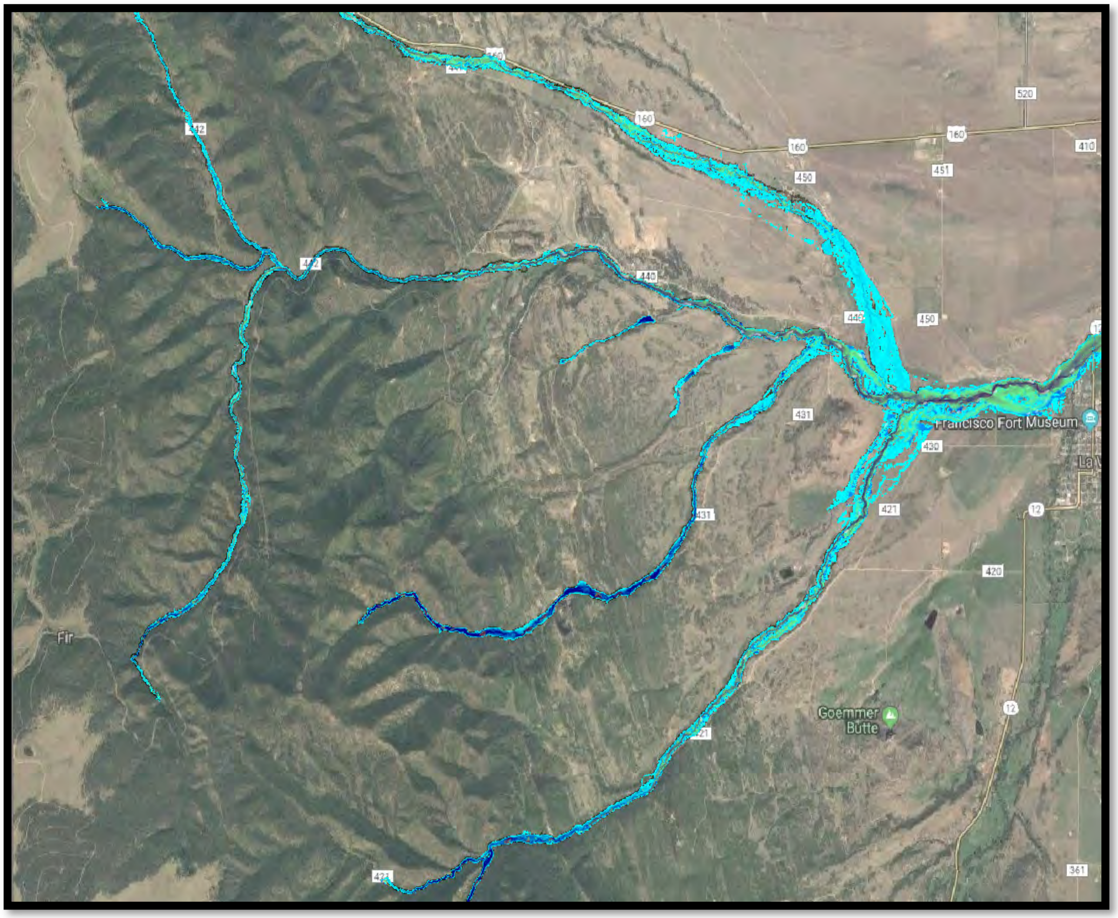
PROJECT FEASIBILITY AND COST STUDY

IDENTIFICATION OF RISK AND COSTING OF PROTECTION FOR THE HUERFANO COUNTY WATER CONSERVATION DISTRICT (HCWCD)



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HUERFANO COUNTY WATER CONSERVANCY DISTRICT

Huerfano County Water Conservation District
(HCWCD)

June 2022

ACNOWLEDGEMENTS

ENGINEERING TEAM

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TABLE OF CONTENTS

FIGURES

TABLES

ENCLOSURES:

Attachment A – Maps of Identified Locations for Stream Enhancement and Asset Protection

Attachment B – Hydrology and Associated Hydrologic Files including Hydrologic Report

Attachment C – Updated Hydraulic Analysis

Attachment D – Fluvial Hazard Study for Middle and Indian Creek

Attachment E – Digital Files from GIS

INTRODUCTION

In 2018, the Spring Creek Fire started near Fort Garland Colorado south and west of La Veta. The fire burned a total of 108,045 acres and, at the time, was the third largest wildfire in Colorado History. As a result of the fire, over 20 million dollars in Emergency Watershed Protection (EWP) funds were secured for La Plata, Huerfano, Costilla, and Eagle Counties. Additional funding from the Colorado Water Conservation Board (CWCB) has been provided for flood recovery efforts. In late 2021, the Huerfano County Water Conservation District (HCWCD) prepared a grant application for a study to identify problem areas and propose solutions and costing for those areas. HCWCD contracted with Enginuity to conduct that work, and the results of that work is presented within this report and its appendices. Appendices A through E provided attached digitally also contain individual reports for the updated hydrology, hydraulics, and fluvial hazard study. Not all the information contained within those attachments are repeated within this report.

SUMMARY OF FINDINGS

This study worked to identify all the locations where potential, or previous issues have occurred and worked to develop a conceptual cost to mitigate those locations. In general, there are likely far too many locations that could reasonably be addressed within the next 5-years. Additionally, the costing for those locations is large with a total cost to mitigate and work at all locations estimated at $25 million dollars.

When watersheds burn, the hydrologic cycle is altered, and the watershed response mimics the type of responses we see with development, the runoff is increased, the timing is decreased, and more volume of runoff per unit of rainfall is expected. To manage this change from developed watersheds, the standard of practice is to detain and slow water at a de-centralized (local) level and then to stabilize stream systems to handle the increased energy. With urban development, this happens over the time of the development and these costs are generally placed onto a developer. This is obviously not possible to do with a fire as there is no developer to offset these costs and the timing of change is immediate and not over decades of change. These facts lead to the following list of recommendations that are presented in order of priority:

Priority 1 – Life and Property

Focus on saving life and property through must do maintenance and work, this includes:

a. Request funds for or budget for cleaning and working areas around the flood warning gages.
b. Requests funds for or budget for work to keep the main river corridors through the Town of La Veta and Huerfano clean of brush, large trees, snags, and blockages.

The total cost for the priority 1 items is estimated at $104,000 dollars. This cost may not required every year, however, we recommend budgeting or requesting at least $36,000 for gage maintenance given that any one of the three gages above La Veta could become damages by flood waters in any year. Table 1 below presents the breakdown of this cost estimate for priority 1 items. Figure 1 below presents the benefits and risk reduction from channel clearing and grubbing alone.

