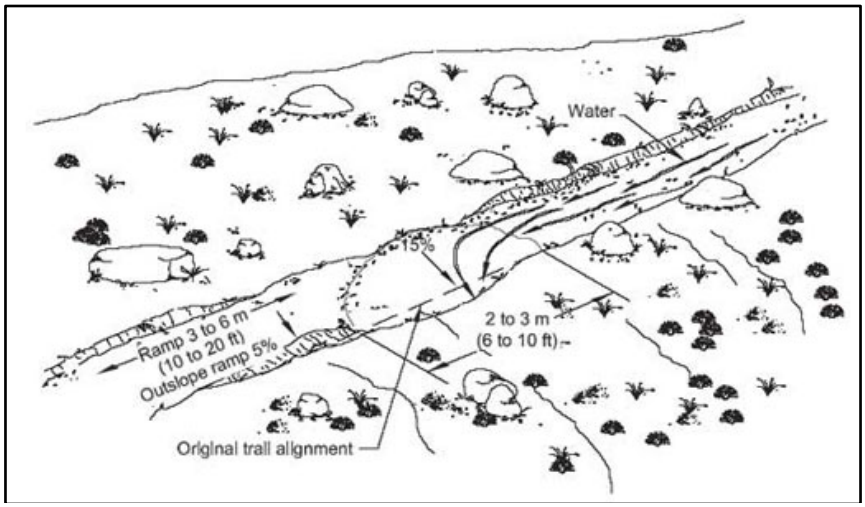

Figure 10. Diagram of a properly constructed grade dip and drain.

Cobbling/Paving

At locations where drain construction was impossible, cobbling or paving a portion of trail was used. Cobbling is useful in low lying sections of trail that collect water and snow melt. Setting stones in these low-lying areas raises the trail tread and protects the trail from erosion.

Retaining/Barrier Walls

Retaining walls and barrier walls are useful treatments in areas with steep side slopes. As water runs downhill, it collects sediment and soil, compromising the stability of the slopes. Retaining walls are installed to help hold the sediment and to support the steep slopes. Though more time consuming than other treatments, walls are often the most appropriate and effective treatment.

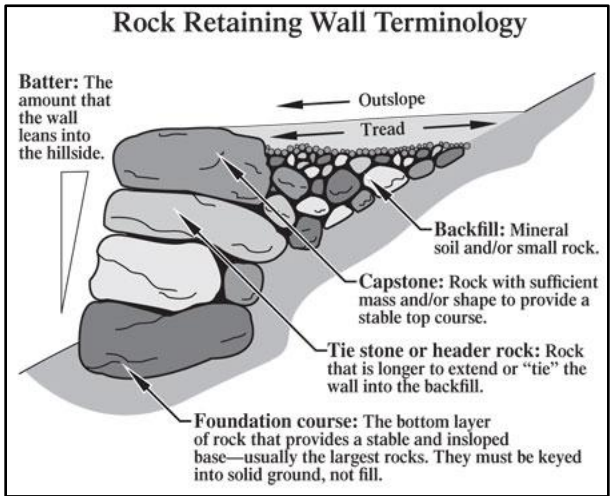

Figure 11. Cross section of a rock retaining wall.

Erosion Control/Active Restoration

Erosion control and active restoration were the primary treatments for many project locations. User created social trails are a major contributing factor to erosion and impacts to riparian areas and water quality. The closure and restoration of these undesignated trails was critical to our success on the project. Social trail closure includes the obstruction and closure of points of egress, decompacting the existing social trail, planting native seeds and transplants, further disguising the trail, and the strategic placement of erosion control structures. RMFI also addressed erosion on hillslopes and streambanks to reduce impacts to streams, creeks, and other water sources. Check dams, log erosion barriers (LEBs), and strategically felled trees all serve to reduce the velocity of run-off, collect sediment, and stabilize slopes.

Social Trail Closure

RMFI implements a proven 5-step restoration process for closing and restoring social trails.

