Cucharas River Wildfire/Watershed Assessment

Prioritization of watershed-based risks to water supplies

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Additional information on the Cucharas River Watershed is available at:

http://www.jw-associates.org/cucharas.html

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Cucharas River Wildfire/Watershed Assessment

Prioritization of wildfire/watershed-based hazards to water supplies

INTRODUCTION

This wildfire/watershed assessment is designed to identify and prioritize sixth-level watersheds based upon their potential to generate flooding, debris flows and increased sediment yields following wildfires, and thereby impacting water supplies. This assessment is is intended to expand upon current wildfire hazard reduction analyses by including water supply watersheds as a community value. The assessment follows a procedure prescribed by the Front Range Watershed Protection Data Refinement Work Group (2009). This analysis also provides an identification of opportunities and constraints for each Zone of Concern.

An additional goal of this assessment was to gather the key water supply stakeholders together in order to communicate the suggested process, listen to any suggested changes, utilize their collective experience, and build collaborative support for the assessment process and outcomes. To date there have been four Watershed Group meetings, which have included a diverse group (Appendix A) that have been engaged in the process.

WATERSHED DESCRIPTION

The Cucharas River watershed is part of the fourth-level (eight-digit) Huerfano Watershed (HUC 11020006) which drains into the Upper Arkansas-Lake Meredith watershed. This wildfire/watershed assessment is designed to assess hazards from forest fires to water supply. Therefore, the subwatersheds that are mostly non-forested or had other factors that limited their wildfire hazard were eliminated from the assessment.

Those watersheds were identified during the first watershed group meeting. The eliminated watersheds include six sixth-level watersheds (Turkey Ridge, Rattlesnake Canyon, Bustos Flat, Cucharas Reservoir, Sandy Arroyo, Santa Clara Creek-Cucharas River) based upon their wildfire hazard, ruggedness, and an examination of how well they fit into this assessment. These watersheds generally contain no or little forested area and are relatively flat compared to the other watersheds in the assessment. The remaining sixth-level watersheds within the Cucharas River Watershed cover 339,219 acres, three fifth-level watersheds and 16 sixth-level watersheds. The sixth-level watersheds are the analysis units for this assessment (Front Range Watershed Protection Data Refinement Work Group 2009). The Cucharas River watershed and its fifth-level and sixth-level watersheds are shown on Figure 1 and listed in Table 1.

Table 1. Fifth-level and Sixth-level Watersheds in Cucharas River Assessment

Fifth-level Watershed	Sixth-level Watershed	Watershed Area (acres)	Hydrologic Unit Code (HUC)
Upper Cucharas River HUC 1102000604	Headwaters Cucharas River	20,849	110200060401
	South Abeyta Creek	11,709	110200060402
	Indian Creek	11,196	110200060403
	Headwaters Middle Creek	20,107	110200060404
	Wahatoya Creek	13,554	110200060405
	Middle Creek-Cucharas River	34,039	110200060406
	North Abeyta Creek	19,092	110200060407
	Chavez Arroyo	12,623	110200060408
	Bear Creek	28,603	110200060409
	City of Walsenburg-Cucharas River	34,858	110200060410
Middle Cucharas River HUC 1102000605	Walsen Arroyo	29,579	110200060501
	North Santa Clara Creek	16,716	110200060502
	South Santa Clara Creek	17,187	110200060503
	Saliba Lake-Santa Clara Creek	33,660	110200060504
Sandy Arroyo HUC 1102000606	Gordon Arroyo	16,306	110200060601
	Pictou Arroyo	19,140	110200060602
Totals		**339,219**	

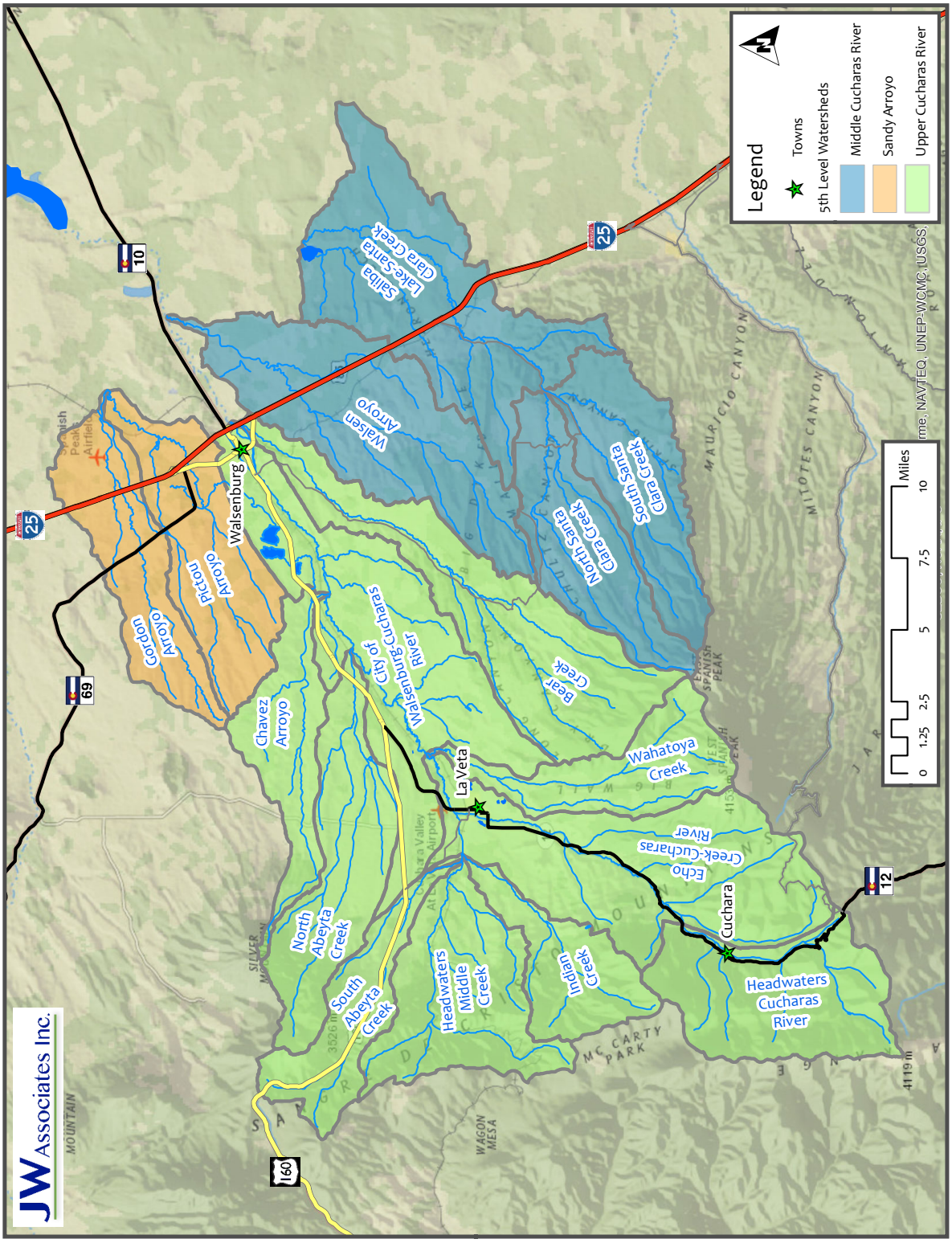

Figure 1. Cucharas River Watershed Analysis Area[1]

[1] The fifth-level watersheds are shown in the legend in Figure 1. The sixth-level watersheds can be seen in this figure outlined in gray lines and labeled.

WATERSHED INTEGRITY/RESILIENCY

Water supply watersheds have higher integrity or resiliency when they have diverse vegetation. Forest diversity can be associated with a mix of species, amount of openings or a variety of ages of trees. Many forested water supply watersheds in Colorado have become vulnerable to disturbance events because they have low diversity. In some cases, low diversity is caused by fire suppression, past human caused disturbances, or may be their current condition without human-caused influences. For example, many watersheds in Colorado currently forested with ponderosa pine and Douglas-fir have lower diversity due primarily to the lack of disturbances.

Watershed conditions that are characterized by increasing forest density present a hazard to their ability to provide high quality water supplies. High elevation forests are typically denser than low elevation forests. On a landscape scale, diversity in Colorado's high elevation forests has been reduced as meadows and openings are slowly filled by trees, as forests move towards climax conditions, and as successional aspen stands are converted to conifers. The openings and areas of lower density forest are important as these areas fill deeply with snow during winter and slowly release water during the spring and early summer. Areas of aspen, meadows and lower density forest also do not burn as intensely in wildfires as densely forested areas.

Fire ecologists use the terms "wildfire severity" or "burn severity" to refer to the effects of fire on soil conditions and hydrologic function. Wildfire severity is the effect that fire has on ground cover and soils. High severity wildfires remove or kill virtually all living forest vegetation above the ground, including trees, shrubs and grasses, and consume fallen needles, decomposed roots and other elements of ground cover or duff that protect forest soils. Hot fires damage soil productivity by destroying organic materials in the soil, and can create hydrophobic conditions where rainfall will not readily soak into the soils. This phenomenon contributes to and increases erosion and the potential for debris flows. In general, the denser the pre-fire vegetation and the longer the fire burns on a particular site, the more severe the impacts on soil and its ability to absorb and process water.

The loss of critical surface cover leaves forested slopes extremely vulnerable to large-scale soil erosion and flooding during subsequent rainfall events. These risks threaten the communities and natural resources downstream, but can also adversely affect watershed integrity over the long-term. The presence of highly erosive soils in several parts of the state, combined with weather patterns that frequently bring heavy rains after the fire season can create difficult and expensive challenges long after the fire is out. For example, during the very severe 2002 Fire Year, at least 26 municipal water storage facilities were severely affected due to wildfire impacts. The South Platte River and Strontia Springs Reservoir are still experiencing the effects of that fire year. In 2012, the High Park Fire adversely impacted the Cache La Poudre River with excessive sediment,

the Waldo Canyon Fire impacted Rampart Reservoir and the Hewlett Gulch Fire impacted Milton Seaman Reservoir.

Public and private entities have invested millions of dollars to implement emergency measures to protect people, communities and critical resources from post-fire events such as flooding, erosion, mudslides, and related degradation of water supplies and storage facilities. In the wake of the 2002 wildfire season, federal agencies invested more than $26 million in emergency rehabilitation, while at least $16 million was invested to shore-up non-federal lands. Denver Water and the Colorado State Forest Service undertook a massive post-fire rehabilitation effort at Cheesman Reservoir.

Increasing forest diversity through active management of water supply watersheds can reduce the effects of wildfires on watersheds. However, equally important are pre- and post-fire planning (see Recommendations Section below).

WATERSHED ASSESSMENT

The potential of a watershed to deliver sediments following wildfire depends on forest and soil conditions, the configuration of the watersheds, and the sequence and magnitude of rain falling on the burned area. High-severity fires can change the watershed condition, dramatically altering the runoff and erosion processes in the affected watershed. Water and sediment yields may increase as more of the forest floor is affected by fire.

The Cucharas River Wildfire/Watershed Assessment considers four components that are integral in evaluating hazardous watershed conditions: wildfire hazard, flooding and debris flow hazard, soil erodibility and water supply. This section of the report presents the watershed assessment analysis that prioritizes the included sixth-level watersheds by hazard categories. It also discusses the technical approach for each component and the process used to assemble the watershed ranking.

The Cucharas River Wildfire/Watershed Assessment was collaboratively developed through a watershed group review process. The watershed group included representatives from water providers; federal, state and local land management agencies; counties; towns and other interested groups (Appendix A). Four meetings were conducted to orient the groups and individuals to the process, provide some local expertise to verify and adjust the results and to understand how the assessment can be useful to the various organizations.

The results for each component are categorized into five categories that are used in the analysis. The categorization is prescribed by the Front Range Watershed Protection Data Refinement Work Group (2009). The categories are used in this analysis for comparing watersheds to each other within the Cucharas River

Watershed. Comparisons with other watershed assessments are not valid because this approach prioritizes watersheds by comparing them to the sixth-level watersheds in this watershed assessment area.

The calculation of ranking for each sixth-level watershed is completed as follows:

1. Use the hazard based on the percentage of each sixth-level watershed (or other metrics).
2. Scale the results so that they fall within five equal categories.
3. Round the scaled result to the nearest whole number (retain the number for Composite Hazard Ranking).
4. Create a map of the results using the following scheme:

    Category 1 – Lowest
    Category 2
    Category 3
    Category 4
    Category 5 – Highest

Component 1 - Wildfire Hazard

Forest conditions that have high wildfire hazards are the highest concern for this assessment. The Colorado Wildfire Risk Assessment Report (CO-WRAP) system was used to generate a variety of wildfire hazard and risk analyses for the Cucharas River Watershed (Colorado State Forest Service 2014). The various elements of the CO-WRAP analysis were evaluated for appropriateness to this project. That evaluation and review by the Cucharas River watershed group determined that Flame Length and Fire Intensity were the two elements that would be used in this assessment. The wildfire risk elements in CO-WRAP were determined to not accurately represent the relative risks in the watershed and therefore, the CO-WRAP elements that were risk-based were not used in this assessment. The Flame Length analysis is similar to the wildfire hazard analysis that has been used in the previous wildfire/watershed assessments in Colorado.

Figure 2 shows the CO-WRAP Flame Length results in six categories ranging from lowest (Category 0) to highest (Category 5). The flame length categories are;

Flame Length Category 0 - Very Low (0-1 feet)

Flame Length Category 1 - Low (1-4 feet)

Flame Length Category 2 - Moderate (4-8 feet)

Flame Length Category 3 - High (8-12 feet)

Flame Length Category 4 - Very High (12-25 feet)

Flame Length Category 5 - Extreme (25+ feet)

Figure 3 shows the CO-WRAP Fire Intensity results. The Fire Intensity results were provided in five categories ranging from lowest (Category 1) to highest (Category 5). The results for both the Flame Length and Fire Intensity were categorized by sixth-level watershed into five categories that are used throughout the analysis (see Table B-1 in Appendix B) using the following formula.

Wildfire Hazard Ranking = (% in Category 3 + 2 x % in Category 4 + 3 x % in Category 5) / Watershed Area

The East Peak Fire burned within the Cucharas River Watershed in 2013. It effectively reduced wildfire hazard in areas that burned at various intensities. The areas that burned were adjusted to low Flame Length and Fire Intensity categories for this assessment. The watersheds that were adjusted are; North and South Santa Clara Creek, and Bear Creek.

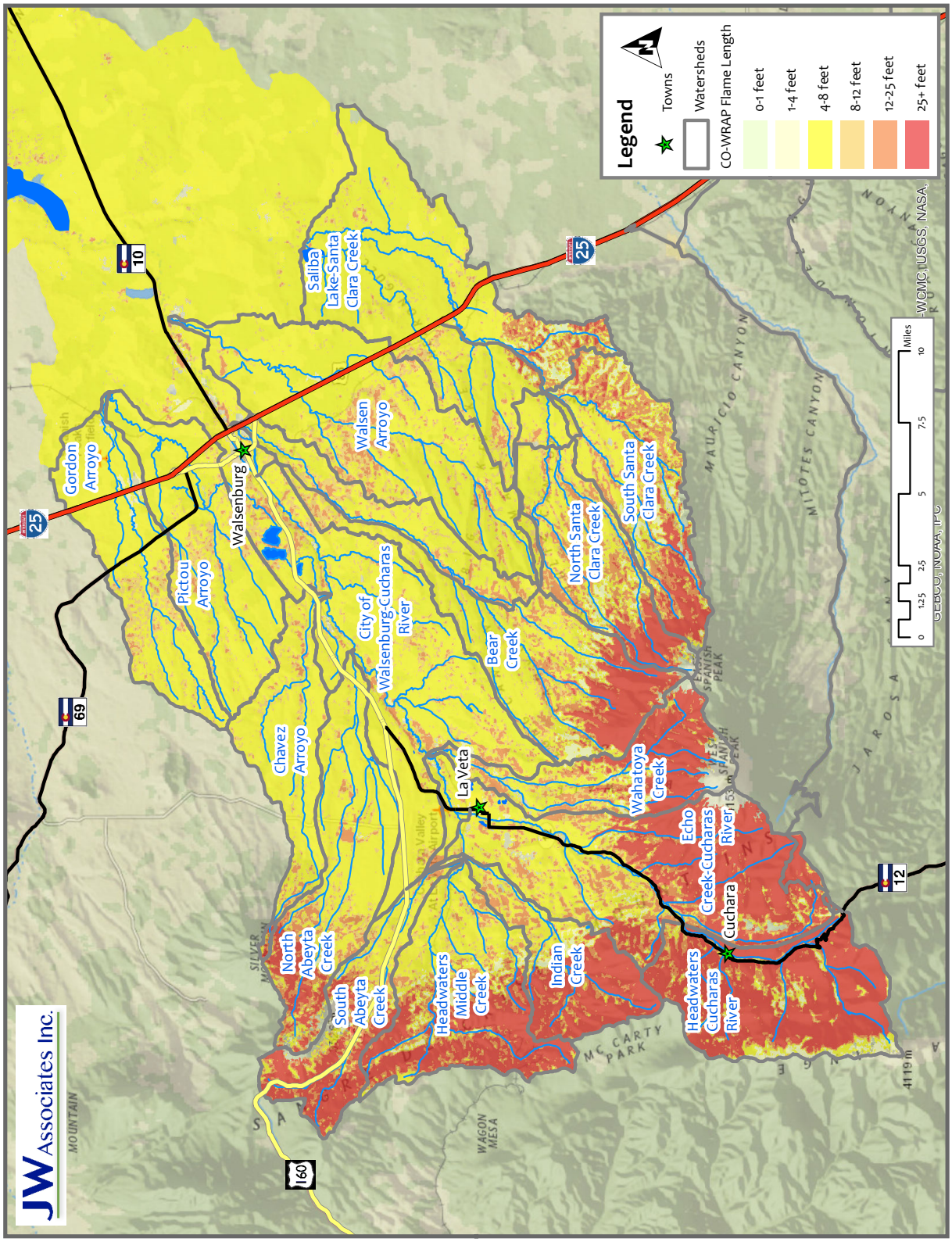

Figure 2. Cucharas River Watershed CO-WRAP Flame Length Results

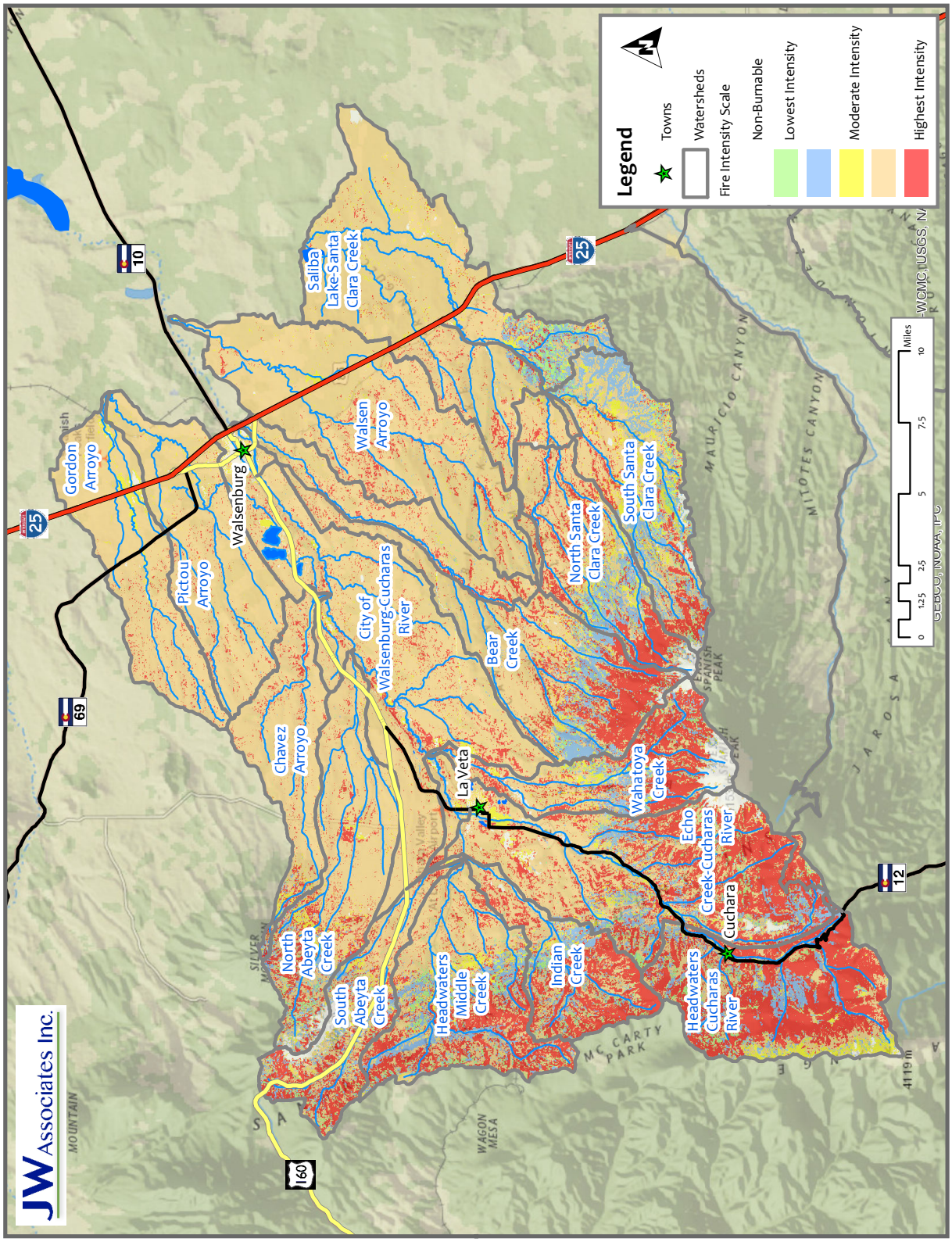

Figure 3. Cucharas River Watershed CO-WRAP Fire Intensity Results

The combined wildfire hazard (flame length combined with fire intensity) by sixth-level watershed was mapped (Figure 4). The map shows that the highest hazards (Category 5) are found in two sixth-level watersheds: Headwaters Cucharas River and Indian Creek (see also Table B-1 in Appendix B).

Tables 2 and 3 are provided as tools for interpreting the implications of the flame length analysis. Ground crews with simple hand tools are not effective against fires with flame lengths over three to four feet. Spotting beyond the immediate vicinity of the fire causes safety concerns and can also result in several, if not numerous, independent fires downwind from the original blaze. Multiple spot fires can compromise firefighter and resident safety by cutting off escape routes to safety zones.

Table 2. Fire Suppression Implications of Flame Length

Flame Length (feet)	Interpretation
0-4	Persons using hand tools can generally attack fires at the head or the flanks. Handlines should hold the fire.
4-8	Fires are too intense at the head for direct attack by persons using hand tools. Handlines can't be relied upon to hold the fire. Equipment such as dozers, engines and retardant aircraft can often be effective on fires with these flame lengths.
8-11	Fires with these flame lengths may present serious control problems such as torching, crowning, and spotting. Control efforts at the head of the fire using dozers and engines will probably be ineffective. Attack using retardant aircraft may still be effective.
11+	Crowning, spotting, and major fire runs are common. Control efforts at the head of the fire, even with retardant aircraft, are usually ineffective.