Table 1 - Estimated Cost for Priority 1 Items

Description	Quantity	Unit	Unit Price	Total Cost
Clearing and Maintenance Gages as Needed	400	LF	$50.00	$20,000.00
Moving and Grading of Material, as Needed	500	CY	$30.00	$15,000.00
Haul away Debris	2	Load	$500.00	$1,000.00
			Total for Gage Maintenance	$36,000.00
Clearing and Grubbing Channel in Town for Flood Protection	1700	LF	$30.00	$51,000.00
			Contingency	$17,400.00
			Total Estimate	**$104,400.00**

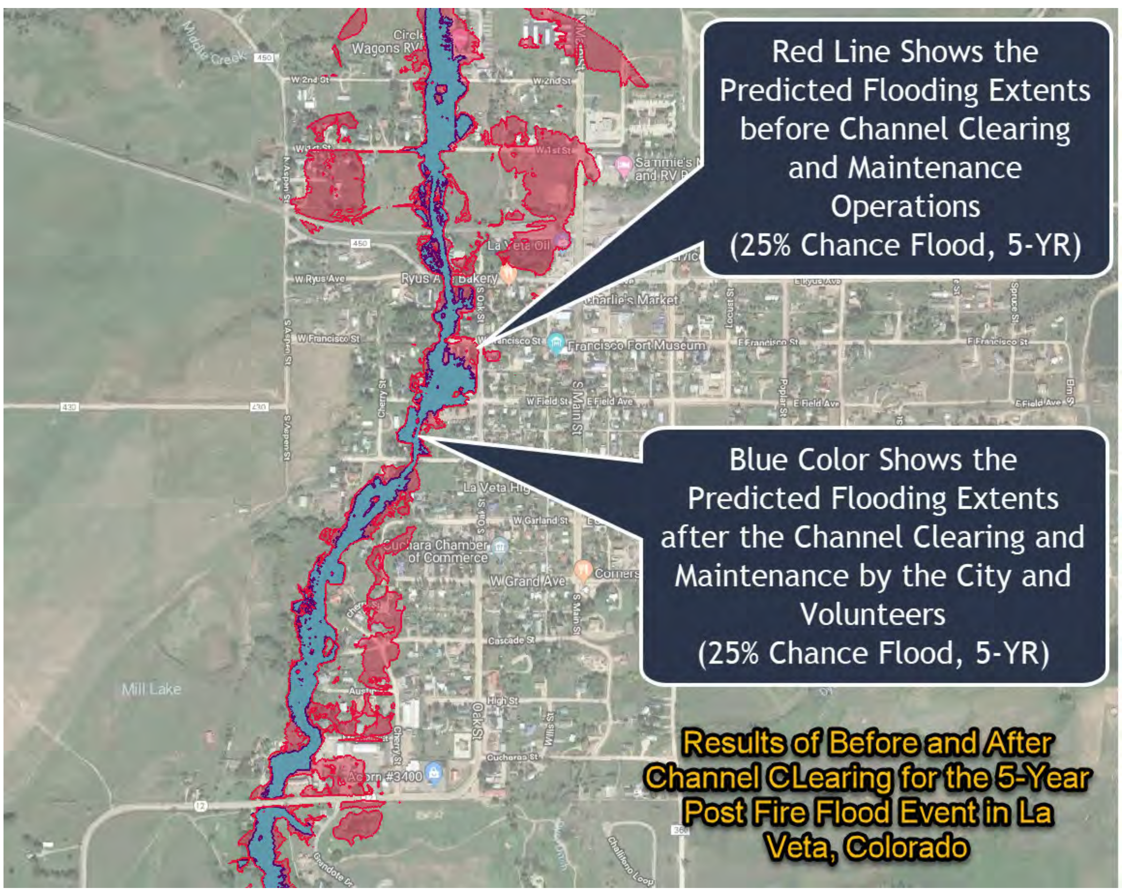

Figure 1 - Image of Before and After Cleaning Operations of the Cucharas River

Priority 2 – Infrastructure and Protection

When re-constructing washed out crossings, roadways, or damaged infrastructure focus on removing that infrastructure from the active stream corridor (ASC), if possible. A GIS shapefile of this boundary has been provided in the Attachments. If crossing the ASC is necessary for access to properties, construct crossings that are resilient to flood flows. This includes a hardened section with cutoff walls up and downstream. Approaches to the section may be expected to breach from large events, however, the main portion of the approach, and most costly to rebuild, would be expected to remain. Figure 2 below is a schematic of this type of crossing.

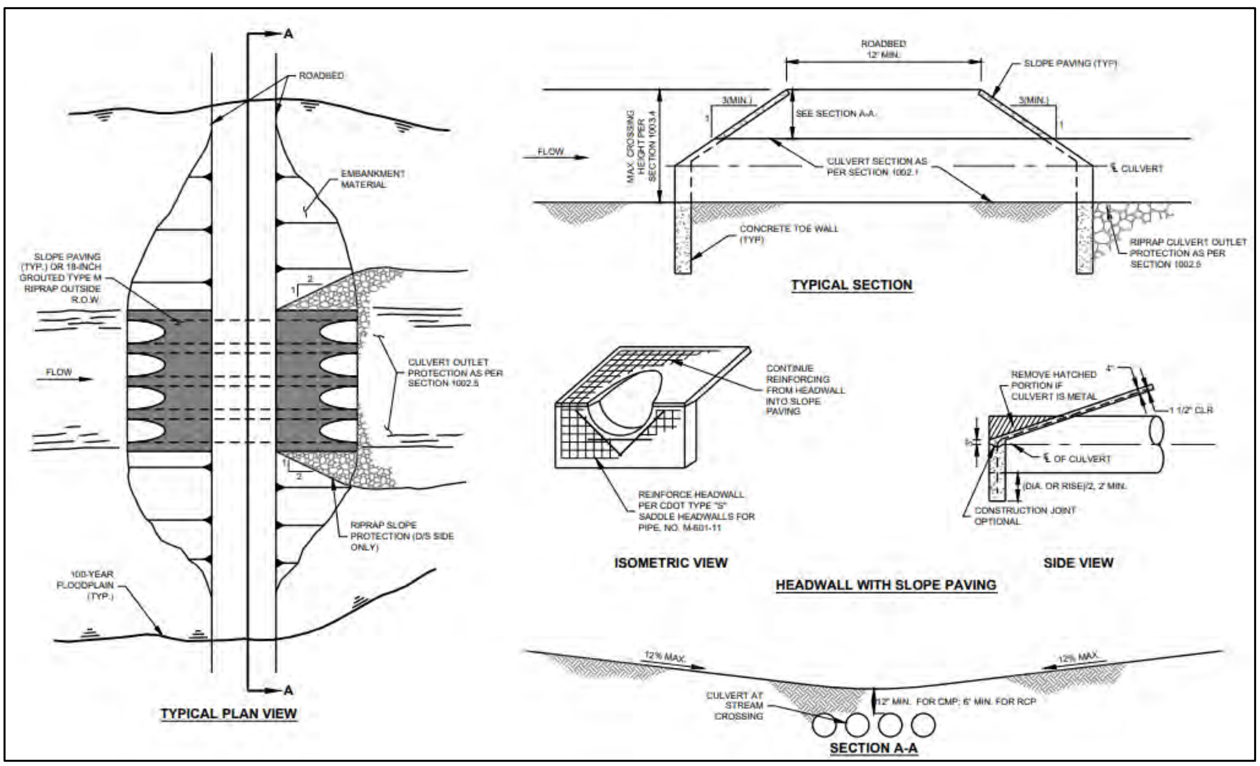

Figure 2 - Example of a Hardened Low Water Crossing

Priority 3 – Add stream Restoration Projects to all Infrastructure Improvements.

When repairing or fixing roadways, bridges, or crossings, use this opportunity to enhance and stabilize the stream around that location. It is recommended to use ecological and natural methodologies that are appropriate for the stream classification, hydrologic conditions, hydraulics, and geomorphological performance. This combines necessary efforts of permitting, design, and construction and creates a cost savings versus constructing projects separately. A healthy stream system is better protection for roadways and crossings than trying to fight the natural tendency of the stream's pathway.