1. Decompact Trailbed – Well established social trails often have very compacted socials, impeding revegetation and restoration. Trails were decompacted at least 4-6 inches in depth prior to any revegetation activities (planting seed, transplanting native plants), avoiding existing vegetation and woody materials.
2. Regrade/Address Erosional Water Flow – Once the trailbed has been decompacted, it is important to address any structural issues on the trail (incision, gullying etc.). Often this can be accomplished by simply recontouring the existing trail. Additional fill material may be required to achieve appropriate grade. In highly impacted and deeply incised areas, additional treatments may be required. The installation of check dams can help prevent water from running the length of the trail, picking up speed and sediment as it moves. Check dams are designed to back fill with sediment over time, bringing the trail back to grade.
3. Revegetation – Once erosion is addressed, re-vegetation treatments are applied to achieve long-term slope stabilization and to develop a self-sustaining, native plant community. Spreading native seed and transplanting native plants in the area help reestablish a native plant community and further disguise the area.
4. Minimize Visibility and Access – As long as use continues on restored areas, erosion control and re-vegetation attempts will be unsuccessful. Camouflaging the restored rogue trail or blending it into its surroundings with on-site natural materials attracts less attention and deters continued use. An effective technique that RMFI implements is the strategic felling of trees at points of entry, particularly in more remote locations where other barriers (fencing, signage) are impractical. Trees are felled at critical choke points to obstruct access to the trail and to disguise the existence of the trail. Slash and other debris is scattered along the length of the trail to further disguise and naturalize the area.
5. Stabilize Trailbed – Other erosion treatments may be required on the most severely eroded sections of social trail. These areas require significant structural treatments to address erosion issues. Some examples of additional treatments include sub-surface stabilization structures, multi-tiered check dams, and erosion control matting.

Check Dams

Check dams are important tools used to address erosion on steep slopes and sensitive areas. Check dams can be constructed with rock, naturally sourced logs, or treated timber. The type of

material is dependent on available resources and the project scope of work. Check dams are installed in incised or gullied sections of social trail or surrounding natural areas, perpendicular to the direction of water flow. Check dams serve several purposes. First, check dams slow the velocity of flowing water, reducing the water's sediment carrying capacity. Slower moving water has less erosive potential. Check dams also collect sediment from run-off, back filling the check dam. Over time, the check dam will gradually bring the area back to grade with the surrounding area. In deeply gullied areas, and additional tier may be required to continue the process.

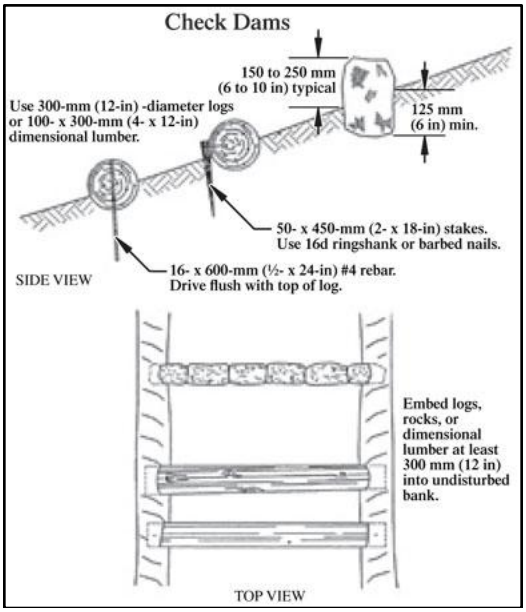

Figure 11. Side view and top-down view of various types of check dams.

Log Erosion Barriers (LEBs)

Log erosion barriers serve a similar function to check dams, but are used primarily on hillslopes rather than in deeply gullied areas. Naturally and locally sourced logs are placed parallel to the contour of a hillside, perpendicular to the directional flow of water. A shallow trench is dug, the log is placed in the trench, and is then secured with stakes. LEBs increase infiltration, add roughness, reduce erosion, and help retain small amounts of soil on site.