Table 3. Rate of Spread Based on Flame Length[2]

Flame Length (feet)	Rate of Spread (Chains/Hour)
0 – 1	0 – 2
1 – 4	2 – 5
4 – 8	5 – 20
8 – 11	20 – 50
12 – 25	50 – 150
> 25	> 150

[2] One chain equals 66 feet

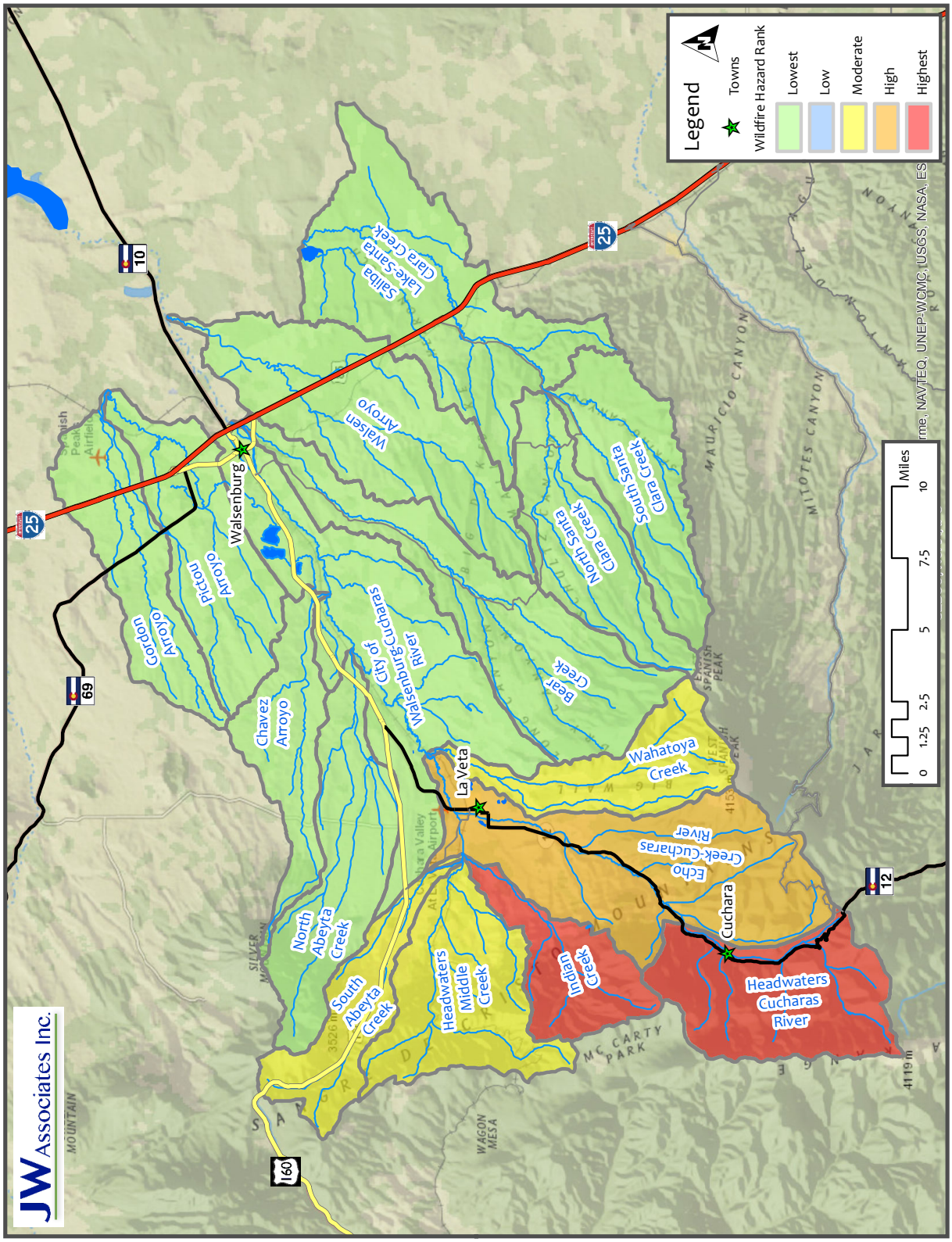

Figure 4. Cucharas River Watershed Wildfire Hazard Ranking

Component 2 - Flooding or Debris Flow Hazard

A combination of ruggedness and road density (miles of road per square mile of watershed area) was used to assess the flooding or debris flow hazard portion of the analysis. The two components, ruggedness and road density, are described below.

Ruggedness

Watershed steepness or ruggedness is an indicator of the relative sensitivity to debris flows following wildfires (Cannon and Reneau 2000). The more rugged the watershed, the higher its sensitivity to generating debris flows following wildfire (Melton 1957). The Melton ruggedness factor is basically a slope index.

Melton (1957) defines ruggedness, R, as;

$$R = H_b A_b^{-0.5}$$

Where A_b is basin area and H_b is basin height measured from the point of highest elevation along the watershed divide to the outlet.

The ruggedness factor was adjusted in some watersheds because it does not accurately assess their sensitivity to generating debris flows. Those situations are most common in composite watersheds because they are disconnected from their headwaters. These watersheds can have a high hazard for debris flows because they contain a main stem of a creek or river with several steep first order streams as tributaries. In those situations, the ruggedness calculation was adjusted up by reducing the watershed area. These adjustments were completed on the Headwaters Middle Creek, Echo Creek-Cucharas River, City of Walsenburg-Cucharas River, and Saliba Lake-Santa Clara Creek watersheds (Appendix B).

Figure 5 displays the categorized ruggedness for the Cucharas River Watershed. The tabular results are presented in Appendix B. The map (Figure 5) shows that the most rugged (Category 5) sixth-level watersheds are; Wahatoya Creek, and Echo Creek-Cucharas River.

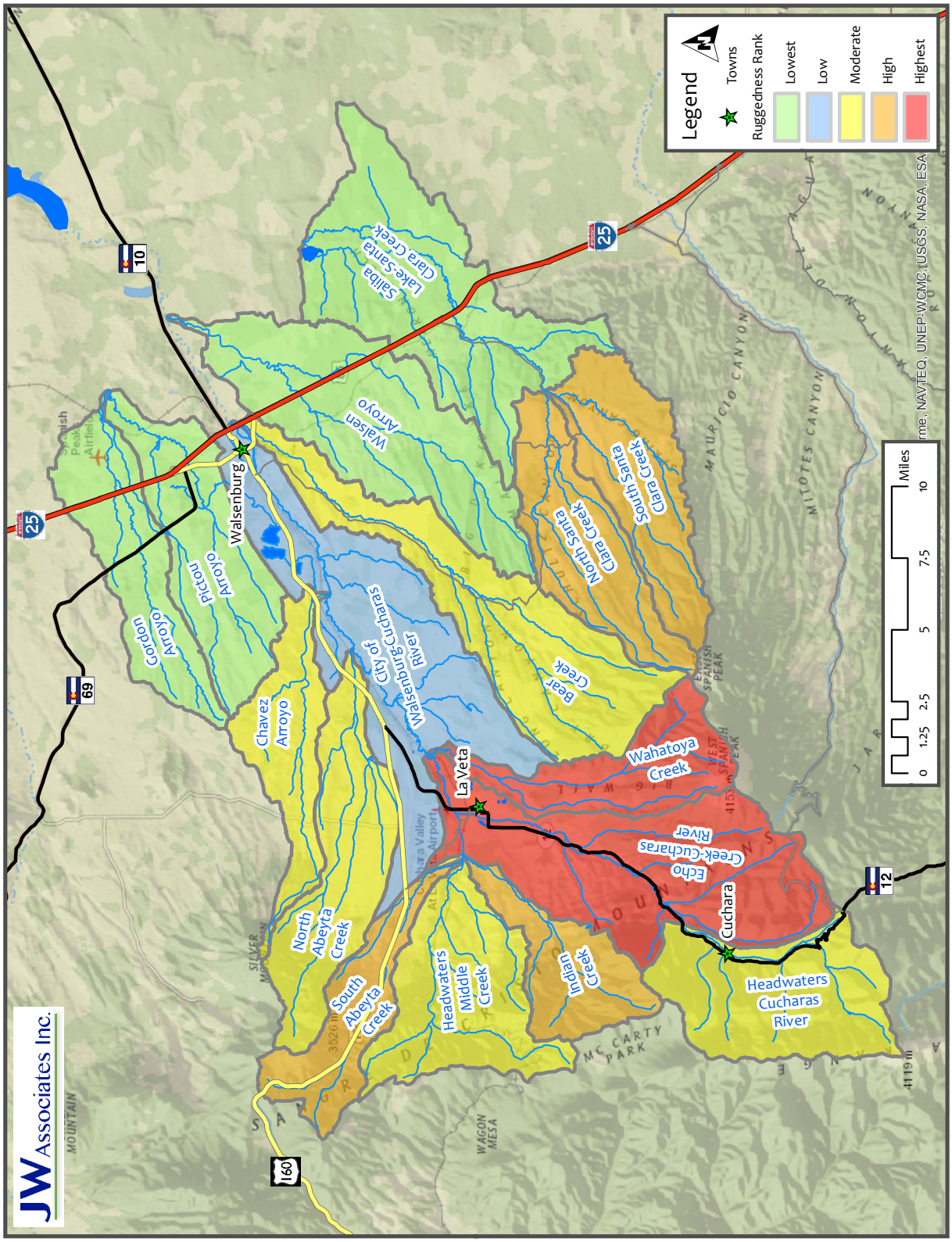

Figure 5. Cucharas River Watershed Ruggedness Ranking

Road Density

Roads can convert subsurface runoff to surface runoff and then route the surface runoff to stream channels, increasing peak flows (Megan and Kidd 1972, Ice 1985, and Swanson et al. 1987). Therefore, watersheds with higher road densities have a higher sensitivity to increases in peak flows following wildfires. Road density in miles of road per square mile of watershed area was used as an indicator of flooding hazard. The U.S. Forest Service roads data was used on National Forest System (NFS) lands because it is the most accurate roads data for those roads in the forest. On all other lands the U.S. Census Bureau's Tiger database was used because it is a consistent roads data layer.

The roads that are of interest in this analysis are those roads that would increase the risk of flooding or debris flows following wildfires in forested areas. Therefore, road densities were adjusted when some of the roads within the watershed are located within towns, developed areas, or outside the forested areas of the watershed. The watersheds were all examined by looking at the roads data overlain on digital images and vegetation mapping. If it was found that there were significant lengths of road outside forested areas, the road density in those watersheds was adjusted down based on ocular estimates.

The road densities for Pictou Arroyo, City of Walsenburg-Cucharas River, Bear Creek, Saliba Lake-Santa Clara Creek, Walsen Arroyo, Gordon Arroyo, Echo Creek-Cucharas River, and Wahatoya Creek watersheds were all adjusted down because they contain towns or housing developments that display very high road density or have road systems outside of the forest. The adjustments are displayed on Table B-3 in Appendix B.

Figure 6 displays the categorized road density for the Cucharas River Watershed and tabular results are presented in Appendix B. It displays some expected differences in road density throughout the watershed. Figure 6 shows that the highest rankings (Category 5) are in the Pictou Arroyo, Chavez Arroyo, and City of Walsenburg-Cucharas River watersheds.

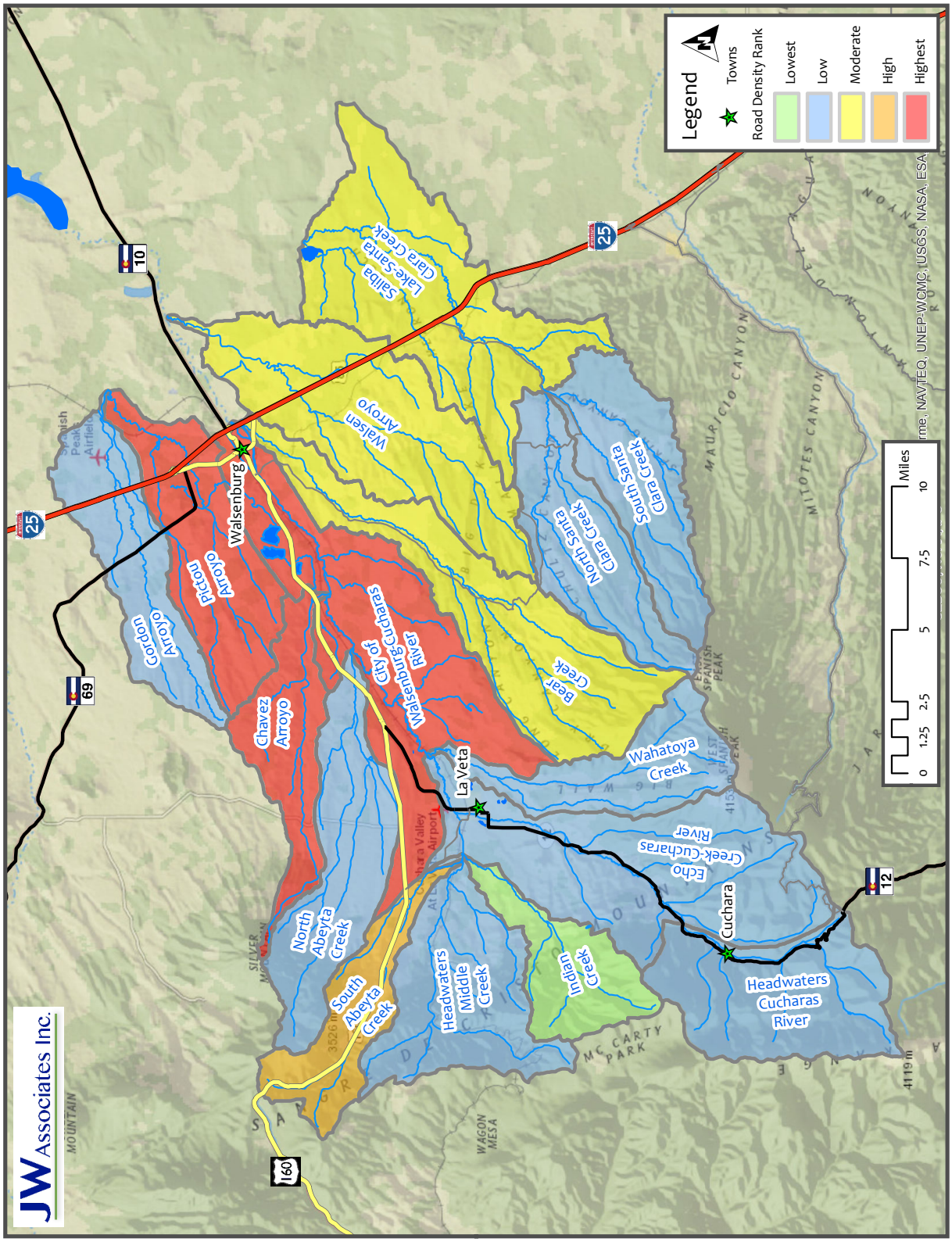

Figure 6. Cucharas River Watershed Road Density Ranking

Flooding or Debris Flow Hazard Ranking

The Flooding or Debris Flow Hazard is the combination of ruggedness and road density. The procedure from the Colorado Watershed Work Group (2009) assigned ruggedness a higher value than road density in this ranking. While ruggedness is the most important factor, an increase in road density will magnify the effects of ruggedness on the flooding/debris flow hazard. Accordingly, the analysis for flooding or debris flow hazard for the Cucharas River watershed used the following formula. The results of this calculation were then re-categorized into five hazard rankings.

Flooding or Debris Flow Hazard Ranking = (Road Density Ranking + 2 x Ruggedness Ranking)

Four sixth-level watersheds (Wahatoya Creek, Chavez Creek, Echo Creek-Cucharas River, and South Abeyta Creek) ranked the highest (Category 5) in the flooding/debris flow hazard ranking (Figure 7). The tabular results are presented in Table B-4 in Appendix B.

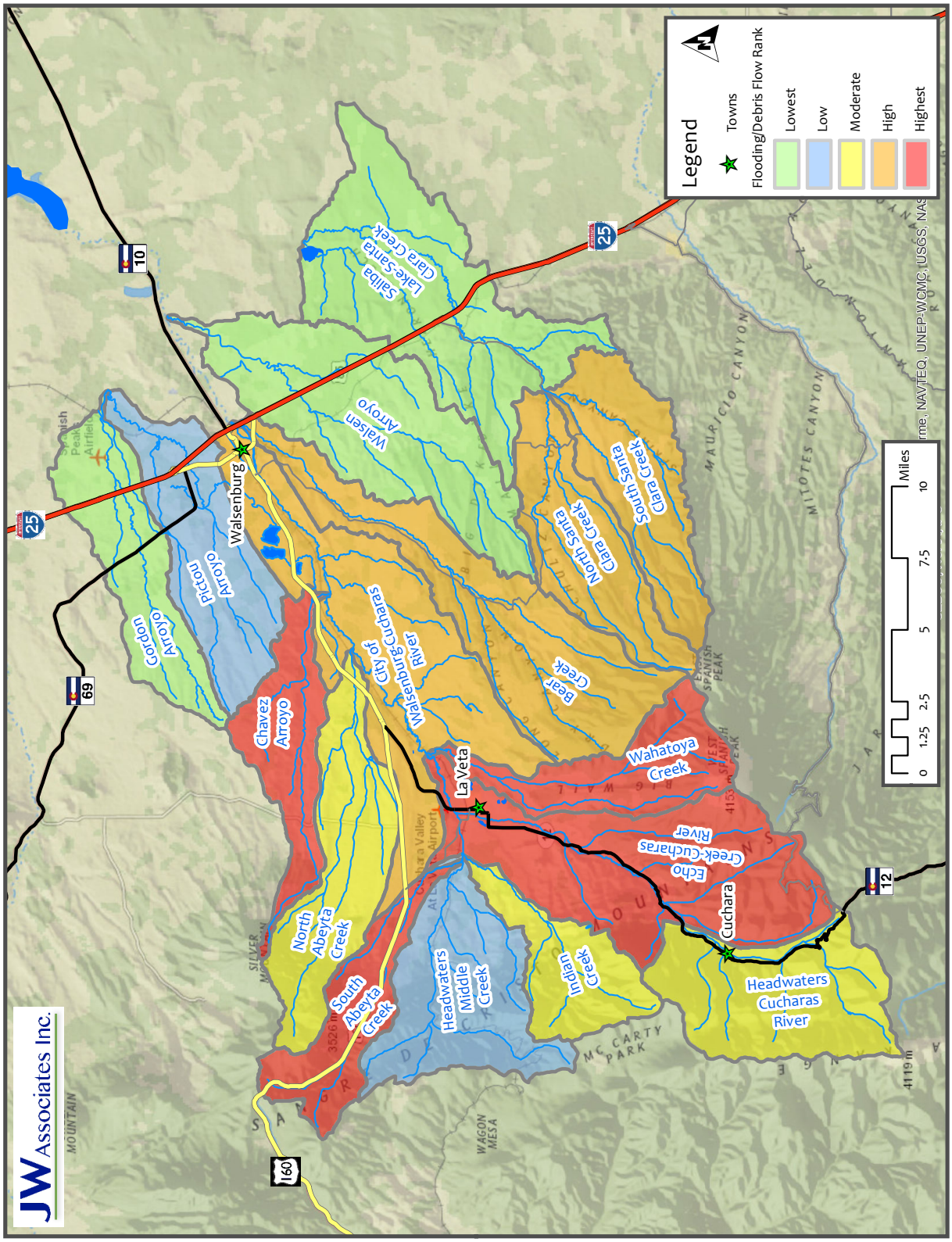

Figure 7. Cucharas River Watershed Flooding/Debris Flow Hazard Ranking

Component 3 - Soil Erodibility

High-severity fires can dramatically change runoff and erosion processes in watersheds. Water and sediment yields may increase as more of the forest floor is consumed (Wells et al. 1979, Robichaud and Waldrop 1994, Soto et al. 1994, Neary et al. 2005, and Moody et al. 2008) and soil properties are altered by soil heating (Hungerford et al. 1991).

The U.S.D.A. - Natural Resources Conservation Service (NRCS) SSURGO soils data were used in the soil erodibility analysis. SSURGO data is available at an appropriate scale (generally ranges from 1:12,000 to 1:63,360) for this analysis.

The soil erodibility analysis used a combination of two standard erodibility indicators: the inherent susceptibility of soil to erosion (K factor) and land slope derived from Unites States Geological Survey (USGS) 30-meter digital elevation models. The K factor data from the SSURGO spatial database was combined with a slope grid using NRCS (USDA NRCS 1997) slope-soil relationships (Table 4) to create a classification grid divided into slight, moderate, severe and very severe erosion hazard ratings.

Table 4. NRCS Criteria for Determining Potential Soil Erodibility

Percent Slope	K Factor <0.1	K Factor 0.1 to 0.19	K Factor 0.2 to 0.32	K Factor >0.32
0-14	Slight	Slight	Slight	Moderate
15-34	Slight	Slight	Moderate	Severe
35-50	Slight	Moderate	Severe	Very Severe
>50	Moderate	Severe	Very Severe	Very Severe

The potential soil erodibility analysis from the SSURGO data and the criteria in Table 4 is displayed on Figure 8. The categorized potential soil erodibility hazard rankings are shown on Figure 9 and the tabular results are presented in Appendix B. The highest ranked (Category 5) sixth-level watersheds are Headwaters Middle Creek, South Abeyta Creek, and Indian Creek.