Priority 4 – Watershed Wide Restoration

Request of budget funds for helicopter seeding or mulching where it is allowed. The Spring Creek burn scar has been slow to re-establish itself. The increased runoff from the hillsides that are increasing the energy in the stream, and this is root cause for the stream erosion, migration, and instability that threatens infrastructure and private property. An opportunity to conduct widespread seeding was possible during the EWP funding of the Spring Creek Fire, however, that opportunity was missed due to the following reasons:

a.) Difficulty getting approval from other federal agencies, such as the forest service.
b.) Being too selective where to perform arial mulching and seeding instead of using the opportunity to broadly apply seed and mulch without requiring individual site visits.

If the opportunity arises and funds become available, it is recommended to be less selective and more opportunistic on where to apply seed and mulch applications. After the fire of 2020, there were political shifts in allowing seeding and mulching on public land. These changes were not available in 2018 and 2019. These changes may be an opportunity to try again for seeding and mulching on public lands to help lesson the impact of runoff in the stream system.

DISCUSSION OF PAST PROJECT IDENTIFICATIONS

Enginuity previously visited locations in both Indian Creek and Middle Creek. Below are brief write-ups on field observations and improvements discussed at eight locations, four on Indian Creek and four on Middle Creek.

Rainfall and Flood Events of July 26-27 and August 3, 2020

Two intense rainfall events occurred over the Spring Creek burn area, specifically the Indian and Middle Creek watersheds on July 26th and August 3rd, 2020. Gage readings on Indian Creek measured depths of up to 6.4 feet on July 26th and 6.2 feet on August 3rd. Approximate flows based on the stage-discharge rating curve at the gage were 7,210 cfs and 6,420 cfs. It is noted that the gage is only an approximation of flow and is not calibrated on a regular basis. These flow rates are in the range of the 100-year event for the watershed. The flows resulted in significant damage, sediment transport, and debris flows through both creeks.

Figure 3: Flooding, sediment, and debris flow on Indian Creek on August 267, 2020.

Indian Creek

PROJECT SITE: UP ON THE ROCK (UTR) DEBRIS CLEANING MAINTENANCE

In the upper portion of the Indian Creek watershed, just downstream of the confluence with Price Canyon the channel suffers from significant debris and sediment flows. The channel itself is highly vegetated with trees that can act as debris catchers, resulting in water leaving the primary channel with overflows traveling down the forest access road. The road has suffered significant damage and is generally impassable. To address this problem, we has suggested two actions:

Figure 4: Forest access road damage near UTR.

1. Regrading the roadway to create a high point just west of the UTR access to push water into the main channel.
2. Clearing the channel downstream of the UTR access to increase conveyance, decrease debris snags, and limit flooding of the forest road.

These improvements were discussed in the field and should improve flooding conditions on the forest access road and improve conveyance through the reach.

PROJECT SITE: OLD SWIMMING POOL, CLEAN OUT ROUND 2

ARWC had previously repurposed an existing "swimming pool" to act as a sediment and debris trap. During the event on July 26/27 the pool facility filled in completely with sediment and debris. It is recommended to continue to clean out the pool and make the area available for additional sediment storage for future events. Some channel grading and modification may be needed upstream to redirect water through the pool while also allowing primary flows to go around the sediment trap.

Figure 5: Looking up at the downstream edge of the "swimming pool" facility following the flood event of July 26.

Figure 6: Channel upstream of "swimming pool".

PROJECT SITE: EMERGENCY WARNING GAUGE AREA, CHANNEL ALIGNMENT TO INCREASE FUNCTIONALITY OF GAGE WARNING SYSTEM

At the existing Indian Creek warning gage site, flood flows have reshaped the channel and have overflowed the channel banks. There is opportunity to catch debris and sediment in the overflow channel that exists on river right. Suggested improvements at this site include:

1. Reconfigure gage area to ensure flows are being measured correctly. This may require some large sandbags to keep flow in the channel through the gage.
2. Downstream of the gage, debris catchers using large wood or other materials could be installed in the overflow. These would act to catch sediment and debris on the overbanks of the channel.
3. In-channel improvements may be needed to prevent further incision and downcutting in the main channel. This would also allow for more frequent activation of the overflow channel. In-stream structures could include rock-riffles or small Temporary Wood Grade Structures (TWGS) with vertical posts and woven willow stakes or wood and debris to act as sediment traps and small grade control structures. It is recommended these structures not be taller than 1.5 feet in height.

Figure 7: Looking downstream from gage site at existing overflow channel (river right).

PROJECT SITE: 421 WATER BARS DRAINAGE PROJECT, CHANNEL CLEARING, PROVIDE POSITIVE DRAINAGE, RELIEVE FLOW ON ROADWAY

In the downstream portions of Indian Creek, the main channel continues to suffer degradation and headcutting, resulting in a disconnection of the main channel with the overbanks and floodplain. In these areas, TWGS may prove useful in maintaining the channel bottom, reconnecting and activating overbanks, and acting to capture debris and sediment. Regarding stream capacity, any clearing efforts should be evaluated via detailed hydraulic modeling to determine erosion risk and/or the need for additional conveyance.

Middle Creek

PROJECT SITE: DAHMER FIELDS-FLOODPLAIN, SOUTH MIDDLE CREEK, INCREASE CAPACITY, PROVIDE ATTENUATION, RECONNECT FLOODPLAIN

In the upper reaches of South Middle Creek, this project site sees regular flooding due to upstream burn scars. Recommendations for this site are:

1. Installation of TWGS to capture sediment and debris, maintain the channel thalweg, and activate the floodplain for additional sediment and debris capture.
2. Installation of some sediment/debris capture structures on the floodplain overbanks.

Given that the site is not in near proximity to any structures, is located high in the basin, and has significant floodplain available for storage of sediment and debris, these improvements appear to have a high probability of success in limiting delivery of sediment to downstream reaches. TWGS should be carefully evaluated considering their hydraulic function to appropriately key in structures and create roughness and complexity on the overbanks to flow velocities and capture materials being transported in flood flows.

Figure 8: Looking downstream along South Middle Creek at Dahmer Fields

Figure 9: Existing wood check structures along South Middle Creek at Dahmer Fields.

PROJECT SITE: IDLEWILD DECELERATION ZONE, NORTH MIDDLE CREEK, SEDIMENT CAPTURE

At the Idlewild site on North Middle Creek, the channel is suffering extreme erosion and downcutting due to increase flows from the burn scar. The channel is also widening as it continues to evolve. Other reports have proposed sediment capture features and stream stability improvements for this reach. Capturing sediment at this location will protect downstream road crossing improvements implemented via the NRCS EWP program. A variety of options could include large wood jams, TWGS, or rock riffle grade structures built to capture sediment upstream of the structure crest.

Figure 10: North Middle Creek at Idlewild

PROJECT SITE: LOWS EARTHEN DAM REPURPOSE, NORTH MIDDLE CREEK

Above the previously implemented Goofy Calf project on North Middle Creek there is an existing water impoundment on the Cashette sub-drainage. The existing pond embankment is suffering from damage due to the impoundment filling with sediment and experiencing overflows. Other reports have proposed to clean out and repair the impoundment to act as a sediment trap for future runoff events, limiting sediment delivery to North Middle Creek. Before implementing this improvement, the impoundment failure and potential life safety and property damage due to a failure should be considered. An adequate emergency spillway would be needed and the embankment itself would need to be evaluated for stability, toe drainage, and dam safety issues. Additionally, sediment yield from the upstream drainage area should be considered as well as maintenance actions and responsibilities. An engineering feasibility study would prove useful at this location to better determine the benefit of the proposed actions.