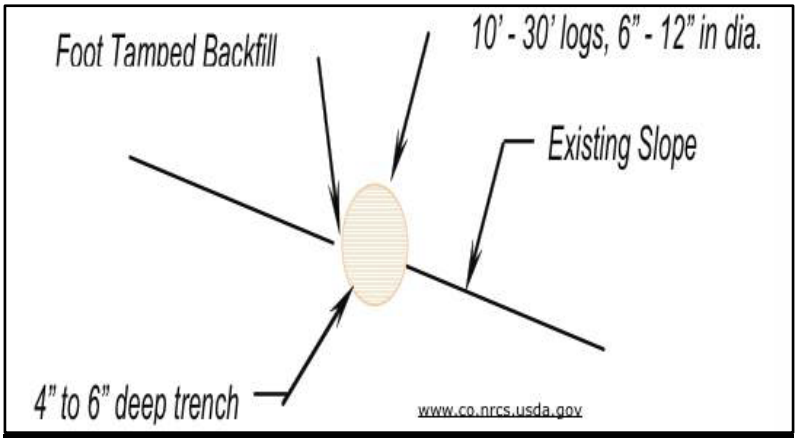

Figure 12. Side view of a properly constructed Log erosion Barrier (LEB).

Results

RMFI completed 202 individual workdays performing watershed health improvement work at 9 unique work sites over the 3-year grant period. Project results and accomplishments are detailed below by project location.

Rainbow Gulch Trail – Rampart Reservoir

Total Workdays: 32
Trail Tread Improved: 73.55 linear feet
Tread Cobbled/Paved: 251.1 square feet
Drains Constructed: 1
Rock Moved: 1.7 tons
Trees Felled for Thinning: 954
Trees Felled for Social Trail Closure: 15
Trees Girdled: 235
Saplings Removed: 2,778
Burn Piles Constructed: 115

Figure 13. Before (left) and after (right) of TSI work completed at Rainbow Gulch.

Figure 14. Before (left) and after (right) of TSI work completed at Rainbow Gulch.

Figure 15. RMFI staff preparing burn piles at Rainbow Gulch.

Sesame Canyon Social Trail

Total Workdays: 10
Trail Tread Improved: 64 linear feet
Tread Cobbled/Paved: 87.8 square feet
Drains Constructed: 9
Rubble Wall Constructed: 14 square feet
Barrier Wall Completed: 4 linear feet
Check Dams Installed: 14
Trees Felled for Closure: 253
Soil Moved: 2.56 cubic yards
Rock Moved: 1.28 tons

Figure 16. Before (left) and after (right) of social trail access closure.

Figure 17. Example of strategic felling to obstruct and disguise social trail access.

Goat Camp Creek

Total Workdays: 44
Trees Felled for Thinning: 3,114
Trees Girdled: 298
Saplings Removed: 10,894
Burn Piles Constructed: 30

Figure 18. Before (left) and after (right) of TSI work at Goat Creek Camp.

Figure 19. Before (left) and after (right) of TSI work at Goat Creek Camp.

Cascade Creek

Total Workdays: 17
Trees Felled for Thinning: 324
Trees Girdled: 193
Saplings Removed: 1,446
Burn Piles Constructed: 71

Figure 20. Before (left) and after (right) of TSI work and burn pile construction at Cascade Creek.

Figure 21. Before (left) and after (right) of TSI work at Cascade Creek.

Harris Park

Total Workdays: 11
Trees Felled for Thinning: 250
Trees Girdled: 31
Saplings Removed: 2,047
Burn Piles Constructed: 53

Figure 22. RMFI staff preparing a burn pile at Harris Park.

Figure 23. Before (left) and after (right) of conifer encroachment removal at Harris Park.