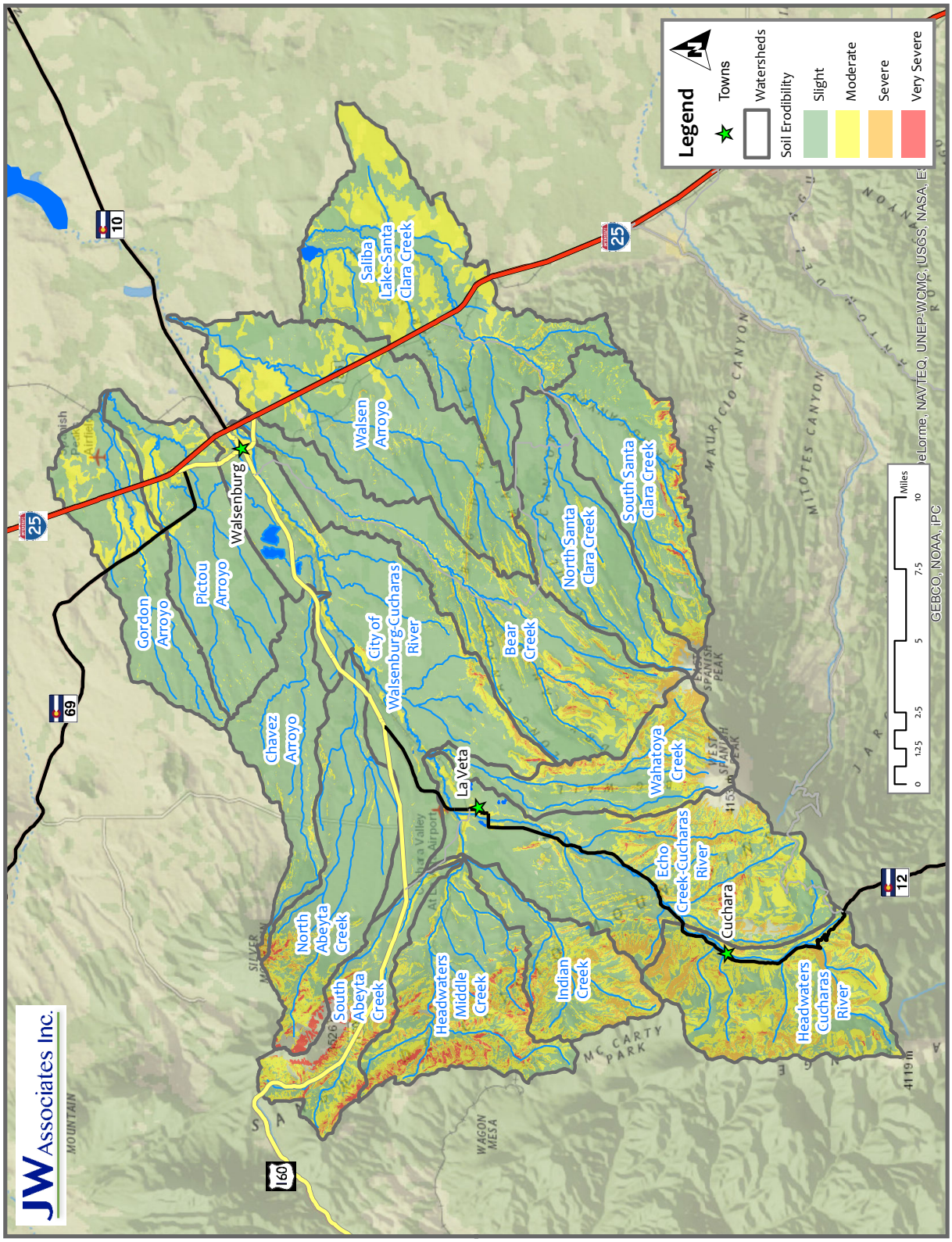

Figure 8. Cucharas River Watershed Potential Soil Erodibility

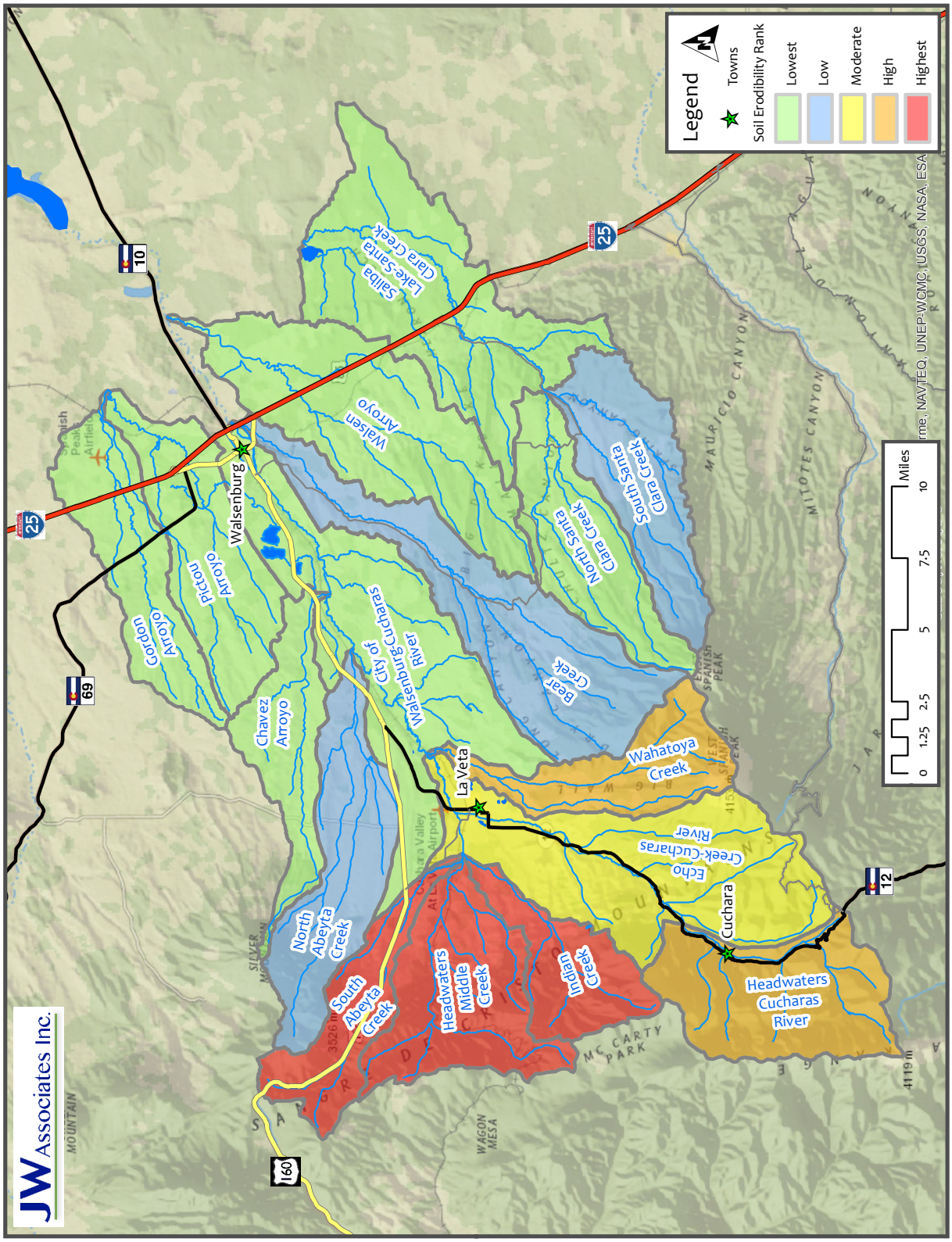

Figure 9. Cucharas River Watershed Potential Soil Erodibility Hazard Ranking

Composite Hazard Ranking

The Composite Hazard Ranking is created by combining the rankings for Wildfire Hazard, Flooding/Debris Flow Hazard and Soil Erodibility for each sixth-level watershed. The watersheds are re-categorized based on the sum of these factors. The Composite Hazard Ranking map is useful in comparing relative watershed hazards based solely on environmental factors. Figure 10 shows the Composite Hazard Ranking for the Cucharas River Watershed. The tabular results that display the individual rankings for Wildfire Hazard, Flooding/Debris Flow Hazard and Soil Erodibility, as well as the composite rankings, are presented in Table B-6 in Appendix B. The highest ranked (Category 5) sixth-level watersheds are Headwaters Cucharas River, South Abeyta Creek, Indian Creek, Headwaters Middle Creek, Wahatoya Creek, and Echo Creek-Cucharas River. There are no watersheds in Category 4.

Component 4 - Water Supply Ranking

Surface water intakes, diversions, conveyance structures, storage reservoirs and streams are all susceptible to the effects of wildfires. The suggested approach from the procedure prescribed by the Colorado Watershed Protection Data Refinement Work Group (2009) is to rank watersheds based upon the presence of water supply locations.

Several sources of data on surface drinking water supply collection and diversion points were used to create an initial list. However, the assistance of Doug Brgoch with the State of Colorado Division of Water Resources was essential in the final determination of water supply locations. The locations were reviewed by the Watershed Group over the course of the group meetings.

The Watershed Group expressed concern that irrigation users were not being considered in this assessment. Therefore, in addition to the municipal supply locations, irrigation sources were identified separately and mapped. The irrigation supply watersheds are identified below.

Figure 11 shows the sixth-level watersheds that have water supply locations in blue and those without water supply locations in green. Irrigation supply watersheds are also shown on Figure 11 as yellow watersheds. Some of the municipal water supply watersheds also provide irrigation water supplies.

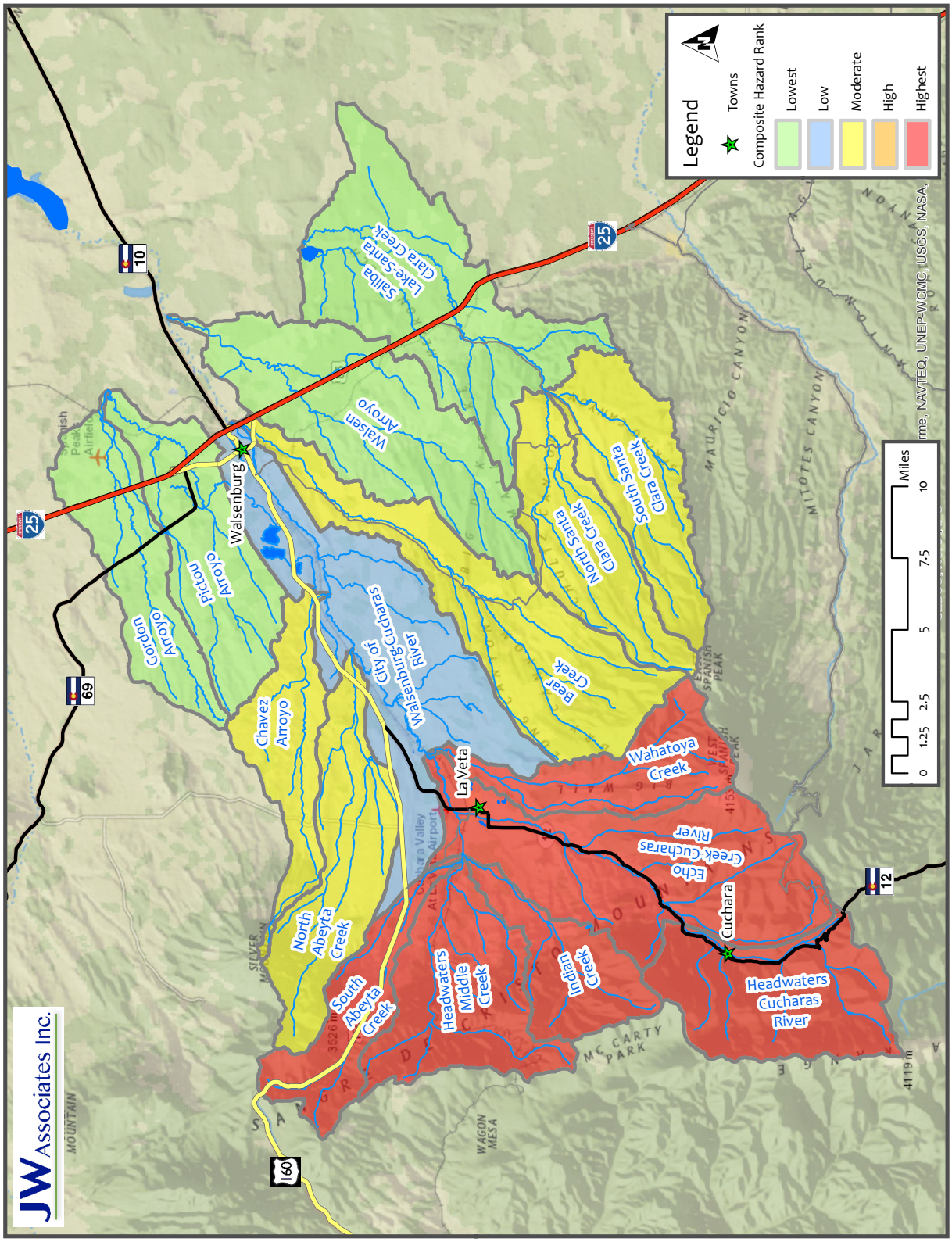

Figure 10. Cucharas River Watershed Composite Hazard Ranking

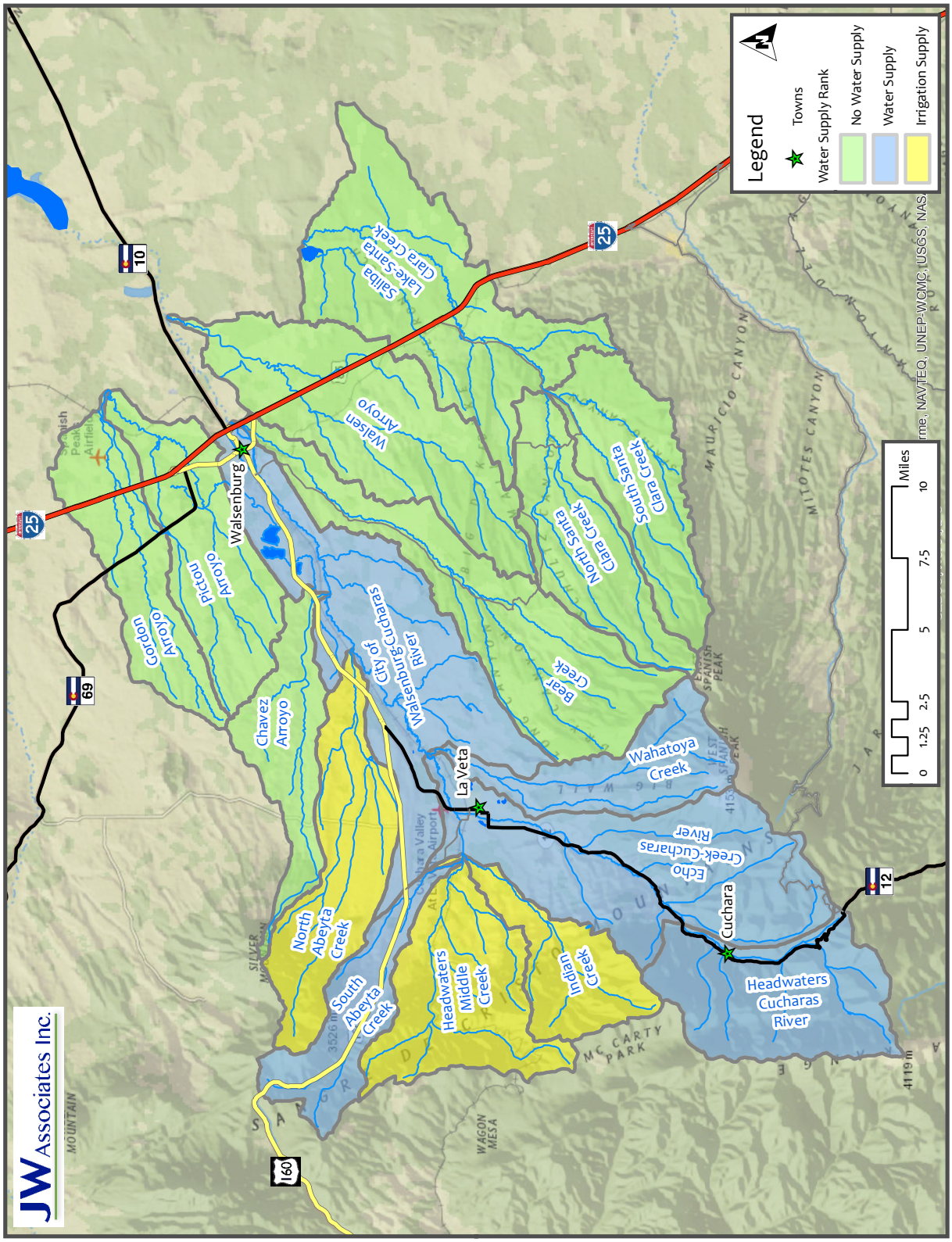

Figure 11. Cucharas River Watershed Water Supply Map

Final Priority

Those watersheds that have a water supply feature (diversion, reservoir or other identified water supply) were given higher priority in the final ranking scheme by increasing their priorities from the Composite Hazard analysis by one hazard category. The irrigation sources were given one-half of the priority as the municipal sources. Those results were then re-categorized into five categories. The final priority combines the hazards of wildfires, flooding/debris flows, soil erodibility and the presence of water supply features. The final priority rankings are shown on the Final Priority map (Figure 12). The sixth-level watersheds that ranked highest on the Headwaters Cucharas River, Wahatoya Creek, South Abeyta Creek, Echo Creek-Cucharas River, and Indian Creek.

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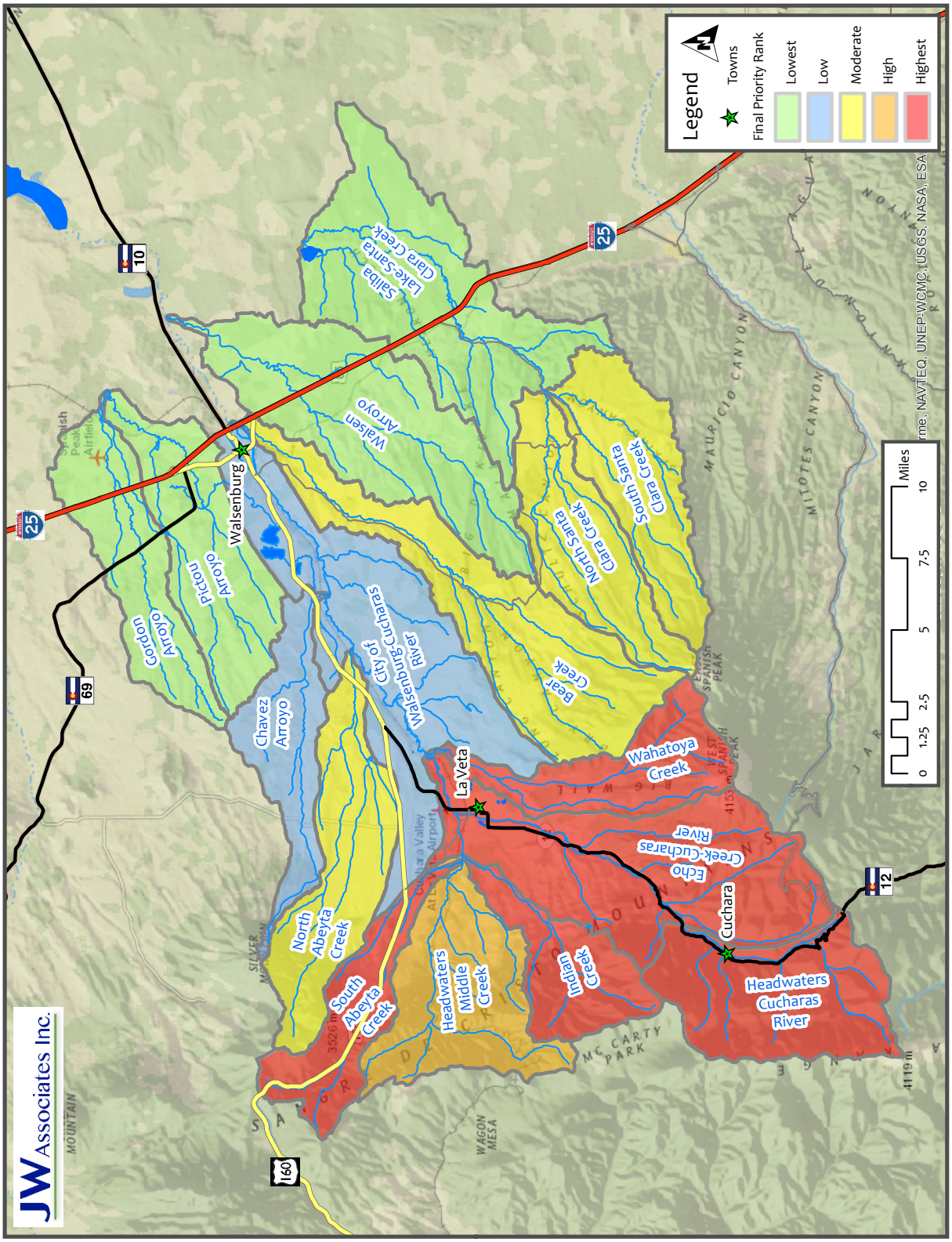

Figure 12. Cucharas River Watershed Final Priority

Zones of Concern

The Watershed Wildfire Protection Group identified an important hazard for water supply related to transport of debris and sediment from upstream source water areas. The source water areas above important surface water intakes, upstream diversion points and drinking water supply reservoirs have a higher potential for contributing significant sediment or debris. These areas, called Zones of Concern (ZoC), can be used by stakeholders to further define project areas for protection planning and actions.

There were several methods suggested by the Colorado Watershed Protection Data Refinement Work Group (2009) to define ZoC. The Cucharas River Watershed Stakeholders initially agreed to use the five-mile upstream distance. This approach is based on Colorado State Statute 31-15-707 which allows municipal water providers to enact an ordinance to protect their water intakes within five miles upstream of their intakes. This municipal statute has been in place since the late 1800s and has been tested in court several times and upheld.

Many of the ZoC stopped at a watershed divide before they reached the five mile upstream distance. The Watershed Wildfire Protection Group suggests extending ZoC to 11 miles upstream in situations where the extra protection appears warranted. The debris flow and flooding following the Buffalo Creek fire in the Upper South Platte watershed in 1996 traveled 11 miles down Spring Creek (Front Range Watershed Protection Data Refinement Work Group 2009). The ZoC were extended to 11 miles upstream for several important diversions and reservoirs based upon input and agreement from the Watershed Group.

Watershed groups may want to expand their Zones of Concern to include all the sixth-level watersheds that have any portion of those watersheds within their Zone of Concern. Erosion, flooding and debris flows can originate high in watersheds and travel long distances. Decisions of what areas to include would be made at the next level in planning (see Recommendations section below).

Eleven ZoC were delineated in the Cucharas River Watershed (Figure 13 and Table 5) totaling more than 95,000 acres. The ZoC are overlaid on the Final Priority map on Figure 13. More detailed maps of the ZoC are presented in the Opportunities & Constraints section below. The water supply agencies for each ZoC have also been identified in Table 5. Some of the ZoC overlap with others, or in other areas, the ZoC are close to overlapping other ZoC. In those situations, ZoC can be combined or viewed as one, combining several stakeholders into a larger ZoC.