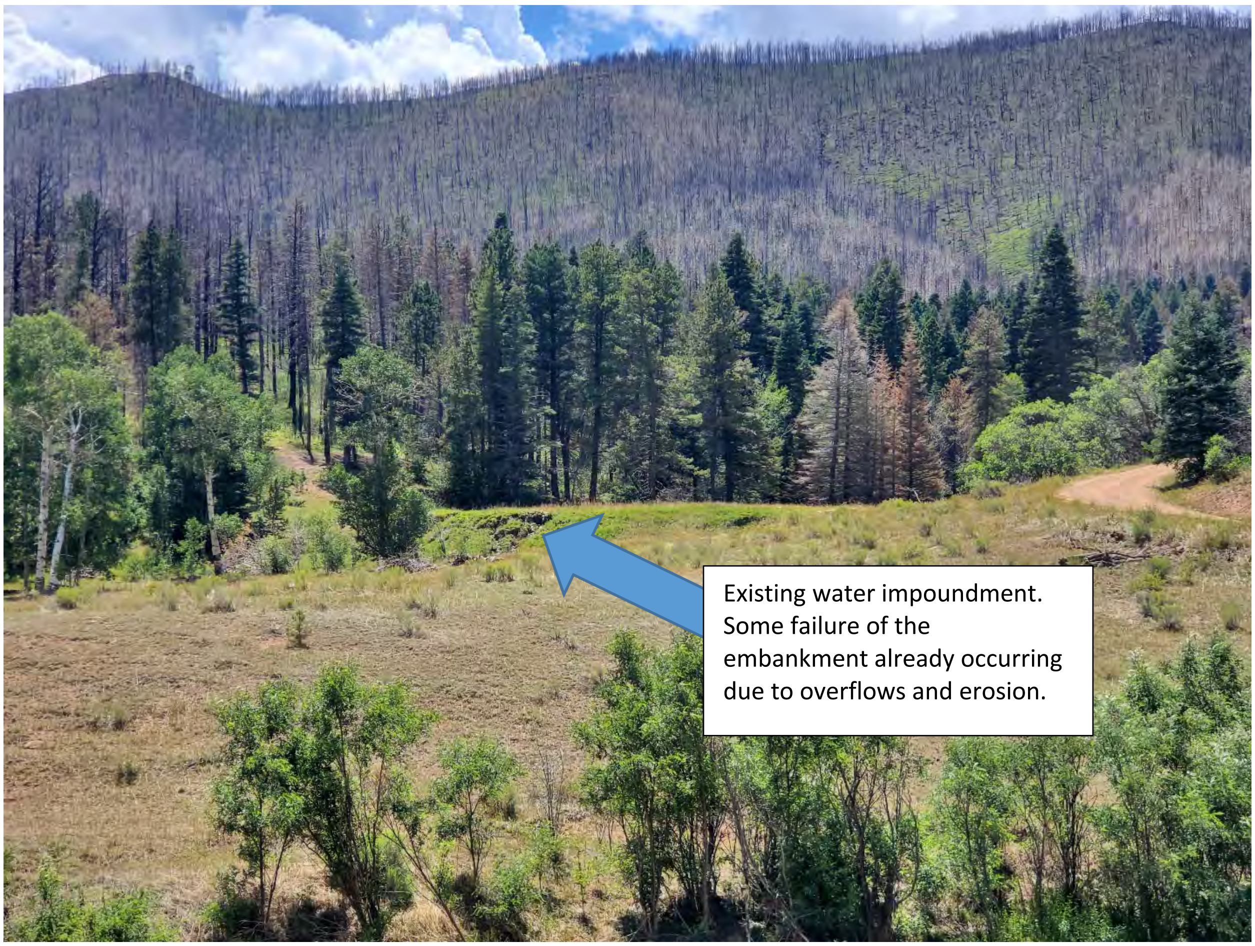

Figure 11: Existing water impoundment on tributary to North Middle Creek.

PROJECT SITE: GUN TERRET BASIN, CAPTURE SEDIMENT AND ATTENUATE FLOW

Below the Middle Creek flood warning gage, and below the mouth of the canyon, Middle Creek enters a transitional zone with broad vegetated floodplains. Currently the channel in this area is degrading and downcutting rapidly, disconnecting the creek from the overbanks. It is proposed to encourage sediment and debris capture in the floodplain in these areas. Improvements might include the use of TWGS or other features to stabilize the channel bottom and encourage more frequent overbank activation. Debris catching structures could be considered on the overbanks to decrease velocities and capture sediment and debris

EXAMPLES OF LOCATIONS EXPERIENCING PROBLEMS IN CUCHARAS DRAINAGE

Rilling Creek Feasibility

A site visit to Rilling Creek was conducted as some increased runoff has still been noted on the highway. Before the fire, hydrologic estimates indicate that 40 cfs could be expected if a storm sat on top of the 7 square miles of Rilling Creek the larger 70 square miles of Cucharas River. Due to attenuation of flows from the Cucharas, 40 cfs was the approximate annual peak estimates for a storms on either watershed as the direct runoff from a storm over Rilling Creek controls the peak.

The post fire estimates are significantly higher. The post fire after 4 years of recovery increase the 40 cfs to 137 cfs.

Figure 12 - Picture of Rilling Creek Downstream of Highway 12 (2022)

Big Branch Upstream of Highway 12 Feasibility

A site visit to Big Branch Creek was conducted as there have been complaints of debris loading onto the highway, long after the 2018 burn. The photo below is a picture of Big Branch upstream of Highway 12 in 2021. Although the flow estimates are lower on big branch the increases from the fire are high. An estimated change from an annual peak of 2 to 3 cfs are increased to 20 to 30 cfs of flow and debris from the burn scar.