Nichols Trail

Total Workdays: 34
New Trail Constructed: 411 linear feet
Trail Maintained: 287 linear feet
Tread Cobbled/Paved: 257.1 square feet
Drains Constructed: 23
Retaining Wall Constructed: 99.25 square feet

Social Trail Restored: 387 linear feet
Check Dams Installed: 60
Log Erosion Barriers Installed: 9
Native Transplants: 344
Trees Felled for Social Trail Closure: 71
Saplings Removed: 10
Signs Installed: 3
Puncheons Constructed: 40 linear feet

Figure 24. Before (left) and after (right) of puncheon constructed through wetland area.

Figure 25. Before (left) and after (right) of social trail closure and restoration.

Figure 26. Before (left) and after (right) of check dam construction at Nichols Trail.

Figure 27. Before (left) and after (right) of retaining wall constructed to mitigate erosion adjacent to a pond.

Ensign Gulch

Total Workdays: 32
Trees Felled for Thinning: 936
Saplings Removed: 6,029
Burn Piles Constructed: 179

Figure 28. Before (left) and after (right) of TSI work at Ensign Gulc.h

Figure 29. Before (left) and after (right) of TSI work and burn pile at Ensign Gulch.

Figure 30. Before (left) and after (right) of TSI work at Ensign Gulch.

Promontory Point Picnic Area – Rampart Reservoir

Total Workdays: 17
Trail Tread Improved: 152 linear feet
Timber Steps Constructed: 13
Drains Constructed/Maintained: 4
Retaining Wall Constructed: 68 square feet
Barrier Wall Completed: 22 linear feet
Check Dams Installed: 109
Area Restored: 3,239 square feet
Native Transplants: 287
Soil Moved: 6.5 cubic yards
Rock Moved: 5.5 tons

Figure 31. Before (left) and after (right) of barrier wall construction and restoration.

Figure 32. Before (left) and after (right) of check dam installation. An example of a 2-tiered check dam center right.

Figure 33. Before (left) and after (right) of check dam installation in a gully flowing towards the reservoir.

Bear Creek Watershed

Total Workdays: 5
Trail Tread Improved: 50 linear feet
Timber Steps Constructed: 13
Drains Constructed/Maintained: 2
Retaining Wall Constructed: 78 square feet
Log Erosion Barriers Installed: 3
Trees Felled for Closure: 28

Figure 34. Before (left) and after (right) of timber retaining wall construction.

Figure 35. Before (left) and after (right) of trail improvement and timber retaining wall.

Conclusions and Discussion

RMFI conducts post-project monitoring at the conclusion of each project. Post-project documentation includes before and after photos of the work accomplished, detailed work metrics, and periodic reports to CWCB and other. Post-project assessment and monitoring indicate that, overall, treatments applied were very effective. Trail maintenance and erosion control treatments significantly reduced run-off and sedimentation into critical water resources. The closure of Sesame Canyon Social Trail in Bear Creek has proved to be very successful. The robust closure and restoration of the trail has deterred access and use, and allowed the area to revegetate. Anecdotal evidence indicates that the reduced use has limited erosion and improved water quality in Bear Creek, enhancing habitat for the greenback cutthroat trout. Maintenance work on Trail #666 in Bear Creek has had similar success. Trail #666 is still open to the public, and treatments have helped stabilize the trail, mitigating user impacts. Additional work on Trail #666 remains, and will be addressed in the coming seasons. Similarly, closure and restoration of the Nichols Trail near Rampart Reservoir has been very effective. The treatments provide multiple benefits. First, improvements to the designated trail (retaining walls, drains, tread cobbling) make the trail more attractive to users. The improvements ensure the trail is more sustainable and will mitigate the creation of future social trails. Second, closure and restoration of the social trail has reduced impacts to the surrounding natural resources and water bodies, primarily Nichols Reservoir and the adjacent wetland and pond. Check dams and LEBs installed have greatly reduced the velocity of run-off and captured sediment that would otherwise end up in the water sources.