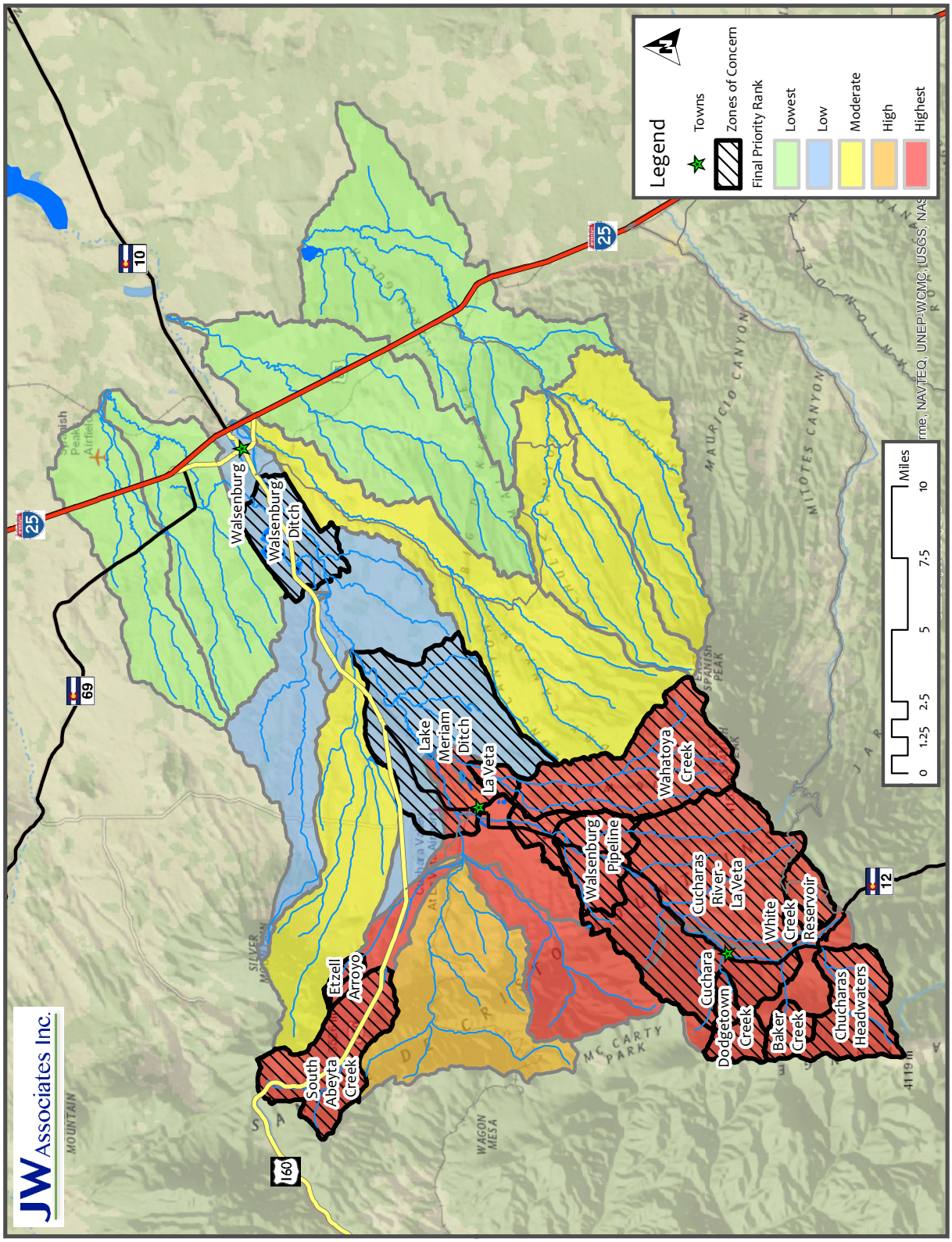

Figure 13. Cucharas River Watershed Zones of Concern

Table 5. Cucharas River Watershed Zones of Concern

Zone of Concern	Total ZoC Area (acres)	Drinking Water Supply
Baker Creek	1,576	Cucharas W&SD
Chucharas Headwaters	5,968	Cucharas W&SD
Cucharas River - La Veta	31,171	Town of La Veta
Dodgetown Creek	2,529	Cucharas W&SD
Etzell Arroyo	547	Tres Valles West Sub.
Lake Meriam Ditch	18,002	City of Walsenburg
South Abeyta Creek	8,177	City of Walsenburg
Wahatoya Creek	12,978	Huajatolla Valley Estates
Walsenburg Ditch	5,804	City of Walsenburg
Walsenburg Pipeline	6,159	City of Walsenburg
White Creek Reservoir	2,113	Cucharas W&SD
Total	**95,024**	

RECOMMENDATIONS

This watershed assessment is a process that sets priorities and identifies both watershed groups and Zones of Concern. The next steps that are taken using the information presented in this report are essential to address the hazards identified through this process. Some potential opportunities are presented in the next section of this report. These recommendations are presented first to guide the reader through the Opportunities & Constraints section.

Watershed Group Organization

The ZoC are natural project areas for stakeholders to start the next planning steps. In some cases several ZoC may be lumped together to form larger project areas. Stakeholder groups will, by definition, include the water providers and/or municipalities that own water rights and operate in those watersheds, but should also include the following;

1. U.S. Forest Service - San Carlos Ranger District of the San Isabel National Forest
2. Colorado State Forest Service - La Veta District
3. La Veta Fire Protection District
4. Huerfano County
5. Home owner associations
6. Ditch Companies and other water users
7. Other interested groups such as power companies

Stakeholders should review the Opportunities & Constraints section below to determine which watersheds/ ZoC should be their priority. Some additional planning will be required to initiate watershed protection/hazard reduction projects within those ZoC. The discussion below presents some of the suggested actions.

The existing La Veta Fire Protection District (LVFPD) Community Wildfire Protection Plans (CWPP) (2011) covers the Upper Cucharas watershed. Specific wildland urban interface (WUI) areas, treatment areas, and priorities are identified in the LVFPD CWPP. Some of those treatments have been implemented and others are planned that are within ZoC. Other efforts, such as implementation of source water protection plans, may also provide some efficiency and consistency by incorporating the results of this assessment.

National Environmental Policy Act (NEPA) planning efforts on federal lands may be able to be modified to incorporate watershed priorities. The NEPA analysis and decision-making process may also benefit from the technical support provided by this watershed assessment. Other existing land and vegetation management plans, fuels treatment plans, source water protection plans, watershed restoration plans or prescribed fire or fire-use plans may exist that cover portions of the critical watersheds.

Wildfire Hazard Reduction Planning and Actions

It is recommended that water supply agencies plan for wildfires in their watershed(s). Planning for future wildfires now is prudent because actions following wildfires are emergency actions and there is little time to determine the best actions. Wildfire hazard reduction or watershed protection actions are logically different before a wildfire than after one, although there are some common actions. Therefore, this section is divided into pre- and post-fire actions.

Pre-Fire Actions

The suggested actions before wildfire are;

1. Complete small-scale analysis and planning within each ZoC to identify specific hazard areas that will be the priority for vegetation or other treatments before fire, or targeted mitigation efforts after fire. Planning should also include setting long-term watershed/forest management goals such as increasing forest diversity to minimize impacts from wildfires, as well as future insect and disease outbreaks. This planning can also be used to provide valuable site-specific information to cooperating agencies on forest management projects or fire management plans in those areas. Small-scale targeting of high hazard areas also allows water supply agencies to justify investments in hazard reduction or watershed protection projects.

2. Reduce wildfire intensity and subsequent fire severity in critical locations within and adjacent to ZoC, where possible. Although there are other strategies that can be pursued, the reduction of wildfire severity is the goal for minimizing adverse hydrologic responses following intense wildfires. Wildfire severity is the effect that the fire has on the ground. Vegetative forest treatments can be effective in reducing the threat of crown fire (Graham et al. 1999), which often leads to higher intensity wildfires and resulting burn severity. Treatments that reduce density and change the composition of forested stands would reduce the probability of crown fire, decrease severity, and enhance fire-suppression effectiveness and safety (Oucalt and Wade 1999, and Pollet and Omi 2002). In forested stands that have developed without regular disturbance, combinations of mechanical harvest/thinning and prescribed fire are the most effective technique for altering the fuels matrix (Graham et al. 2004).

3. Consider alternative treatment options in high hazard areas identified within ZoCs that may not be available for traditional vegetation treatments because they are economically or administratively

inaccessible. Examples of economic inaccessibility include areas that are far from existing roads where it would be very costly to build new roads to provide access, or areas that are so steep that removal of logs using ground-based yarding may not be economically feasible and helicopter yarding may be the only option. An example of an administrative limitation would be wilderness or roadless areas.

These areas should be evaluated to determine if less traditional approaches could be used to reduce hazards to water supply. These methods could include; hand treatments, prescribed fire, created openings, fuel breaks and aspen enhancement. Although these treatments do cost more per acre than mechanical treatments, in some cases the treatments may be cost effective, or the only option, for reasons discussed above. Additionally, if they are targeted in identified high hazard areas, the additional cost could provide substantial watershed protection compared to treatments in areas with fewer limitations but a lower hazard.

4. Establish ongoing communications with key federal, state and local agencies that will be responsible for fire suppression and mitigation following fires.

5. Where forest treatments are not possible and/or water supplies are critical and at risk, complete pre-planning of sediment control structures downstream from high hazard areas. Following the Hayman Fire in 2002, Denver Water installed a sediment control structure in Turkey Creek above Cheesman Reservoir. It took more than one year to get all approvals and permits in place to construct that structure. The highest sediment yield from wildfires is usually in the first 2-3 years. Most of the planning work can be completed ahead of time, including finding appropriate sediment basin locations, conceptual design and planning with the appropriate government agencies.

6. Work with federal and state agencies to plan for managing wildland fires in specific locations as a management tool that would allow wildfire to reduce wildland fuels under defined circumstances. The conditions would be monitored frequently to ensure that the fire stays within that management prescription or suppression efforts would be required.

Post-Fire Actions

The suggested actions during and following wildfire are;

1. During a wildfire, review the small-scale analysis completed pre-fire, to determine if the fire is burning or likely to burn intensely in high hazard areas. Use that assessment to guide suppression efforts to either let that area burn under current conditions or encourage maximum suppression efforts in high hazard areas.

2. Contact the appropriate agencies and request a spot on the Burned Area Emergency Rehabilitation (BAER) Team. Review the large-scale and small-scale hazard assessments and bring that information to the BAER Team meetings. Advocate for watershed protection measures during the determination of mitigation measures by the BAER Team.

3. Target fire mitigation in specific areas of high hazard to water supply. Use the small-scale hazard identification analysis and overlay the burn severity mapping to determine high priority areas.

4. Determine mitigation measures on a site-specific basis. Mitigation measures should focus on effectiveness of treatment rather than cost per acre. Mitigation that targets fewer acres but with a higher effectiveness will likely be more successful. For example, wood shred mulch is much more effective on steep, high burn severity slopes than agricultural straw, but costs more. Targeting specific high hazard areas to be treated allows these more effective, more expensive treatments to provide higher levels of watershed protection, sometimes at the same overall cost.

5. Consider additional mitigation measures in high hazard areas. These measures could include; grade control structures high in watersheds to minimize gully head-cutting, felling of dead trees into small channels to provide roughness, seeding with native plants, and hand application of wood shred or wood straw mulch.

6. Review plans for sediment control structures and determine if they should be taken through the final stages of permitting and installed. Although these structures are expensive, the effects from fire may be even more expensive. Several water agencies with recent experience in Colorado have estimated that it is 10-20 times more expensive to remove sediment from a reservoir than the cost of these temporary structures.

OPPORTUNITIES & CONSTRAINTS

This section of the assessment presents the first step in identifying opportunities and constraints within the ZoC. This analysis is intended to identify potential opportunities that will aid the stakeholders in deciding whether to pursue watershed protection/hazard reduction efforts, the overall scope of those efforts, and identification of the key partners for those projects. This section is organized by general descriptions of the opportunities and constraints first and then presentation of potential opportunities for each ZoC that are shown on Figure 14.

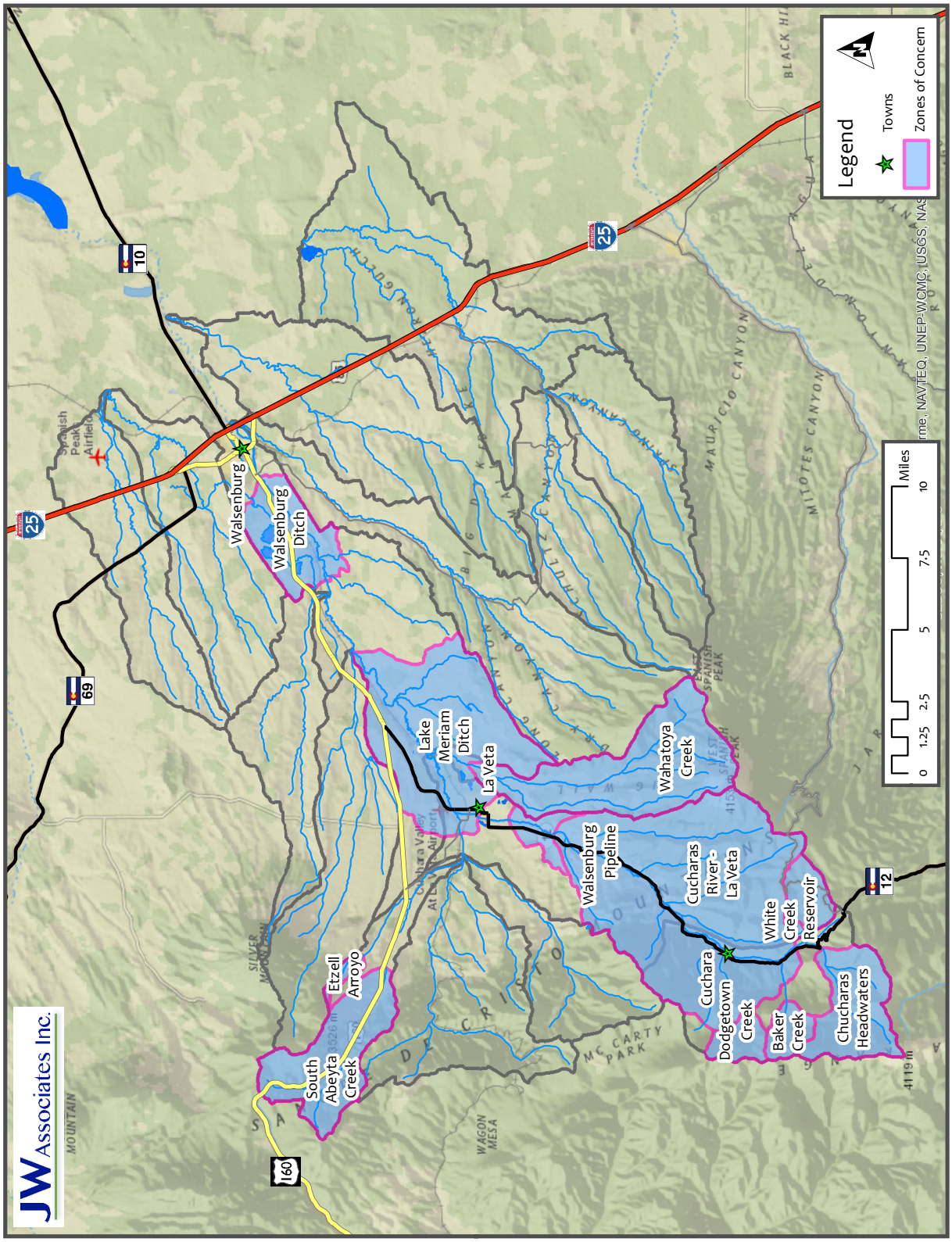

Figure 14. Cucharas River ZoC Base Map

General Opportunities & Constraints

The opportunities and constraints described below were applied to the ZoC as a series of filters and identifiers of potential opportunities.

Ownership

Major ownership classifications are Federal, State, Local Government and Private. Federal Lands include the National Forest System Lands, Bureau of Land Management (BLM), National Park Service, Department of Defense, and potentially other agencies and departments. State lands are typically those owned or managed by the State Land Board, the Colorado Parks & Wildlife, or State Parks. However, there are other agencies or institutions, such as state universities, that may also own significant acreages.

Local Government lands typically include county, city or town-owned properties. County-owned lands are often managed as open space or park lands. City-owned lands are also often owned and managed for open space or parks, but also for watershed protection or other purposes.

The final category, Private Lands, is a catch-all that can include a myriad of other types of ownerships including special district lands, company or corporate-owned lands, privately-owned properties and more. These, too, can be of all sizes. Privately-owned parcels can form an extremely complex ownership pattern, particularly where they are comprised of old mining claims. The overall ownership pattern for the Cucharas River watershed is displayed on Figure 15.

Access

Access to and within a watershed or ZoC is a key factor in determining opportunities for mitigating wildfire hazards or the ability to install, operate and maintain erosion and sediment control structures following wildfires. The analysis often is limited by the data available in determining what roads exist within any given area. Normally, data layers available for the analysis show major roads and access routes, but often fail to include small, local roads and trails, particularly on non-federal lands. Such roads are very important for accessing backcountry areas for mitigation activities. Experience has shown that old roads used for mining or logging that can be temporarily re-opened to conduct project work may not be shown on any maps. Another option is temporary roads that can be constructed and closed following treatment, but they add costs to projects and current policies on many federal lands make even use of temporary roads difficult.

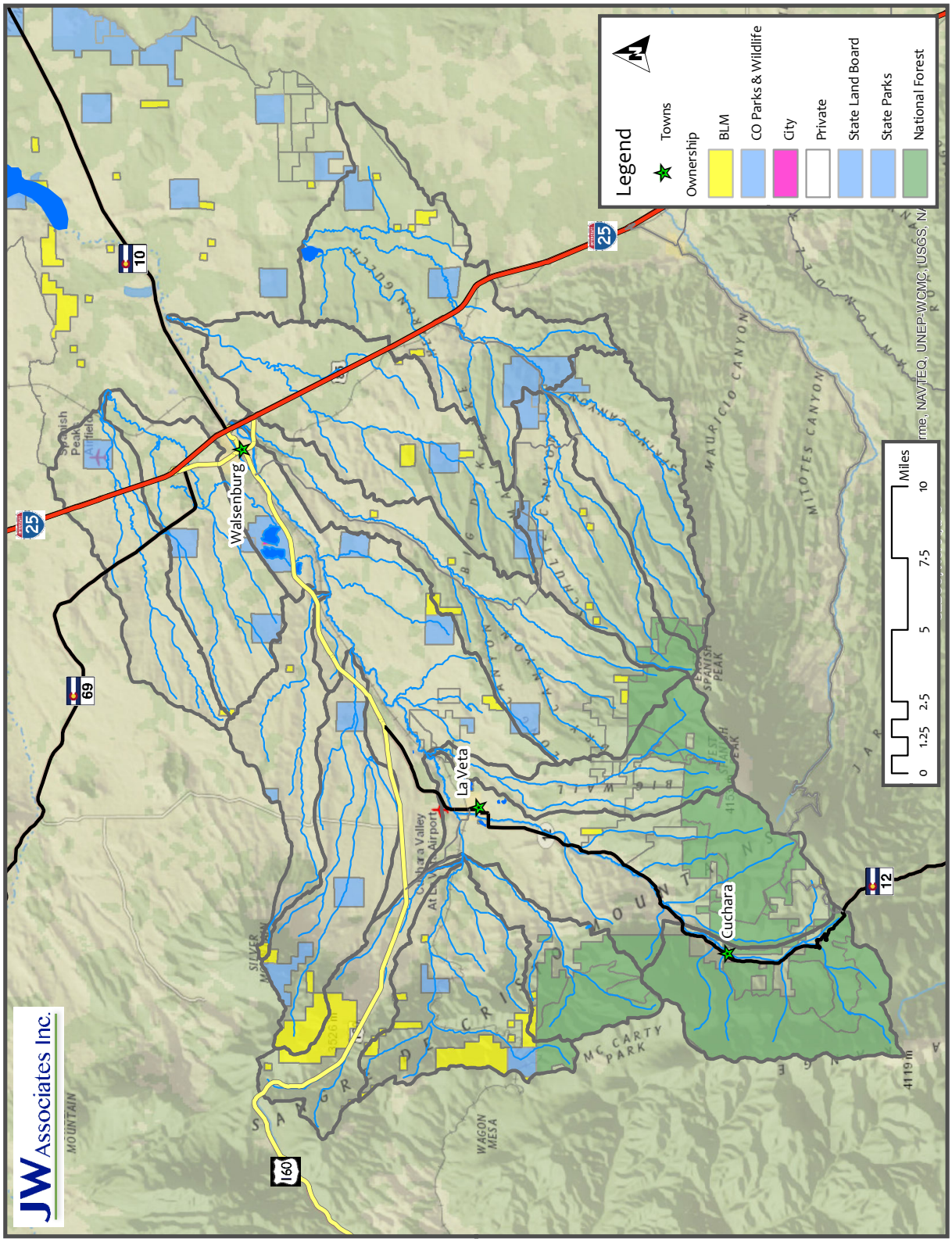

Figure 15. Cucharas River Ownership Map

When conducting traditional logging and thinning operations where products are removed from the forest, areas within ¼ to as much as ½ mile of roads can be considered. Specialized logging equipment commonly referred to as "forwarders" can be used to move logs and other products to the roadside from as far as 2 miles or more if terrain allows. If products do not have to be removed to meet fuel loading requirements and alternate treatment methods such as "mastication" or mulching can be used, equipment can be "walked" to treatment units as far from roads as terrain allows and it is practical to maintain and support the equipment.

Slopes

Land slope can be a major constraint when considering where and what treatments may be conducted to reduce wildfire hazards. Slope constraints are related directly to the typical harvesting or treatment systems and equipment employed and available within Colorado. Land management agency policies may also constrain the slopes upon which treatments may be conducted.

Slopes of 30 percent or less are the easiest to treat and the most traditional threshold for treatment given typical harvesting systems and equipment availability. Technological, power and other improvements now allow equipment to operate on slopes of 40 percent or perhaps even steeper ground. Experimental work conducted by the Colorado State Forest Service on Denver Water's lands in the Upper South Platte showed that tracked mastication equipment could work on slopes of up to 55 percent without causing erosion.

Recently in Colorado there have been several cable logging and even a few helicopter logging operations. Slope is typically not an absolute constraint with these types of operations, but other factors such as the shape of the hillside (convex vs. concave), whether the project can be treated from above or below and others determine actual project feasibility.

The Watershed Group decided to use a 40 percent slope as the upper limit of mechanical treatments. Potential opportunities were identified as greater on shallower slopes (less than 40 percent slope).

Wilderness Areas

Operations in designated Wilderness Areas are highly restricted by law and agency policies. Often the only treatments possible would be to plan for use of natural fire to reduce wildfire hazards. The Spanish Peaks Wilderness Area is the only designated wilderness area in the Cucharas River Watershed (Figure 16).