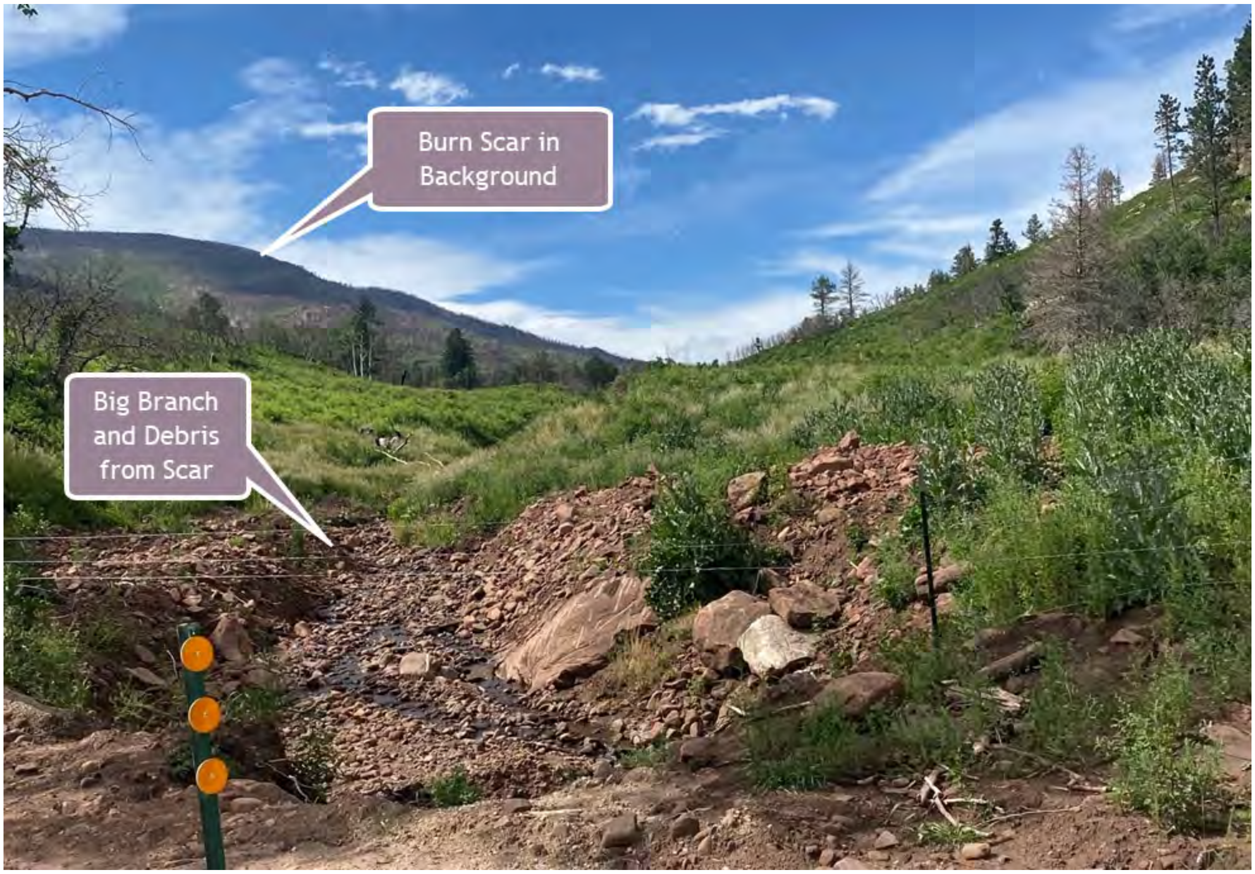

Figure 13 - Picture of Big Branch in 2022

UPDATED HYDROLOGIC ANALYSIS

Enginuity developed a pre and post hydrologic model within the Hydrologic Engineering Center Hydrologic Modeling System (HEC HMS Version 4.8). HEC-HMS is a widely used, accepted, and well-reviewed hydrologic model published by the US Army Corps of Engineers (USACE) and is designed to simulate the complete hydrologic processes of watershed systems[1]. HEC HMS models the widely used and accepted process known as TR-55 (Technical Release 55)[2] and the Soils Conservation Service (SCS) Unit Hydrograph. Four (4) models were developed within HEC HMS and are as follows:

1. **Cucharas River Pre-Fire:** This model simulates runoff from the Cucharas River Watershed using the SCS Curve Number (CN) method with the Type II rainfall distribution for the annual (99% Chance) through 500-year (0.2% Chance) floods. CN values were derived from an overlay of the National Land Cover Database (NLCD)[3] and soil information from the Natural Resources Conservation Service (NRCS)[4].
2. **Cucharas River Post Fire**: This model is a copy of (1) above and adjusted the CN values of the basins that were burned to be CN+12 to CN+15 depending on the burn intensity.
3. **Cucharas River Post Fire-2**: This model is a copy of (2) above and adjusted the CN values of the basins that were burned to be CN+8 to CN+10 depending on the burn intensity and recovery that has occurred over 2-years.
4. **Cucharas River Post Fire-4**: This model is a copy of (3) above and adjusted the CN values of the basins that were burned to be CN+5 to CN+8 depending on the burn intensity and recovery that is expected over 4-years from the time of the fire.

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[1] https://www.hec.usace.army.mil/software/hec-hms/
[2] https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/?cid=stelprdb1042901
[3] https://www.mrlc.gov/national-land-cover-database-nlcd-2016
[4] https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053629

Attachment B delivered with this study includes a more detailed hydrologic report summary and the HEC HMS digital model files.

UPDATED HYDRAULIC ANALYSIS

During intense fires, such as the Spring Creek Fire, convective heat and burning of the canopy produces organic litter on the forest floor. As the fire intensity increases, the conductive and radiant heat into the soil horizon goes deeper into the ground. This heats up the soil column and creates a water repellent layer of ash and organic litter. The more intense a fire, the deeper it will burn into the soil column, and the deeper it burns into the soil column, the longer it takes for vegetation to re-establish itself on the canopy floor. A water repellent layer left after a fire is termed as hydrophobicity or soil water repellency. Hydrophobicity decreases infiltration and initial rainfall losses and increases direct runoff from a watershed. Additionally, the burned canopy and soil horizon increase the amount of sediment from a watershed since there are no longer roots and plants to hold the soil column during storm events.

Estimating hazard zones and sediment transport zones as a result of a burned watershed required the following steps:

1.) How much more water? (Hydrology)[5]
2.) How fast and deep is that water going? (Hydraulics)
3.) How much debris and sediment will that water carry? (Hydraulics and Sediment Transport)
4.) Are there projects we can to do protect property and more quickly restore the watershed? (Project Identification)

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[5] First an estimate of pre and post burn hydrology must be performed (this is presented in the report titled *Pre and Post Burn Hydrologic Analysis of the Spring Creek Fire,* prepared by Enginuity (July 2020)

HEC RAS 2D Hydraulic Model Computational Development

Enginuity was provided a short amount of time to develop hydrology, hydraulics, geomorphology and to identify risk locations within the watershed. As such, the estimates provided within the hydraulic model are a function of the time provided to develop such a model. Although this was developed within a short time frame, it is our opinion that this hydraulic model still provides a reasonable estimate of inundation extents, depths, velocities, and identification of hazard locations for the annual, 2-, 5-, 10-, 25-, 50-, and 100-year storm frequencies developed in the previous analysis[6].

The HEC RAS 2D model developed for this study covers the Indian, Middle, and South Abeyta Creeks from the Town of La Veta to near the top of the watershed, this coverage is presented below.

[6] *Pre and Post Burn Hydrologic Analysis of the Spring Creek Fire,* prepared by Enginuity (July 2020)