Although CWCB funding was used to address project work focused primarily on erosion control and stabilization, additional project objectives targeted conifer encroachment in riparian areas and wildfire mitigation. Conifers are a fast growing, opportunistic species that, when established, can quickly outcompete other plant species in the area. Conifers are highly susceptible to wildfire, and when clustered in dense stands adjacent to riparian areas, pose a major threat to water quality. The treatments implemented were successful across all project work sites. Removal of conifer species in critical drainages and riparian areas had a number of beneficial outcomes. Thinning the density of conifer stands greatly reduced fuel loads, alleviating the threat of a severe wildfire. Severe wildfires compromise soil integrity and can increase erosion in a burned area. This is doubly impactful near water bodies and riparian areas, as the increased erosion can impact water quality and aquatic species habitat. Removal of conifers also enhanced the opportunity for riparian vegetation and other fire-resistant species, particularly aspen, to establish and perpetuate. Removing conifers releases the canopy, allowing more sunlight to reach preferred species, breaks canopy continuity to mitigate wildfire “crowning”, and increases the structural diversity in a given area.

While the vast majority of treatments were successful, there were opportunities to learn and improve our operations. U.S. Forest Service and RMFI program staff worked closely to develop specific treatment prescriptions for each project site. Occasionally, realities on the ground required adjusting these prescriptions in real time. For example, as crews began constructing burn piles, there was often not enough space to accommodate additional piles. The prescription was then adjusted to allow for the "lop and scatter" method. In some areas, the terrain proved to be a challenge. While working on Trail #666 in Bear Creek, RMFI staff observed that the steep slopes on either side of the trail were extremely hazardous for tree felling operations. RMFI has plans to return to the area in the next 3 years to continue addressing erosion issues on the steep slopes. We have modified our prescription to focus on erosion control structure installation (LEBs) in the area to mitigate any risk associated with felling operations. Finally, as with any trail closure, points of entry must often be reinforced to continue to deter access. Users occasionally remove emplaced obstructions (felled trees) to gain access. RMFI began leaving felled trees attached to their stumps to mitigate this activity, and the slight adjustment has proved very successful.

Some of these "lessons learned" concerned operational logistics. Most of the project work sites were located in remote, backcountry areas. RMFI has extensive experience working in these conditions, but each site provides its own challenges. Accessibility to safe drinking water was an obstacle that we had to overcome. For many locations, the only option was to pack-in our own water. This often required a resupply in the middle of the hitch. Transportation of equipment was also a challenge on some projects. RMFI engaged community volunteers to assist with gear pack-ins at Bear Creek. This greatly expedited the process, allowing more time for on the ground project work. In addition, adapting to the challenges of the COVID-19 pandemic proved challenging. RMFI created protocols and procedures in 2020 that were adapted during the 2021 field season to keep our staff, partners, and our community safe. We will continue to deal with the challenges of the pandemic in the coming seasons, but are well prepared to navigate these as an organization.

The success of the Enhancing Watershed Health program has garnered significant support from our partners, particularly the U.S. Forest Service. RMFI has updated our agreement with the U.S. Forest Service and will receive additional support from the agency to continue activities directed at enhancing watershed health and function on the Pike National Forest. The agreement will partially support project work in the coming field seasons. This investment will help ensure the long-term sustainability of the program. RMFI has also applied for additional grant funding through CWCB to support the program for an additional 5 years and to further leverage funding received from the U.S. Forest Service. Enhancing watershed health is an ongoing effort on Pikes Peak. Water is a limited resource, and efforts to protect and enhance watersheds are critical to the long-term health of the forest and local communities. RMFI is currently working with our partners at the U.S. Forest Service to develop work plans for the 2022 season. We coordinate

early each year to determine goals and objectives for the coming season. While we will likely continue TSI work in riparian areas, our early discussions with U.S. Forest Service personnel have centered on erosion control measures in sensitive riparian areas. RMFI's experience with erosion control and active restoration position us to have a tremendous impact on our Forest's water resources.

References

- "Investments in Wetland, Riparian, and Stream Health: Taking a Proactive Approach to Land Management" (see attached pdf)

- Bear Creek Watershed Assessment
  https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5434203.pdf

- Environmental Assessment Decision for the Bear Creek Watershed Restoration Project
  https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3846428.pdf