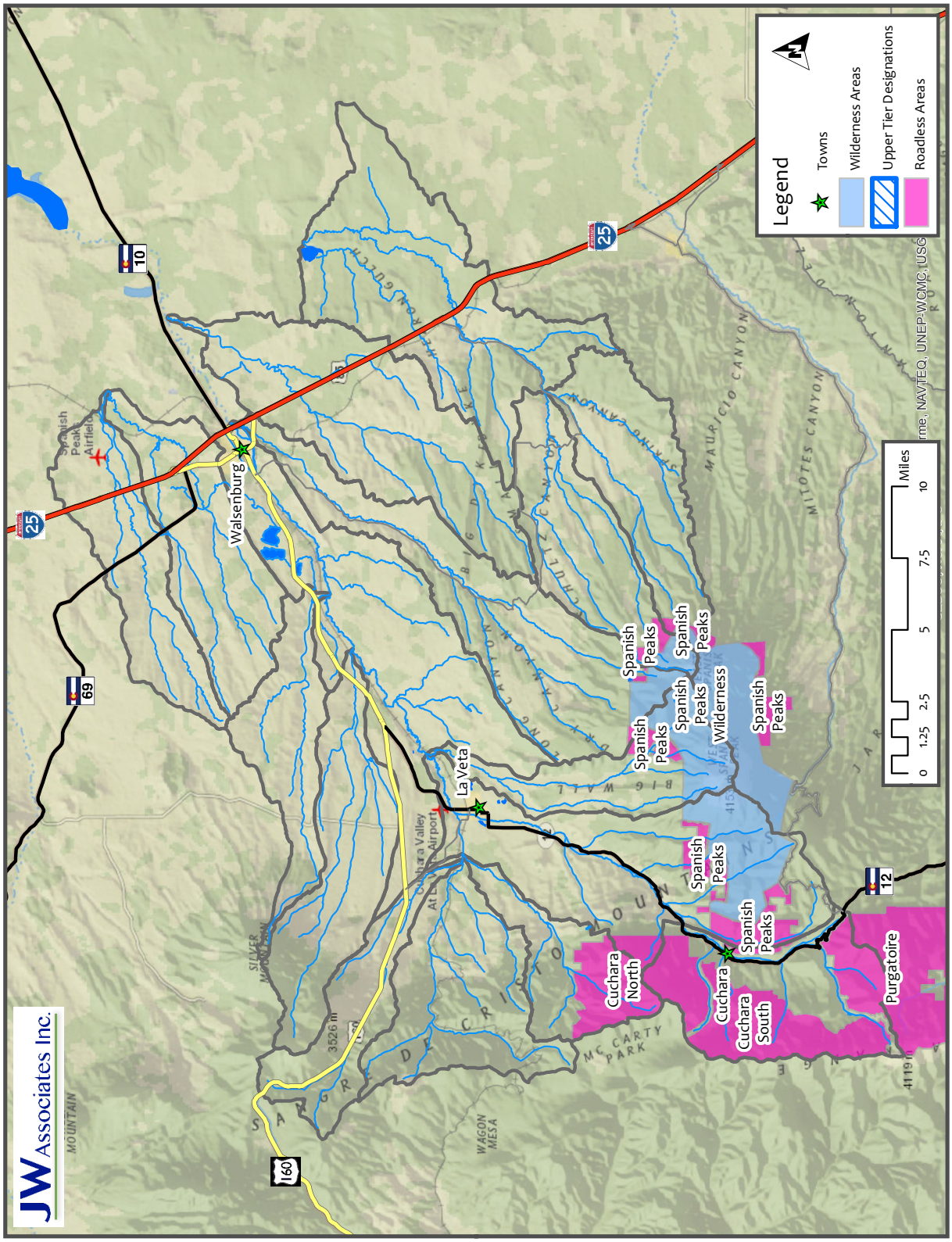

Figure 16. Cucharas River Special Designations Map

Roadless Areas

Operations in designated Roadless Areas are restricted primarily by agency policies. Regulations allow construction of temporary roads, and their closure upon project completion, for the purpose of conducting harvests and wildfire hazard reduction treatments. Agency policies has focused forest treatments on areas other than roadless areas whenever possible.

Colorado has developed rules for treatments within federal Roadless Areas. Treatments within Colorado Roadless Areas may be possible adjacent to at risk communities and for reducing wildfire hazards within watersheds. Areas within ½-mile of communities, and in some circumstances up to 1.5-miles from communities, may be treated to reduce wildfire hazards. Areas within watersheds may be treated if the USFS Regional Forester determines a significant risk of wildfire exists.

The Colorado Roadless Areas include some areas that are designated as Upper Tier areas that further restrict the types of allowed activities. The Upper Tier designation does not allow tree cutting and temporary road building for watershed protection. There are some Upper Tier areas in the assessment area. There are several roadless areas in the assessment area, some are associated with an adjacent wilderness area. The roadless areas are shown on Figure 16.

Vegetation

Vegetation is what fuels a wildfire. The vegetation type and its arrangement, size, density, and moisture content; the slope of ground and the aspect it is found on; whether it is dead or alive; the weather and season of the year, and more all dictate if and how intensely that fuel will burn.

The Colorado State Forest Service is developing a series of documents related to watersheds and their protection. The first document, tentatively titled, "*A Comprehensive Strategy for the Management and protection of Colorado's Watersheds,*" will have a series of companion documents entitled, "*Management and Protection Techniques for Colorado's Watersheds*." The first companion document discusses management of ponderosa and lodgepole pines and uses numerous photographs to illustrate what these treatments might look like. Additional species will be added to this series over time.

For the Cucharas River assessment area the Watershed Group decided to use aspen, ponderosa pine, lodgepole pine, mixed conifer and spruce/fir as targets for vegetation treatments to reduce wildfire severity. Some of the ZoC also contain areas of pinyon juniper and Gambel oak at lower elevations.

Ponderosa pine occupies only a small transitional area in the Cucharas River assessment area but this forest type is the one considered most "out of whack" from an ecological perspective. It is the forest type that has received the greatest impacts from human use and settlement and has the greatest departure from its

historical conditions. These factors have contributed to conditions that make it very conducive to large, intense and damaging wildfires. Indeed, some of Colorado's most damaging fires, from a watershed perspective, have burned in this forest type. Treatments that return and emphasize characteristics of pre-settlement ponderosa pine stands may provide the best opportunity to improve forest sustainability in this forest type. (See Forest Restoration Guidelines for Front Range Ponderosa Pine, Colorado State Forest Service.)

Aspen is an aggressive invader to disturbed areas. It quickly populates areas damaged by fire, rockslides or mass soil movement, avalanche paths and run-out areas, large areas of windthrow, and other areas where conifers have been killed. It is normally a successional species in that as it matures, more shade tolerant conifer species begin to grow and alter the forest type. However, In some areas aspen can be a climax species.

Aspen is somewhat "resistant" to fire as crown fires will seldom carry through this forest type except under extreme drought combined with windy conditions. Its susceptibility to fire is usually seasonal: normally only burning during dry fall periods, often after their leaves have fallen; and, occasionally, in the spring, prior to green-up if conditions are dry. Because of these characteristics, it is a good species to maintain or promote within the landscape. This can be done using a variety of silvicultural and prescribed fire techniques.

Spruce/fir is a major component of the high-elevation forest vegetation in the Cucharas River Watershed. This forest type is comprised of mixtures of Engelmann and Colorado blue spruce, subalpine fir and other minor species. It is a forest type that, under natural conditions, has a very long fire interval – perhaps as long as 500 to 700 years. When it does burn, it burns very intensely and can cause severe erosion and sedimentation problems. Human-caused fires are a wildcard that can occur anytime weather conditions allow, introducing an unnatural fire event into that normally long historic fire interval.

Spruce/fir is difficult, within a short time period, to thin sufficiently to develop diversity significant enough to reduce wildfire hazards. This much needed diversity must be developed by creating varied conditions at the stand and landscape levels by group selection, small patch cutting, creating permanent openings, converting areas to aspen, and by other techniques. Once management has begun for watershed protection, in some situations it, too, may be advisable to utilize less traditional management techniques for long-term management. Less traditional techniques may include; thinning, group selection, patch cuts and small clearcuts to break up crown density.

In Colorado, lodgepole pine is also found in dense, continuous stands. Lodgepole pine normally comes in after a fire. It often can be considered the climax species under normal fire intervals. In the absence of fire lodgepole stands will transition to more shade tolerant species. Lodgepole pine has a natural fire interval that may begin at about 150 years of age up to perhaps 300 years. Mature stands begin to "fall apart" due to insect, disease, rot and other factors. As trees fall, they add significant heavy fuel to the forest floor, and helping to create conditions that make the species susceptible to hot, fast-moving crown fires. It too, like the spruce/fir, is

difficult within a short time period, to thin lodgepole pine sufficiently to develop diversity significant enough to reduce wildfire hazards. Diversity must be developed by creating diversity at the stand and landscape levels by clearcutting, patch cutting, creating permanent openings, or converting areas to aspen. Once management has begun for watershed protection, in some situations it may be advisable to utilize less traditional management techniques for long-term management (Lodgepole Pine Management Guidelines for Land Managers in the Wildland -Urban Interface, Colorado State Forest Service, 2009). Less traditional techniques may include; thinning, group selection, patch cuts and small clearcuts to break up crown density.

Mixed conifer areas are generally composed of limber pine, Douglas-fir, white fir and some ponderosa pine. The disturbance regime is mixed-severity fires with a fire recurrence interval of 30-100 years (Crane 1982). Therefore, they contained a mosaic of conditions composed of structural stages ranging from young to old trees. Stands were variable but generally uneven-aged and open, with occasional patches of even-aged structure. Denser tree conditions existed in some locations such as north facing slopes and valley bottoms. The historical pattern would be small clumps and groups of trees interspersed within variable-sized openings of grasses and shrubs.

Mixed conifer forests within the assessment area can be at a high risk of large crown fires because they have become more dense due to lack of disturbances. Treating mixed conifer stands can be more complex because of their mix of species and more complex disturbance regimes.

Walsenburg Ditch ZoC

This section addresses the Walsenburg Ditch ZoC (Figure 17). Note that the ZoC are shown here in blue shading, but in the remaining figures the outlines appear as bold black lines with no shading.

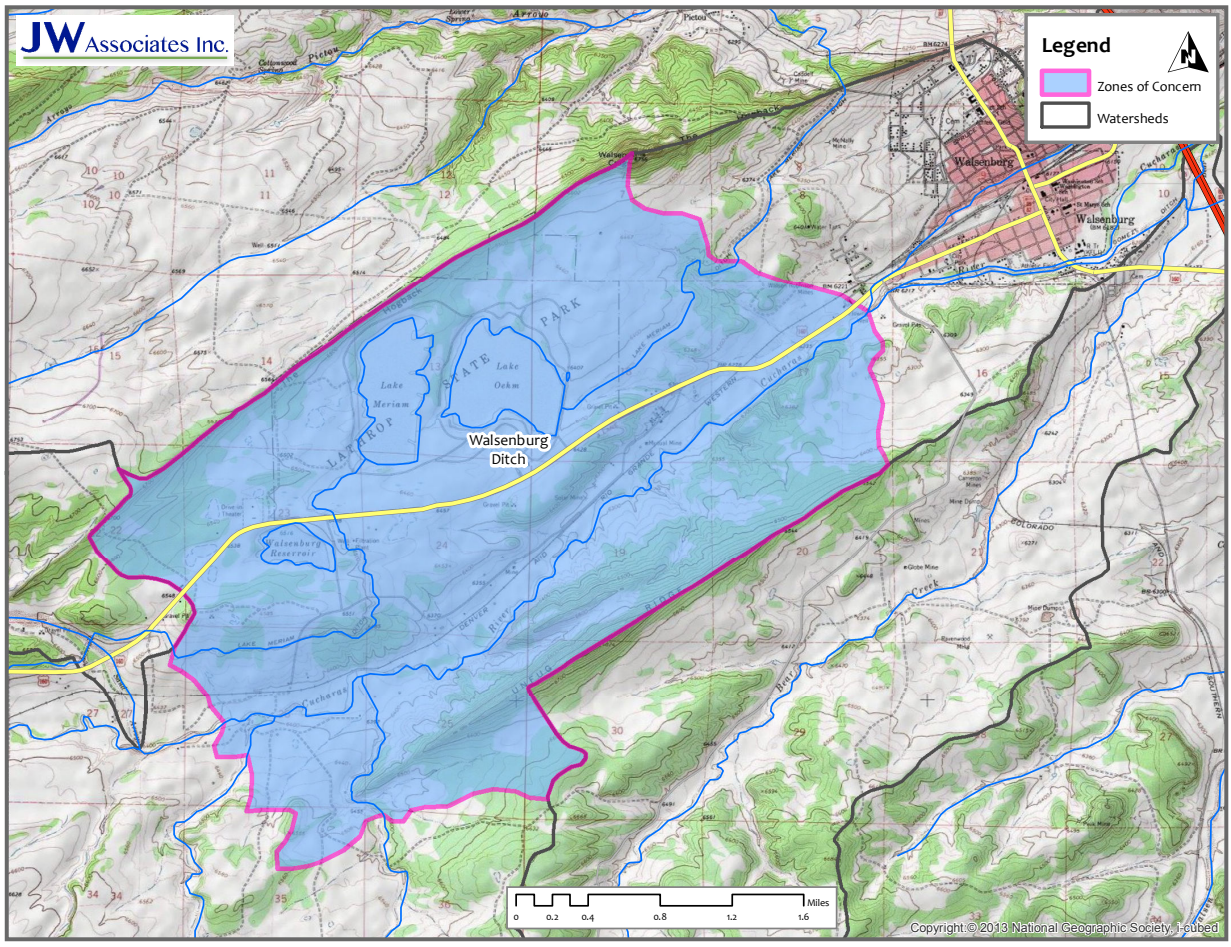

Figure 17. Walsenburg Ditch ZoC Location

Walsenburg Ditch Ownership

The Walsenburg Ditch ZoC covers mostly private land with Lathrop State Park occupying a large area surrounding Lake Meriam and Lake Oehm (Figure 18). A portion of Lathrop State Park is owned by the Town of Walsenburg.

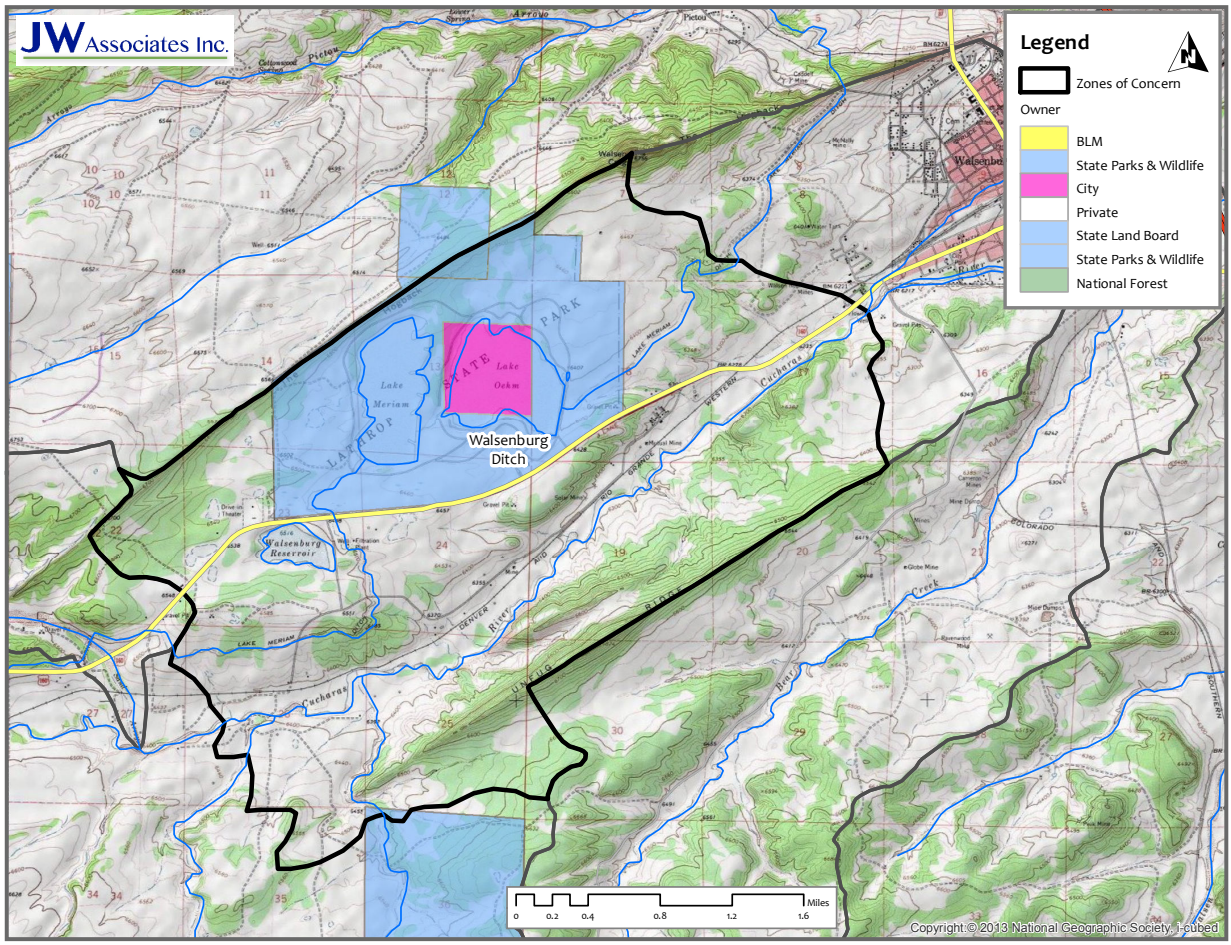

Figure 18. Walsenburg Ditch ZoC Ownership

Walsenburg Ditch Watershed Priority

The City of Walsenburg-Cucharas River watershed is ranked Blue (Category 2) overall (Figure 19).

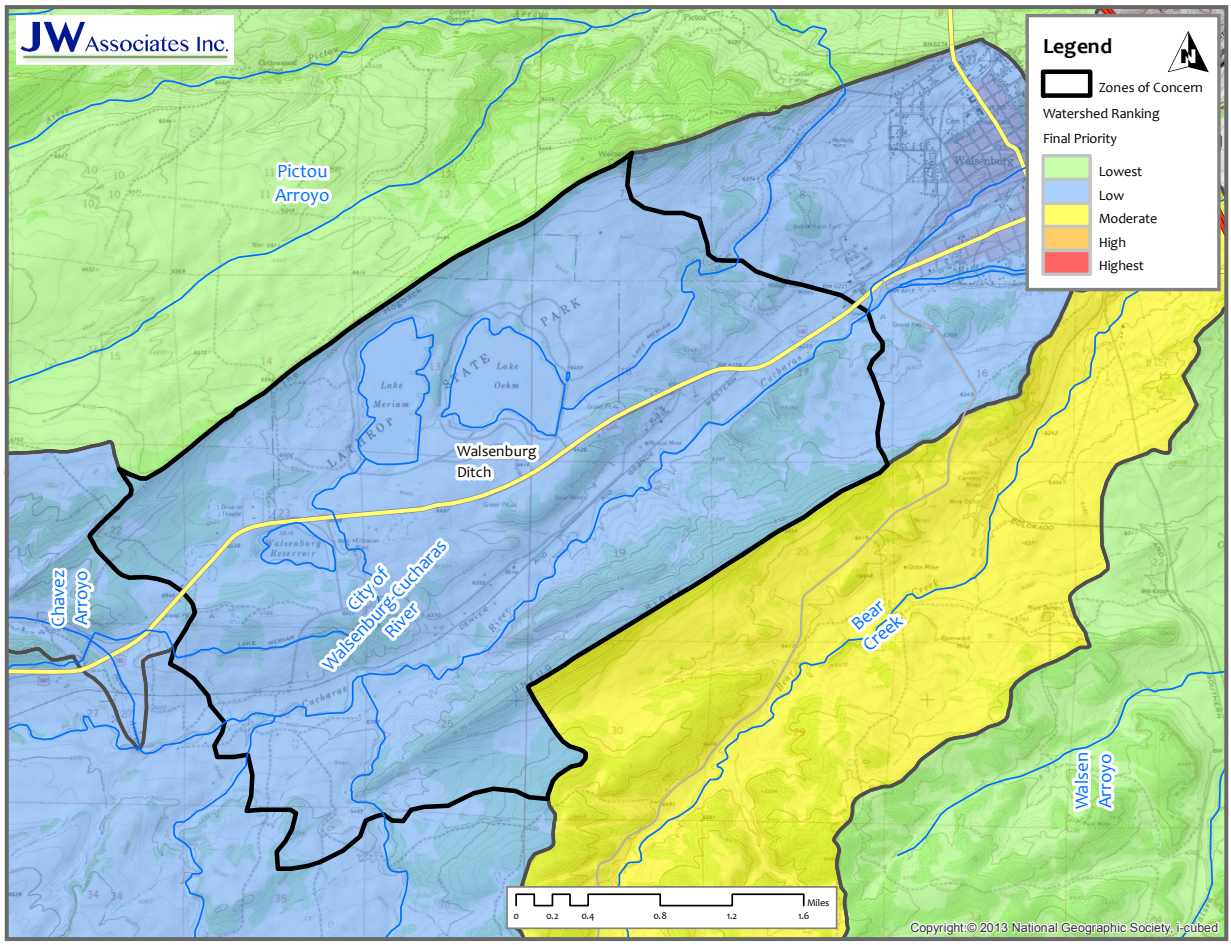

Figure 19. Walsenburg Ditch ZoC Watershed Priority

Walsenburg Ditch Slopes

The Walsenburg Ditch ZoC has mostly shallow slopes with only a few small areas of steep slopes (Figure 20).

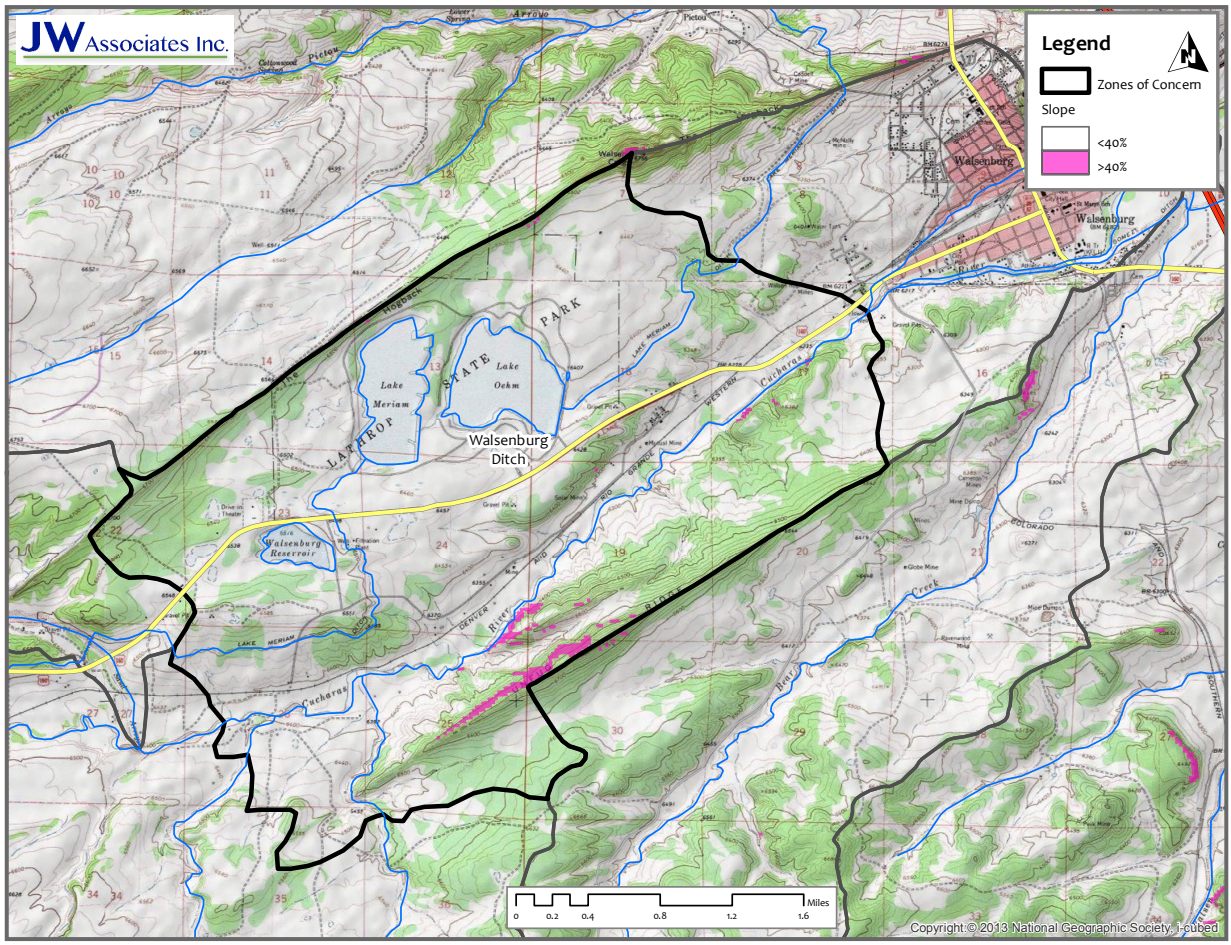

Figure 20. Walsenburg Ditch ZoC Slopes

Walsenburg Ditch Special Areas (Wilderness/Roadless)

The Walsenburg Ditch ZoC contains no wilderness or roadless areas (Figure 21).