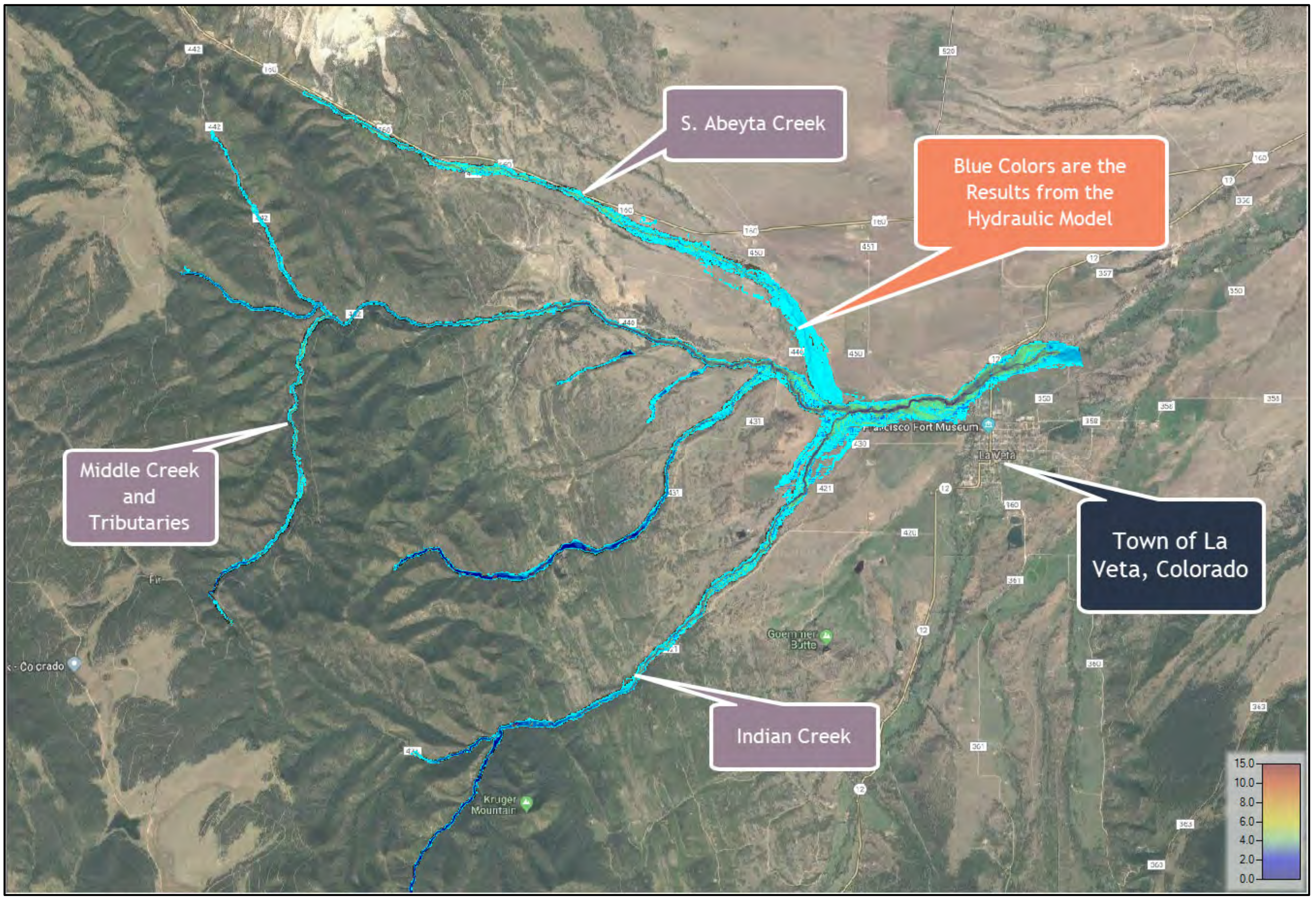

Figure 14 - Image of the Hydraulic Model Extents

FLUVIAL HAZARD BOUNDARY ASSESSMENT

Indian Creek and Middle Creeks are located in Huerfano County (south central Colorado in just west of the town of La Veta). The 2018 Spring Creek Fire burned much of the Indian Creek and Middle Creek watersheds. The impacts to the vegetation and soil because of the fire have altered the watersheds hydrology (flood frequency and magnitude) as well as soil and sediment transport capability (sediment and debris is more easily mobilized in the aftermath of a fire). As a result, the corridor and adjacent hillslopes within the Indian and Middle Creek corridors are vulnerable to flooding along with erosion and deposition associated with increased runoff and sedimentation because of precipitation falling on the burn scar

A fluvial hazards analysis for this study was conducted to determine, for planning and possible mitigation purposes, the areas adjacent to Indian and Middle Creeks that are susceptible to fluvial geomorphic change. The Fluvial Hazard Zone (FHZ) is defined as the area a stream has occupied in recent history, may occupy, or may physically influence as it stores and transports water, sediment, and debris. The methods and criteria used in this analysis are from the Colorado Fluvial Hazard Zone Delineation Protocol v1.0 that was released in August 2020. This analysis was compared with the results from the updated hydrologic and hydraulic analysis.

STREAM BY STEAM COST ESTIMATE

South Abeyta Creek

South Abeyta Creek is the northern most tributary that contributes to Middle Creek, and ultimately the North Side of La Veta. There are numerous low water crossings that are used to access private property. There are also sections of road embankment that are near the Active Stream Corridor (ASC) and are at risk of erosion. It does not mean that it is imminent that those sections will fail, it only means those sections are at higher risk. If all potential improvement were to be addressed, the preliminary cost estimate is in the range of 2.8 millions dollars. Table 2 and Figure 15 below is a break down of the cost estimate for this stream reach and a figure presenting the locations identified as part of this study.

Table 2 – Preliminary Cost Estimate to Address All Areas at Risk in the ASC for South Abeyta Creek

Item	Cost Per Item
Low Water Crossings	$ 309,960
Road Protection and or Re-Locations	$ 499,800
Stream Enhancement	$ 805,950
Total Capital Cost	**$ 1,615,710**
Mobilization and Permitting Costs	$ 161,572
Engineering and Administrative Costs	$ 533,184
Contingency	$ 977,505
Total Cost	**$ 2,754,787**

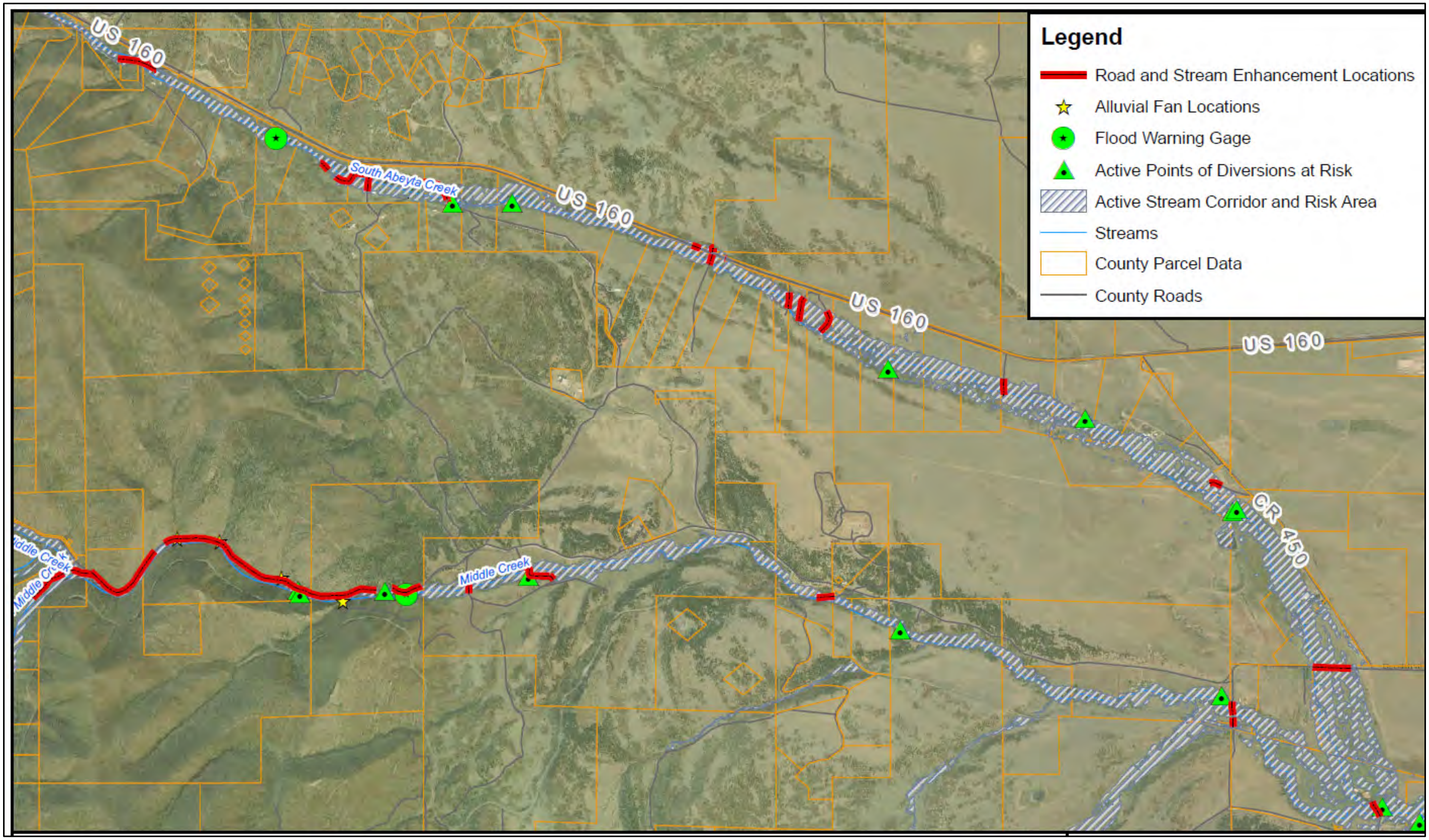

Figure 15 – Image of the South Abeyta Creek Improvement and Enhancement Locations