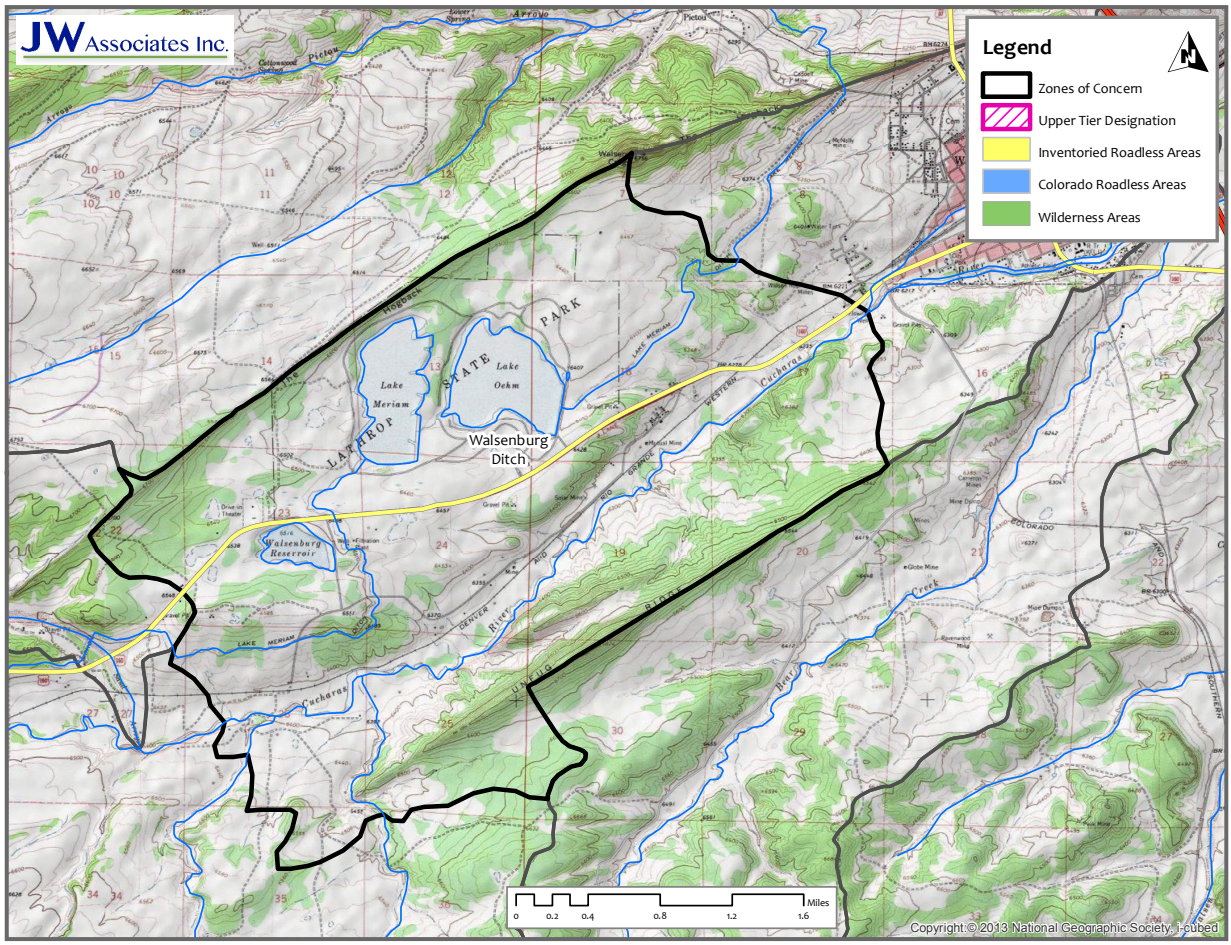

Figure 21. Walsenburg Ditch ZoC Special Areas

Walsenburg Ditch Vegetation

The Walsenburg Ditch ZoC is covered by a combination of Gambel oak, pinyon-juniper, and grasslands with some cottonwoods occupying riparian areas (Figure 22).

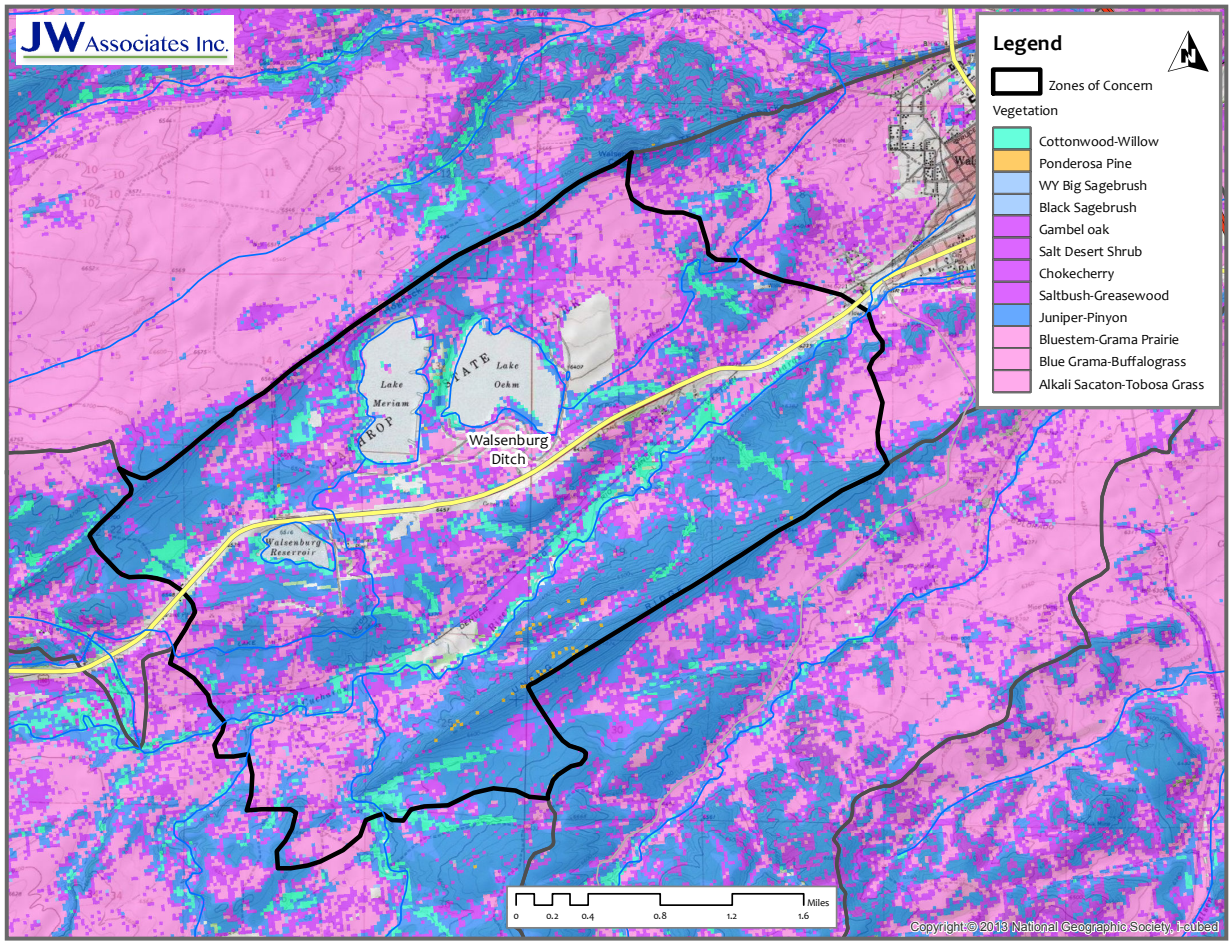

Figure 22. Walsenburg Ditch ZoC Vegetation

Walsenburg Ditch Access

There are many existing roads that provide access throughout the Walsenburg Ditch ZoC (Figure 23).

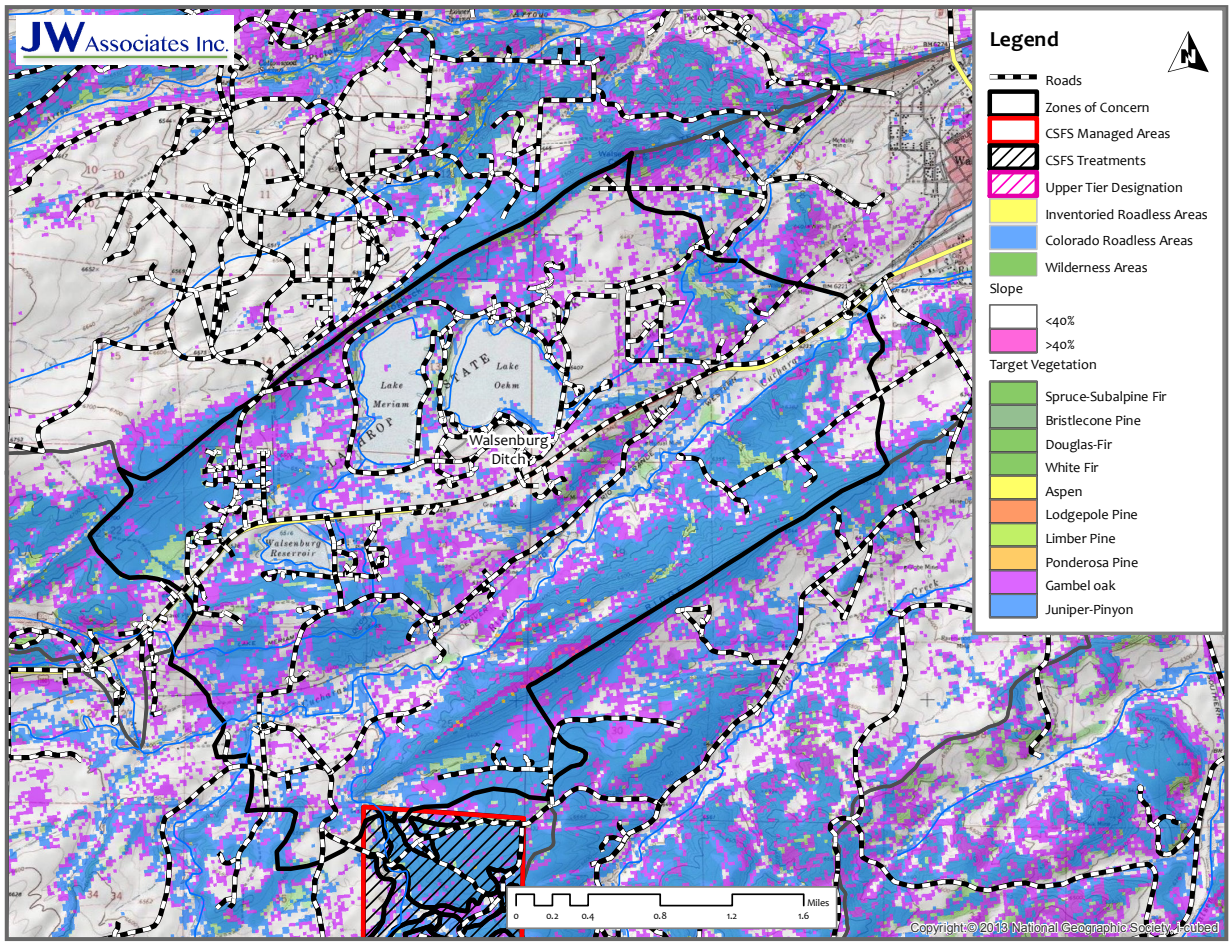

Figure 23. Walsenburg Ditch ZoC Opportunities

Walsenburg Ditch Opportunities

The wildfire hazard ranking for this watershed is very low. There are some areas of pinyon-juniper that are on relatively shallow slopes and can be accessed from existing roads. However, the hazards of these areas to the Cucharas River appear to be low. It is possible that small scale hazards could identify some potential treatments that would have a watershed protection benefit, but those cannot be identified at this scale.

Lake Meriam Ditch ZoC

This section discusses the Lake Meriam Ditch ZoC (Figure 24). Note that the ZoC are shown here in blue shading, but in the remaining figures the outlines appear as bold black lines with no shading.

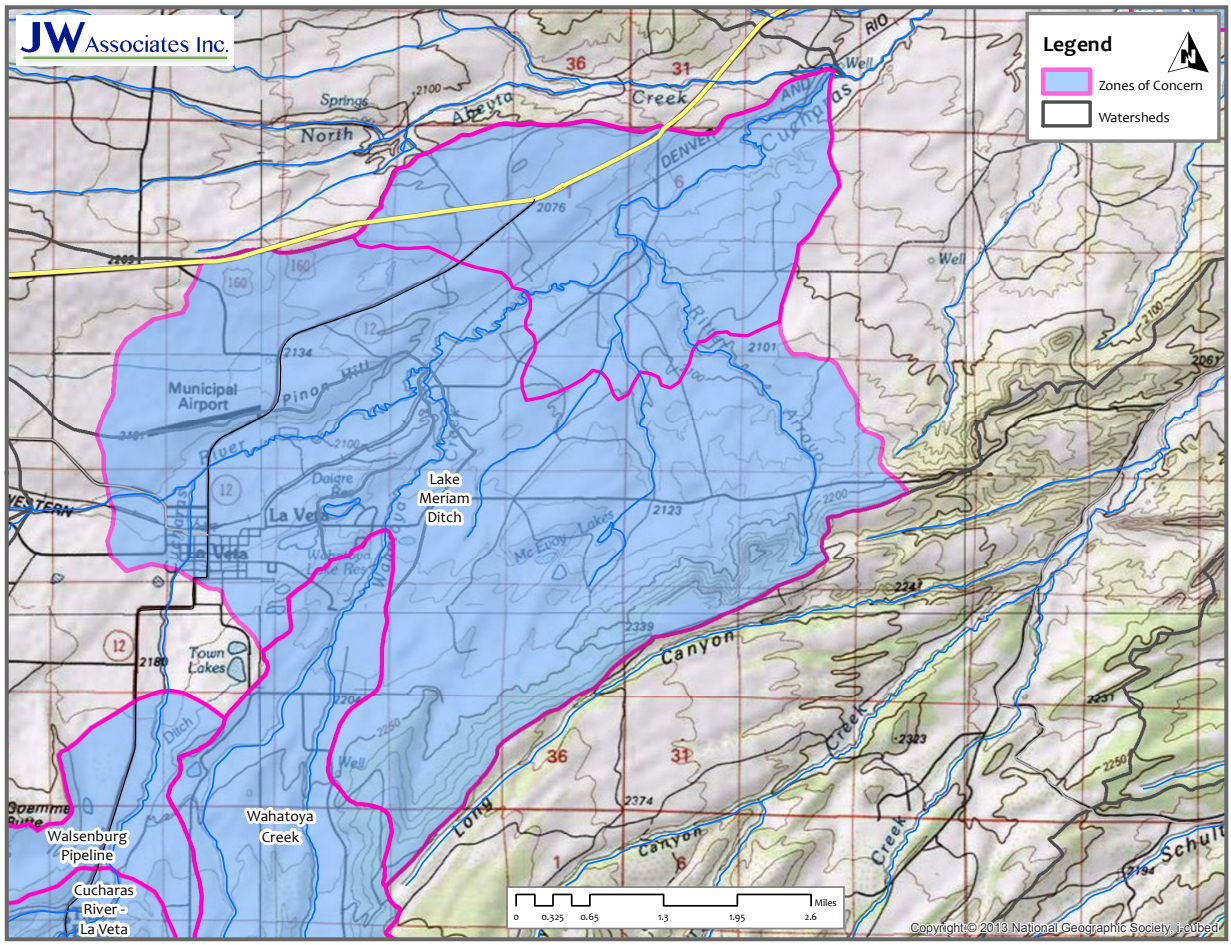

Figure 24. Lake Meriam Ditch ZoC Location

Lake Meriam Ditch Ownership

The Lake Meriam Ditch ZoC is mostly private lands (Figure 25). There is one piece of BLM land and a few small pieces of state owned land.

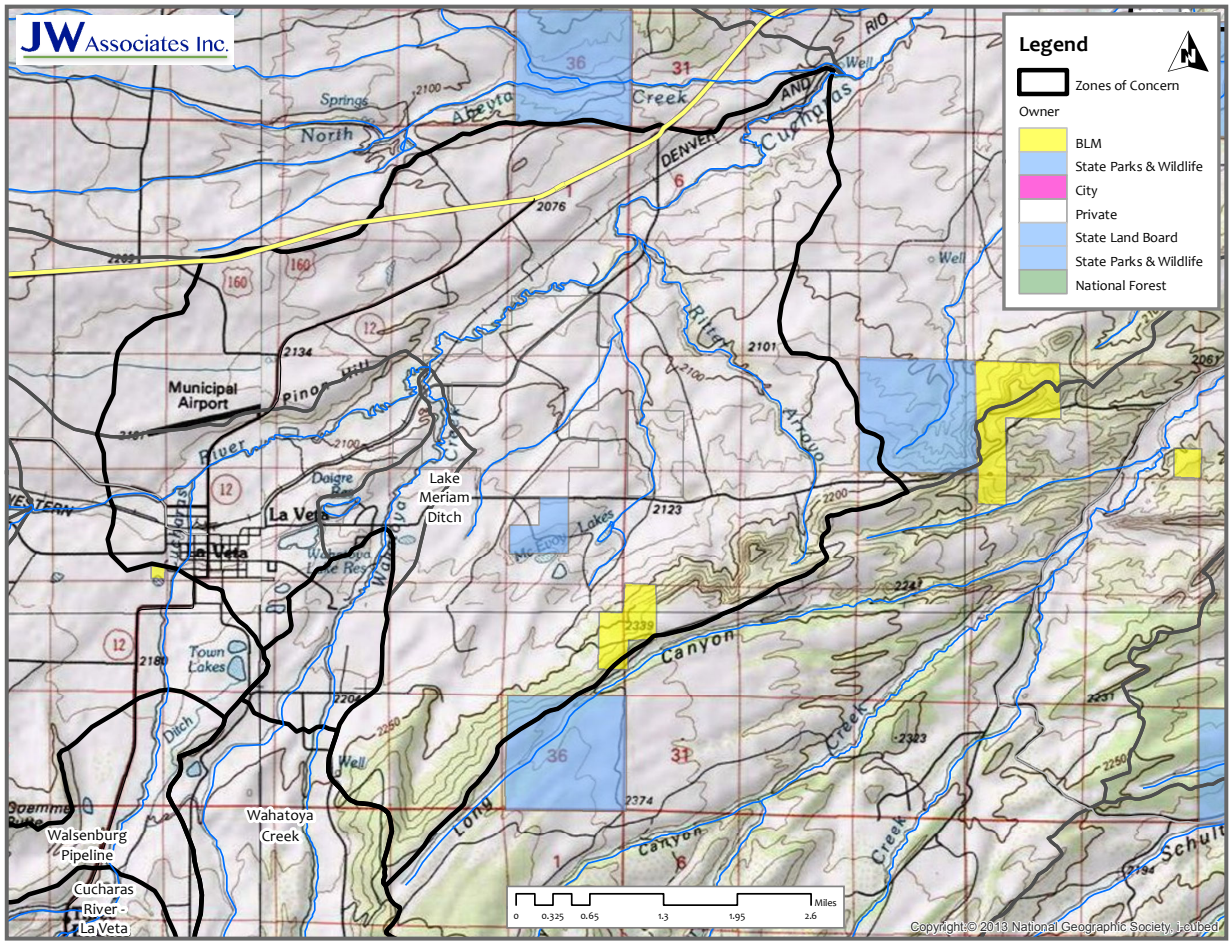

Figure 25. Lake Meriam Ditch ZoC Ownership

Lake Meriam Ditch Watershed Priority

The Lake Meriam Ditch ZoC covers three watersheds. The majority of the Lake Meriam Ditch ZoC is within the City of Walsenburg-Cucharas River watershed that is ranked Blue (Category 2) overall (Figure 26). The lower portions of the Echo Creek-Cucharas River and Wahatoya Creek watersheds are within the upper Lake Meriam Ditch ZoC and are ranked as Red (Category 5 - Highest) overall. The Echo Creek-Cucharas River and Wahatoya Creek watersheds are also both ranked as Red (Category 5 - Highest) for Flooding/Debris Flow Hazard and Composite Hazard.

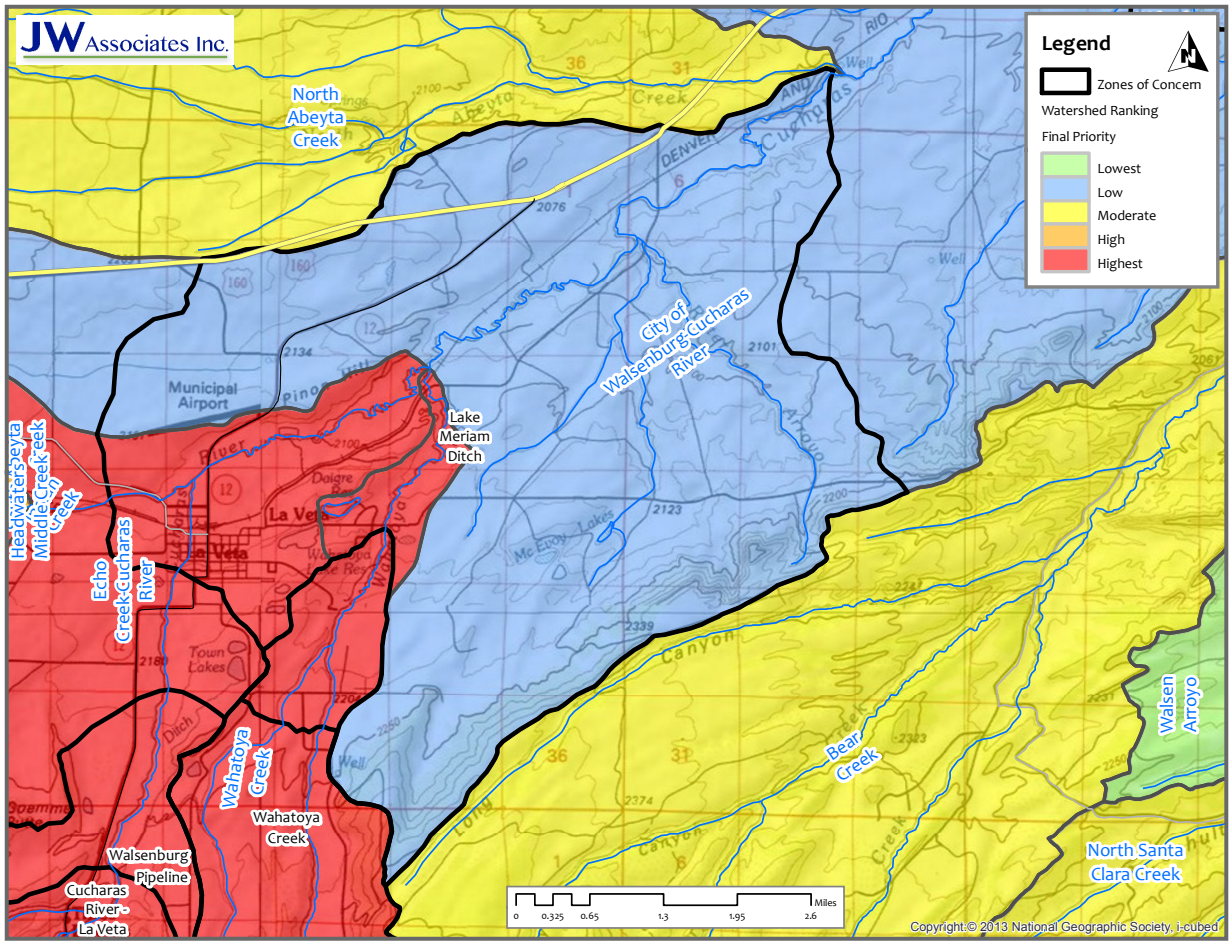

Figure 26. Lake Meriam Ditch ZoC Watershed Priority

Lake Meriam Ditch Slopes

The Lake Meriam Ditch ZoC is covered by relatively shallow slopes (Figure 27). There are just a few small areas of steep slopes.

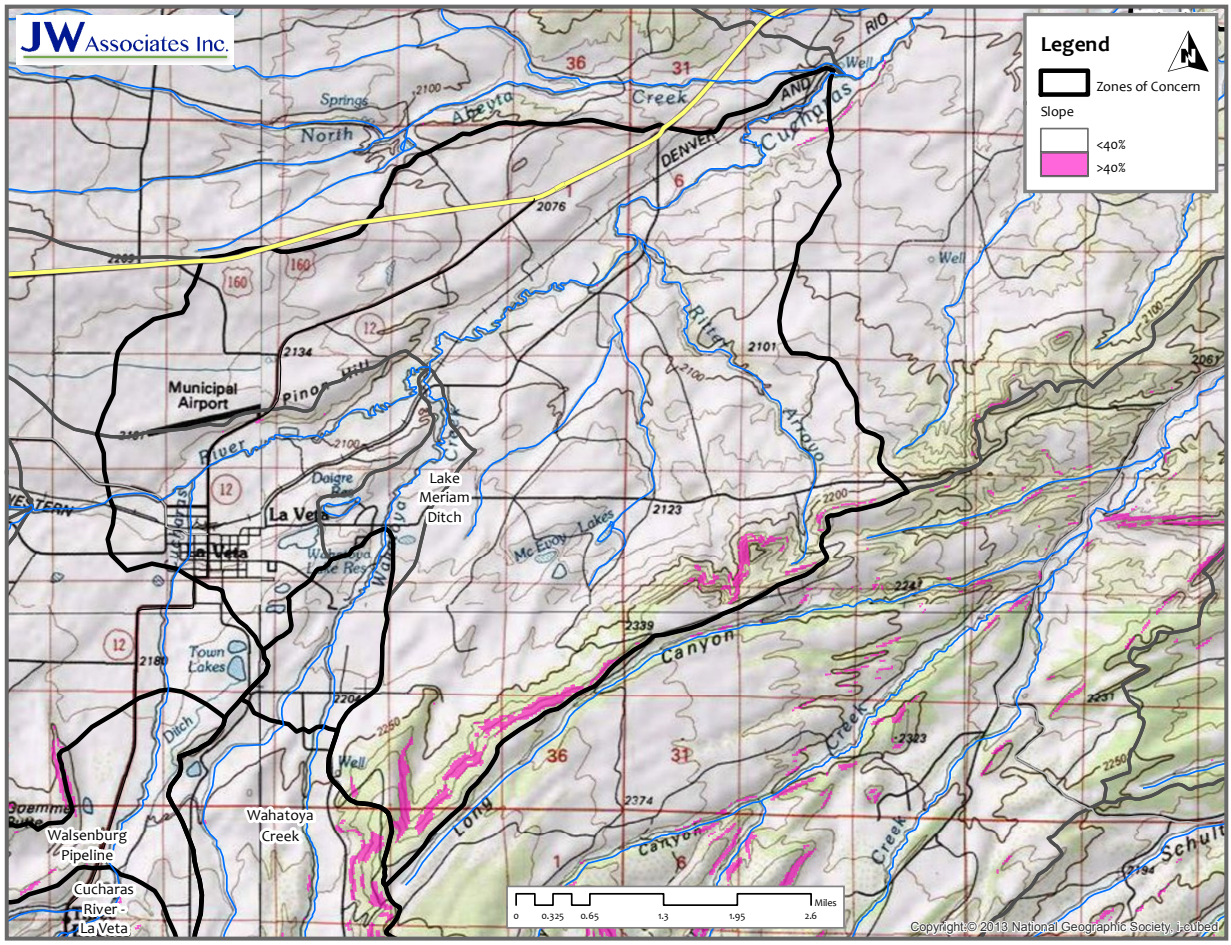

Figure 27. Lake Meriam Ditch ZoC Slope

Lake Meriam Ditch Special Management Areas

There are no special management areas within the Lake Meriam Ditch ZoC (Figure 28).

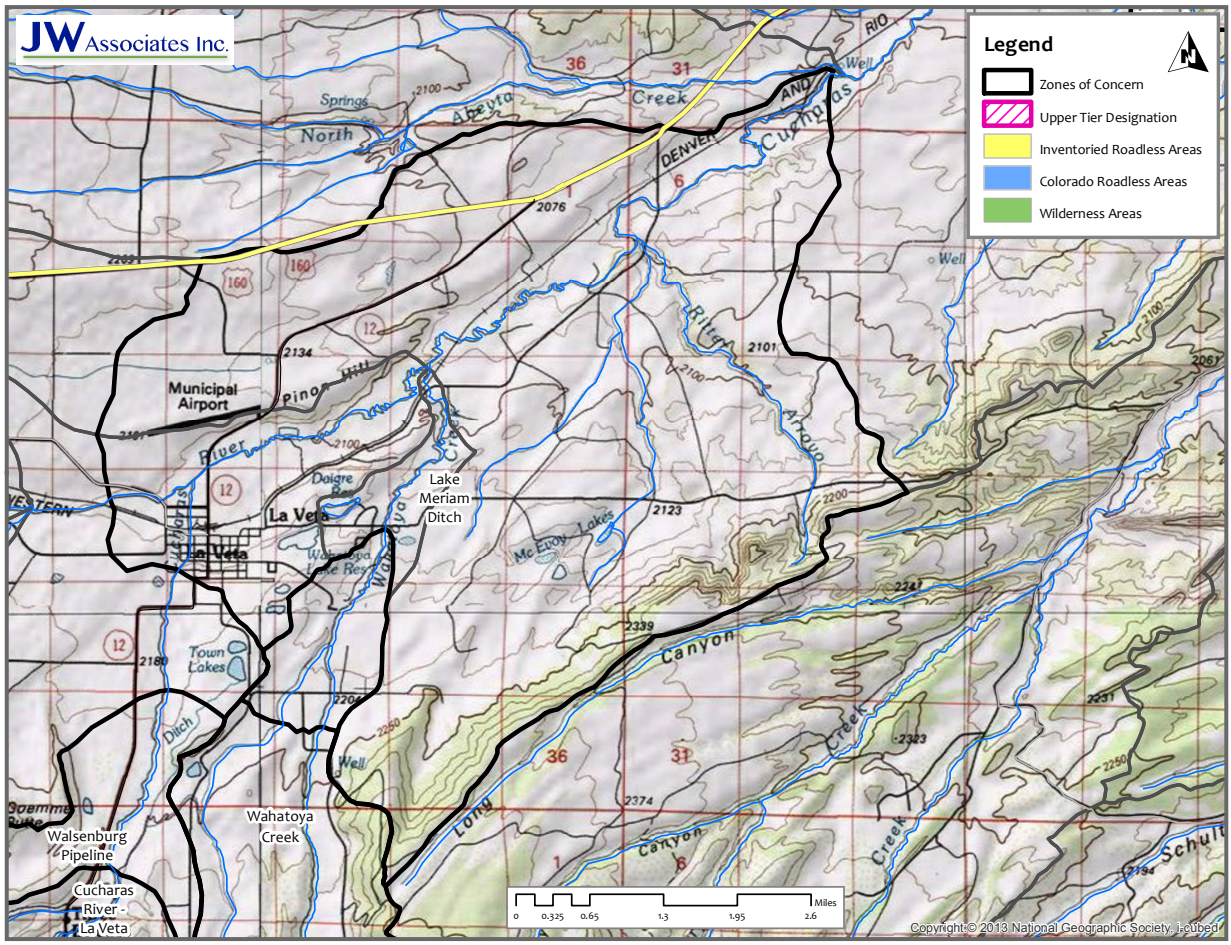

Figure 28. Lake Meriam Ditch ZoC Special Areas

Lake Meriam Ditch Vegetation

The Lake Meriam Ditch ZoC is covered mostly by grasslands with some large areas of Gambel oak (Figure 29). The riparian areas contain some large areas of cottonwoods.

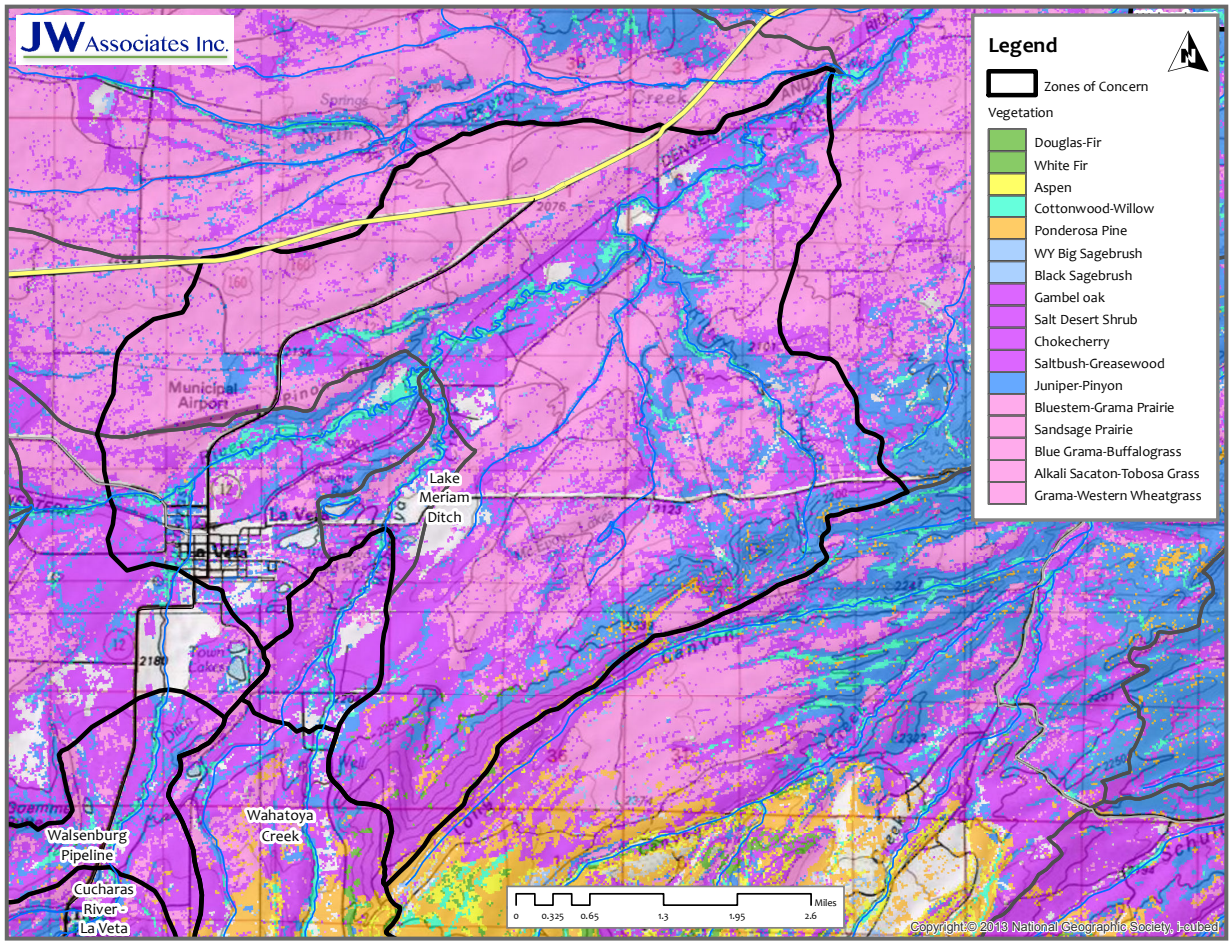

Figure 29. Lake Meriam Ditch ZoC Vegetation

Lake Meriam Ditch Access

There are many existing roads that provide access throughout the Lake Meriam Ditch ZoC (Figure 30).

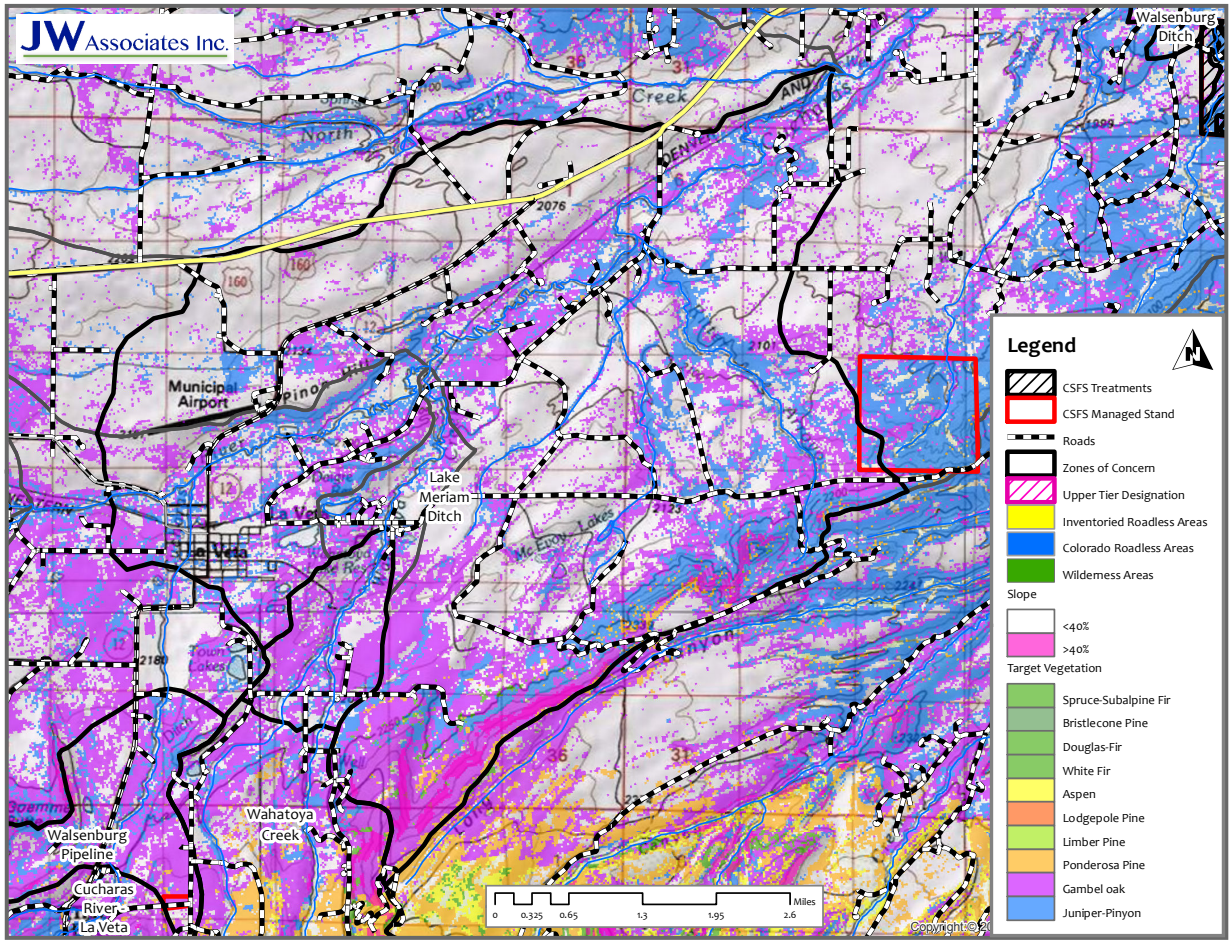

Figure 30. Lake Meriam Ditch ZoC Opportunities

Lake Meriam Ditch Opportunities

The wildfire hazard ranking for the City of Walsenburg-Cucharas River watershed, which covers most of this ZoC, is very low. There are some areas of pinyon-juniper that are on relatively shallow slopes and can be accessed from existing roads. However, the hazards of these areas to the Cucharas River appear to be low. This ZoC covers the lower portions of the Echo Creek-Cucharas River and Wahatoya Creek watersheds which have high hazard rankings. However, the potential treatment opportunities in the lower elevations of those watersheds that this ZoC covers is very similar to the rest of the ZoC. It would be prudent to collaborate with groups that are planning watershed protection projects within the Echo Creek-Cucharas River and Wahatoya Creek watersheds. Those watersheds likely present a higher hazard to the Lake Meriam Ditch ZoC than any areas within the ZoC itself.

Wahatoya Creek ZoC

This section discusses the Wahatoya Creek ZoC (Figure 31). This ZoC has been extended beyond the initial 5 mile upstream distance. Note that the ZoC are shown here in blue shading, but in the remaining figures the outlines appear as bold black lines with no shading.

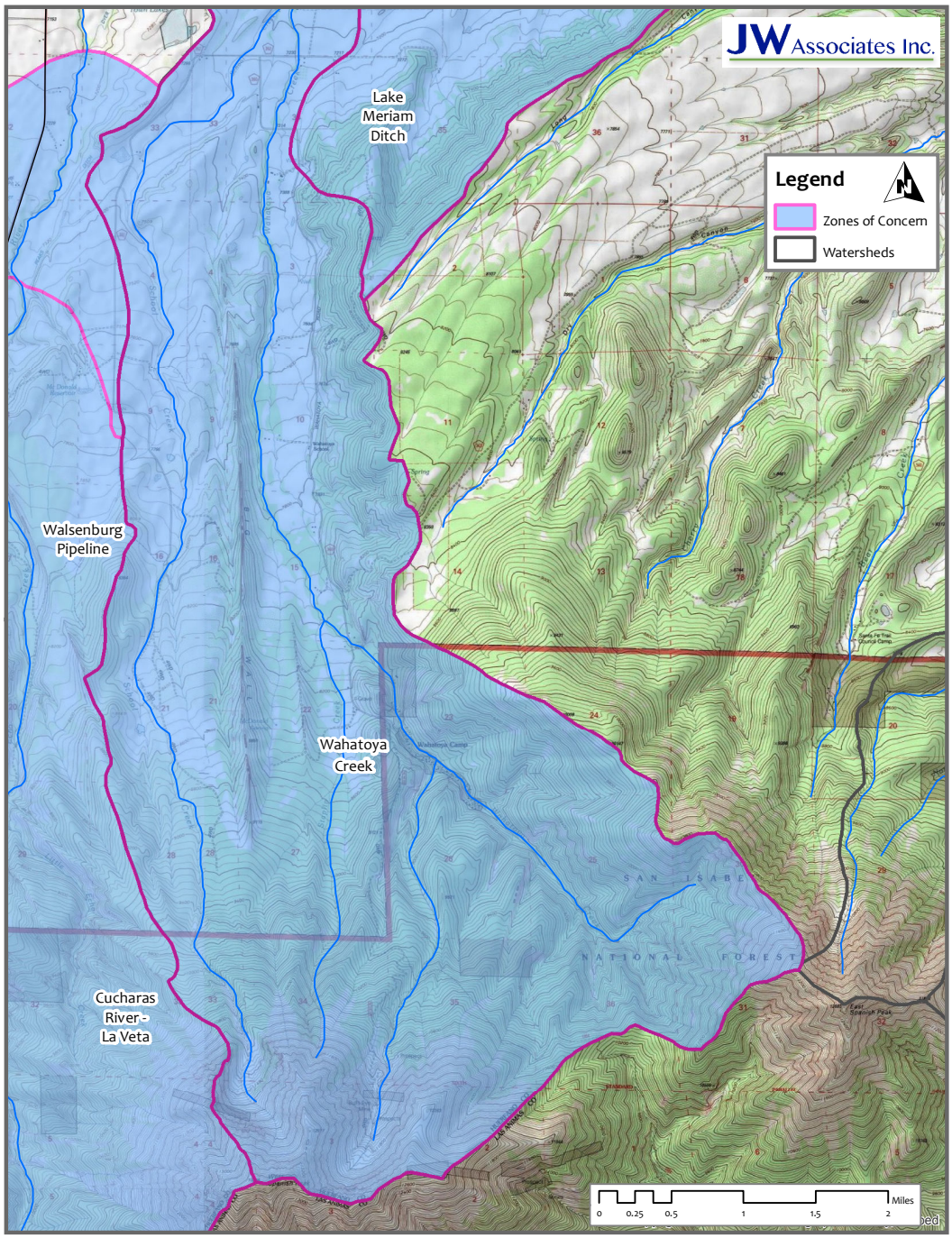

Figure 31. Wahatoya Creek ZoC Location

Wahatoya Creek Ownership

The Wahatoya Creek ZoC is mostly private lands with the upper portions of the ZoC being dominated by National Forest System lands (Figure 32).