Middle Creek

Middle Creek continues to see a lot of rainfall, higher flow rates, and unraveling of the stream bed. Some work was conducted under the EWP program to protect life and property, however, that program has ended, and those funds are no longer available. Middle Creek has a series of crossings onto private property that could be at risk of failing. There are numerous locations where the county road has been washed away as it heads up the canyon. To address all the locations of stream instability, roadway protection and/or relocation the total cost expected is approximately $6.5 million. Table 3 and Figure 15 (above) present the locations in Middle Creek where there are road protection and stream enhancement opportunities.

Table 3 – Preliminary Cost Estimate to Address All Areas at Risk in the ASC for Middle Creek

Item	Cost Per Item
Low Water Crossings	$ 247,968
Road Protection and or Re-Locations	$ 1,398,900
Stream Enhancement	$ 2,158,350
Total Capital Cost	**$ 3,805,218**
Mobilization and Permitting Costs	$ 380,522
Engineering and Administrative Costs	$ 1,255,722
Contingency	$ 1,046,435
Total Cost	**$ 6,487,897**

North Middle Creek

North Middle Creek continues to see a lot of rainfall, higher flow rates, and unraveling of the stream bed. There are numerous locations where the county road has been washed away as it heads up the canyon. To address all the locations of stream instability, roadway protection and/or relocation the total cost expected is approximately $1.5 million. Table 4 presents the preliminary cost estimate for all the potential improvements in North Middle Creek.

Table 4 – Preliminary Cost Estimate to Address All Areas at Risk in the ASC for North Middle Creek

Item	Cost Per Item
Low Water Crossings	$ 123,984
Road Protection and or Re-Locations	$ 310,500
Stream Enhancement	$ 465,750
Total Capital Cost	**$ 900,234**
Mobilization and Permitting Costs	$ 90,024
Engineering and Administrative Costs	$ 297,078
Contingency	$ 247,565
Total Cost	**$ 1,534,901**

South Middle Creek

South Middle Creek is higher in the watershed and has been experiencing as many issues as the mainstem of Middle Creek. To address all the locations of stream instability, roadway protection and/or relocation the total cost expected is approximately $3 million. Table 5 presents the cost break down for doing construction and restoration within South Middle Creek.

Table 5 – Preliminary Cost Estimate to Address All Areas at Risk in the ASC for South Middle Creek

Item	Cost Per Item
Low Water Crossings	$ -
Road Protection and or Re-Locations	$ 698,250
Stream Enhancement	$ 1,047,375
Total Capital Cost	$ 1,745,625
Mobilization and Permitting Costs	$ 174,562
Engineering and Administrative Costs	$ 576,056
Contingency	$ 480,047
Total Cost	**$ 2,976,290**

Idlewild Creek

Idlewild Creek is higher in the watershed and has been experiencing as many issues as the mainstem of Middle Creek. To address all the locations of stream instability, roadway protection and/or relocation the total cost expected is approximately $3 million. Table 6 presents the cost break down for doing construction and restoration within Idlewild Creek.

Table 6 – Preliminary Cost Estimate to Address All Areas at Risk in the ASC for Idle Wild Creek

Item	Cost Per Item
Low Water Crossings	$ -
Road Protection and or Re-Locations	$ 402,000
Stream Enhancement	$ 603,000
Total Capital Cost	**$ 1,005,000**
Mobilization and Permitting Costs	$ 100,500
Engineering and Administrative Costs	$ 331,650
Contingency	$ 276,375
Total Cost	**$ 1,713,525**

Oak Creek

Oak Creek is a tributary to Middle Creek. There has been some work performed by private land owners within the creek after the fire. However, it's not known if that work has held or has been washed away. To address all the locations of stream instability, roadway protection and/or relocation the total cost expected is approximately $0.6 million. Table 7 presents the cost break down for doing construction and restoration within Oak Creek.

Table 7 – Preliminary Cost Estimate to Address All Areas at Risk in the ASC for Oak Wild Creek

Item	Cost Per Item
Low Water Crossings	$ 185,976
Road Protection and or Re-Locations	$ 76,650
Stream Enhancement	$ 114,975
Total Capital Cost	**$ 377,601**
Mobilization and Permitting Costs	$ 37,760
Engineering and Administrative Costs	$ 124,608
Contingency	$ 103,840
Total Cost	**$ 643,809**

Indian Creek

Indian Creek has been hit hard by the Spring Creek fire and subsequent runoff, debris flow, and sedimentation. A past study by ARWC and Enginuity presented a series of alternatives to address issues along Indian Creek. This study also found some of the same areas that were found in previous studies as locations of needing improvements.

Table 8 – Preliminary Cost Estimate to Address All Areas at Risk in the ASC for Indian Creek

Item	Cost Per Item
Low Water Crossings	$ 371,952
Road Protection and or Re-Locations	$ 2,002,950
Stream Enhancement	$ 3,084,425
Total Capital Cost	$ **5,459,327**
Mobilization and Permitting Costs	$ 545,932
Engineering and Administrative Costs	$ 1,801,578
Contingency	$ 1,501,315
Total Cost	**$ 9,308,152**

Total Cost

The total cost for all improvements in the watershed is presented below in Table 9

Table 9 – Cost Summary for all potential restoration, protections, and improvements

REACH	CAPITAL	ENGINEERING	LEGAL / ADMINISTRATIVE	CONTRACT ADMIN/CM	CONTINGENCY	TOTAL CAPITAL COST
South Abeyta	$1,777,282.00	$266,592.00	$88,864.00	$177,728.00	$444,321.00	$2,754,787.00
Middle Creek	$4,185,740.00	$627,861.00	$209,287.00	$418,574.00	$1,046,435.00	$6,487,897.00
North Middle	$990,258.00	$148,539.00	$49,513.00	$99,026.00	$247,565.00	$1,534,901.00
South Middle	$1,920,187.00	$288,028.00	$96,009.00	$192,019.00	$480,047.00	$2,976,290.00
Idelwild Creek	$1,105,500.00	$165,825.00	$55,275.00	$110,550.00	$276,375.00	$1,713,525.00
Oak Creek	$415,361.00	$62,304.00	$20,768.00	$41,536.00	$103,840.00	$643,809.00
Indian Creek	$6,005,259.00	$900,789.00	$300,263.00	$600,526.00	$1,501,315.00	$9,308,152.00
Totals	**$16,399,587**	**$2,459,938**	**$819,979**	**$1,639,959**	**$4,099,898**	**$25,419,361**

CONCLUSIONS AND RECOMMENDATIONS

This study analyzed potential improvement locations and developed cost estimates for a series of streams impacted by the Spring Creek Fire. Updated hydrology analyzed an estimated 4 years of watershed recovery and remodeled the Spring Creek fire following some of the most widely accepted modeling practices for burned watersheds. A new HEC HMS and hydrology report is provided in Attachment B. Although 4 years is a significant recovery period, some of the locations analyzed for this study are still expected to experience 10 to 20 times the flows and volumes of a pre fire watershed.

The total costs to stabilize and enhance the impacted streams and to protect infrastructure in the watersheds above La Veta is over $25 million. This total cost is likely un-feasible to obtain, budget for, or request.

Due to the substantial costs associated with the large level of idenfied improvements, it is recommended to focus on easy and obtainable goals before trying to accomplish large expensive projects. One goal is to consider another clearing and grubbing operation of the Cucharas through Town. This operation could be done by a contractor or by volunteers and would provide a large amount of benefit to flood protection and be significantly less in cost. It is also recommended to maintain and request or budget funding for protection and functionality of the flood warning system.

The following priorities are recommended:

Priority 1

Focus on saving life and property through must do maintenance and work, this includes:

c. Request funds for or budget for cleaning and working areas around the flood warning gages.

d. Requests funds for or budget for work to keep the main river corridors through the Town of La Veta and Huerfano clean of brush, large trees, snags, and blockages.

The total cost for the priority 1 items is estimated at $104,000 dollars. This cost may not required every year, however, we recommend budgeting or requesting at least $36,000 for gage maintenance given that any one of the three gages above La Veta could become damages by flood waters in any year. Table 1 below presents the breakdown of this cost estimate for priority 1 items.

Table 10 - Estimated Cost for Priority 1 Items

Description	Quantity	Unit	Unit Price	Total Cost
Clearing and Maintenance Gages as Needed	400	LF	$50.00	$20,000.00
Moving and Grading of Material, as Needed	500	CY	$30.00	$15,000.00
Haul away Debris	2	Load	$500.00	$1,000.00
			Total for Gage Maintenance	$36,000.00
Clearing and Grubbing Channel in Town for Flood Protection	1700	LF	$30.00	$51,000.00
			Contingency	$17,400.00
			Total Estimate	**$104,400.00**

Priority 2

When re-constructing washed out crossings, roadways, or damaged infrastructure focus on removing that infrastructure from the active stream corridor (ASC), if possible. A GIS shapefile of this boundary has been provided in the Attachments. If crossing the ASC is necessary for access to properties, construct crossings that are resilient to flood flows. This includes a hardened section with cutoff walls up and downstream. Approaches to the section may be expected to breach from large events, however, the main portion of the approach, and most costly to rebuild, would be expected to remain. Figure 16 below is a schematic of this type of crossing.

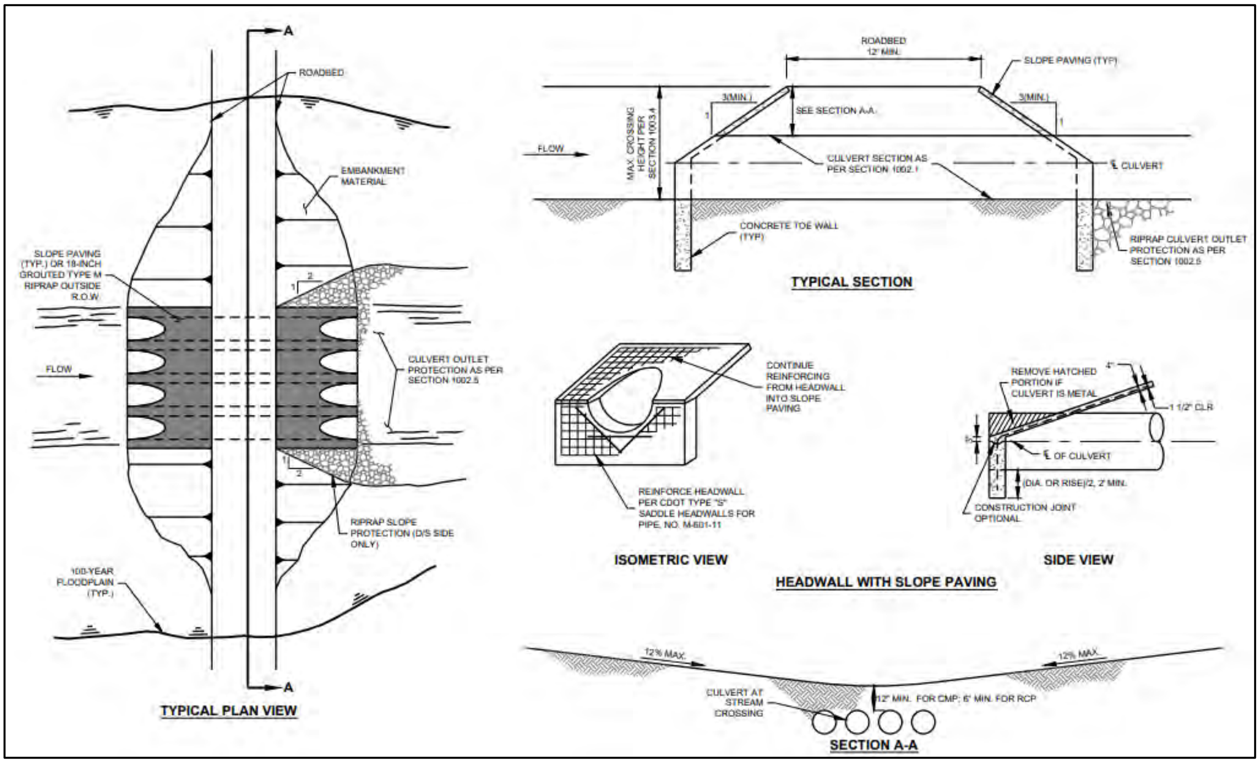

Figure 16 - Example of a Hardened Low Water Crossing

Priority 3

When repairing or fixing roadways, bridges, or crossings, use this opportunity to enhance and stabilize the stream around that location. It is recommended to use ecological and natural methodologies that are appropriate for the stream classification, hydrologic conditions, hydraulics, and geomorphological performance. This combines necessary efforts of permitting, design, and construction and creates a cost savings versus constructing projects separately. A healthy stream system is better protection for roadways and crossings than trying to fight the natural tendency of the stream's pathway.

Priority 4

Request of budget funds for helicopter seeding or mulching where it is allowed. The Spring Creek burn scar has been slow to re-establish itself. The increased runoff from the hillsides that are increasing the energy in the stream, and this is root cause for the stream erosion, migration, and instability that threatens infrastructure and private property. An opportunity to conduct widespread seeding was possible during the EWP funding of the Spring Creek Fire, however, that opportunity was missed due to the following reasons:

c.) Difficulty getting approval from other federal agencies, such as the forest service.
d.) Being too selective where to perform arial mulching and seeding instead of using the opportunity to broadly apply seed and mulch without requiring individual site visits.

If the opportunity arises and funds become available, it is recommended to be less selective and more opportunistic on where to apply seed and mulch applications. After the fire of 2020, there were political shifts in allowing seeding and mulching on public land. These changes were not available in 2018 and 2019. These changes may be an opportunity to try again for seeding and mulching on public lands to help lesson the impact of runoff in the stream system.