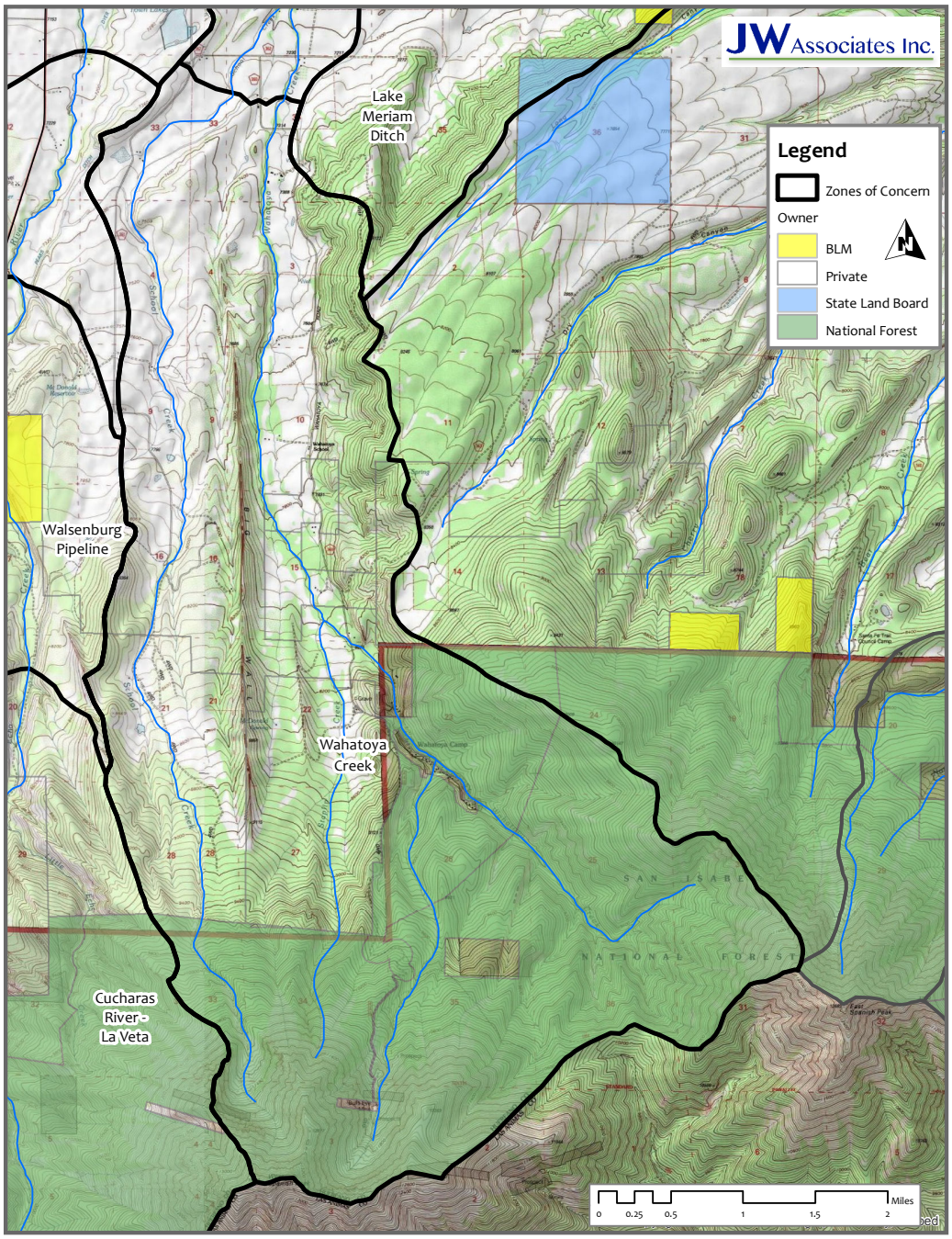

Figure 32. Wahatoya Creek ZoC Ownership

Wahatoya Creek Watershed Priority

The Wahatoya Creek watershed is ranked Red (Category 5 - Highest) overall. It is also ranked in the highest category for wildfire hazard, flooding/debris flow hazard, composite hazard and final priority.

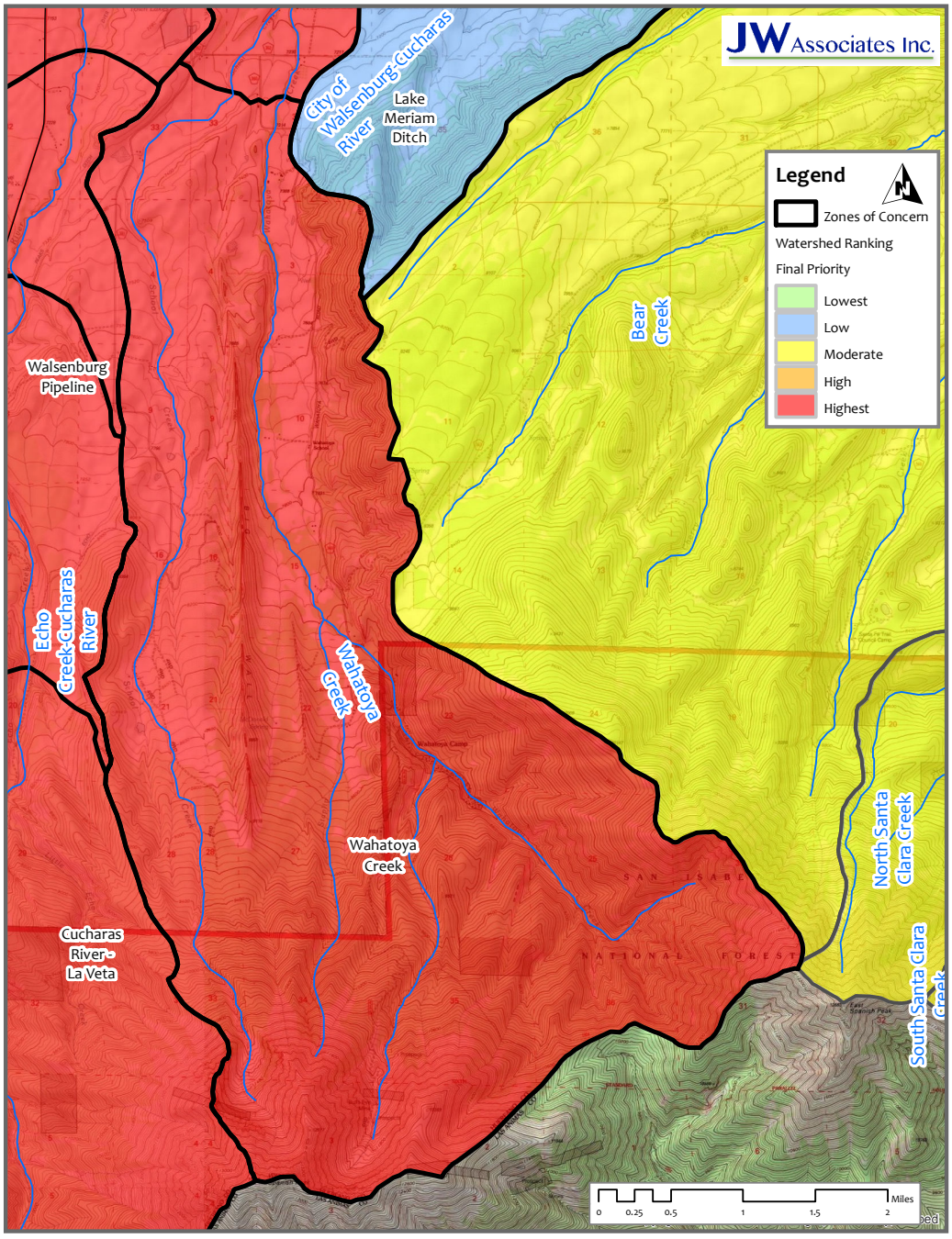

Figure 33. Wahatoya Creek ZoC Watershed Priority

Wahatoya Creek Slopes

The Wahatoya Creek ZoC is covered by relatively shallow slopes (Figure 34) except for the upper portions of the ZoC that are mostly relatively steep slopes.

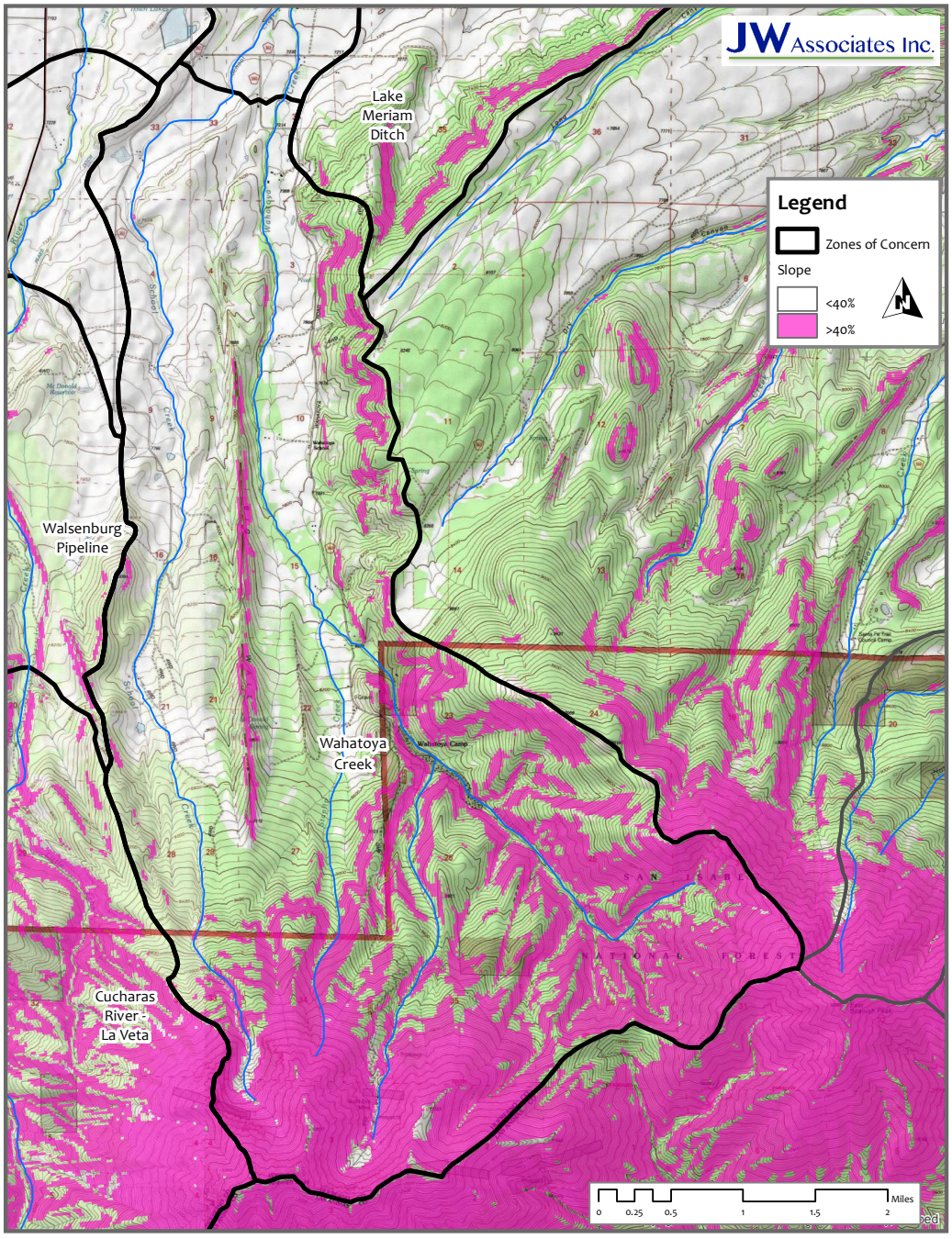

Figure 34. Wahatoya Creek ZoC Slope

Wahatoya Creek Special Management Areas

The Spanish Peaks Wilderness Areas covers the upper portions of the Wahatoya Creek ZoC (Figure 35). The Spanish Peaks Roadless Area is below and adjacent to the wilderness area.

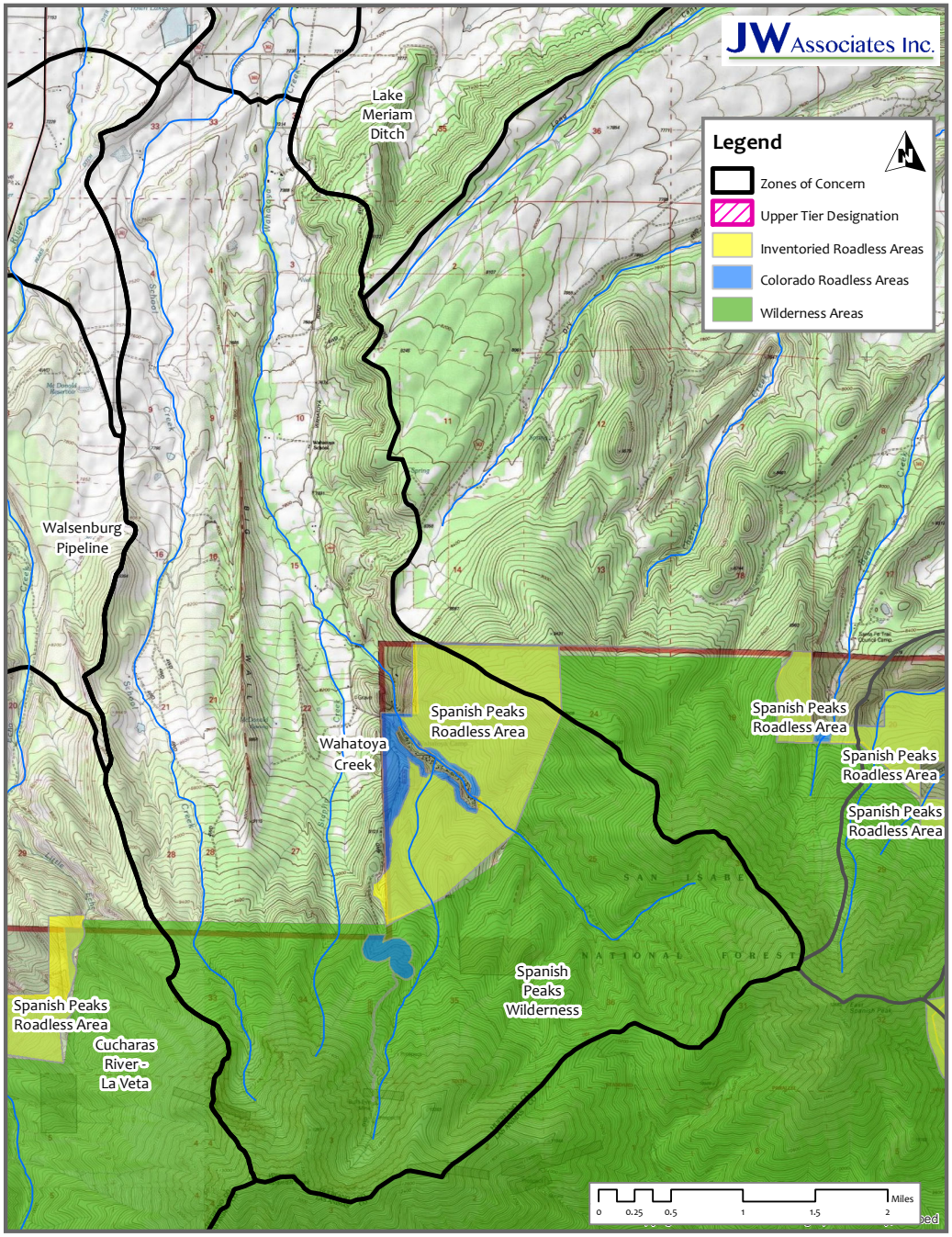

Figure 35. Wahatoya Creek ZoC Special Areas

Wahatoya Creek Vegetation

The vegetation in the Wahatoya Creek ZoC transitions from lower elevations comprised of grasslands, Gambel oak and pinyon juniper through an area of ponderosa pine and Douglas-fir (Figure 36). The largest vegetation zone is comprised of mixed conifer, aspen and spruce-fir that reaches to high elevations and then transitions to alpine at the highest elevations (Figure 36).

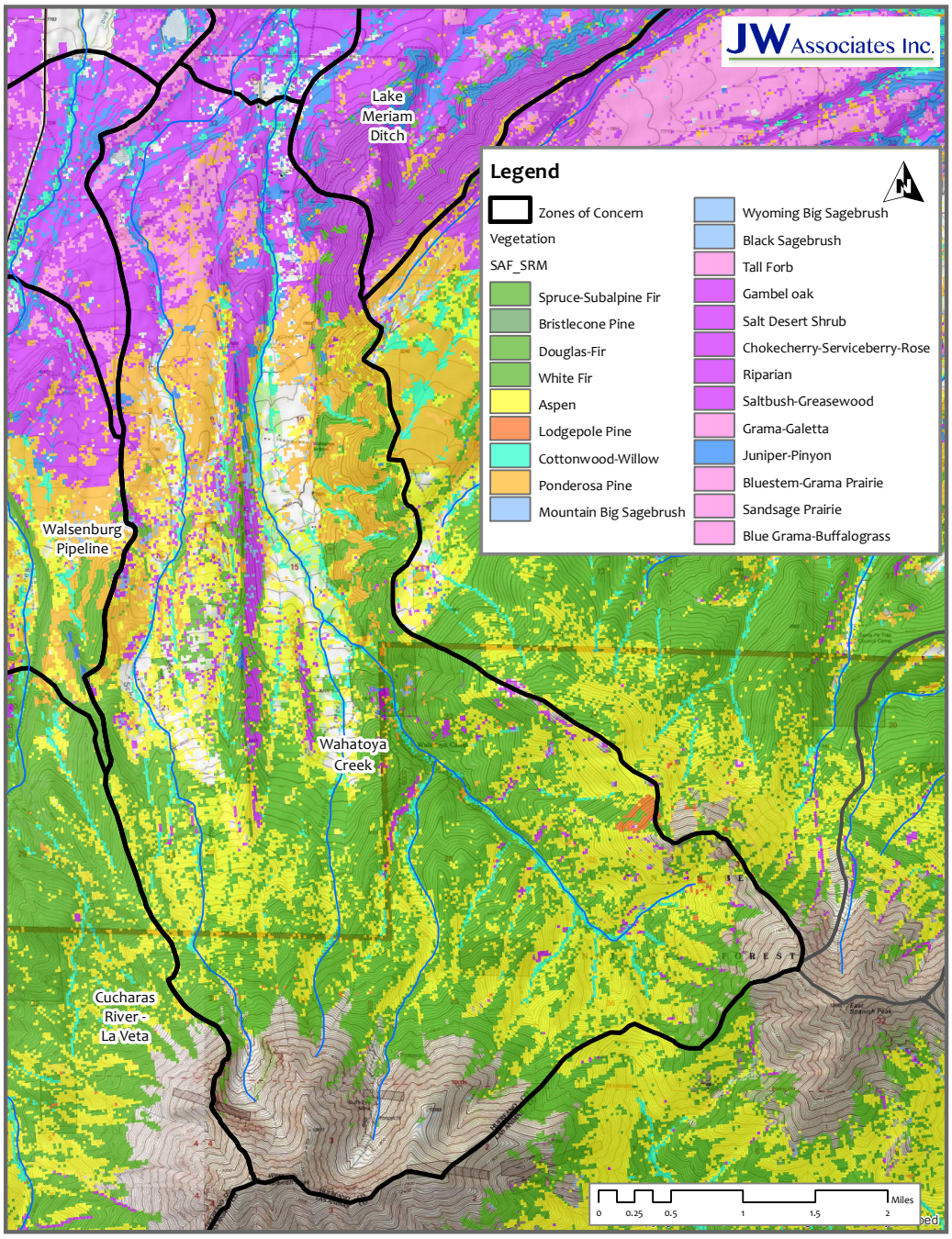

Figure 36. Wahatoya Creek ZoC Vegetation

Wahatoya Creek Access

The lower (northern) portion of the Wahatoya Creek ZoC has good access from several existing roads (Figure 37). The southern portion of the Wahatoya Creek ZoC has little to no access. The Spanish Peaks Wilderness and Roadless Areas have no access and even areas outside of some portions of the wilderness do not have access due to steep slopes and rough terrain.

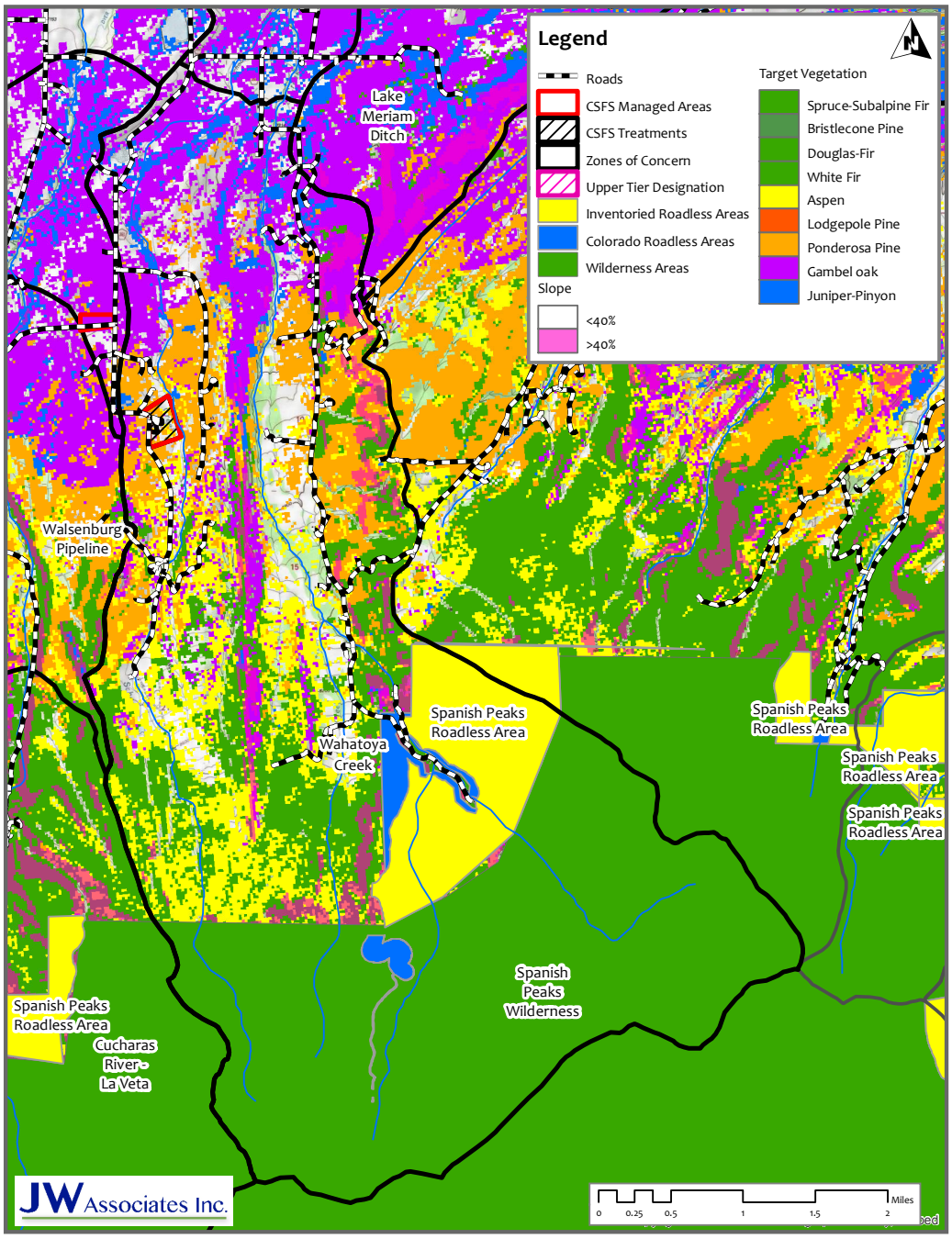

Figure 37. Wahatoya Creek ZoC Opportunities

Wahatoya Creek Opportunities

There are some opportunities in this ZoC but they are limited by access and special designations. The forest vegetation to the east of County Road 360 does not appear to be a high hazard due to the flat open grasslands between that area and the creek, and there appear to no defined creeks draining that area (Figure 37). The forested area surrounding County Road 361 does not appear to be dense enough to warrant treatment except for the southern portion of that road. The highest hazard areas appear to be in the mixed conifer and aspen in the southern end of the ZoC.

Three areas that have some potential for treatment have been identified and displayed on Figure 38. The areas displayed are examples of areas that could have some opportunities for forest management activities. More detailed analysis could refine those areas, identify more opportunity areas, or possibly remove those areas from consideration.

The treatments in these areas could include;

1. Restoration of dense ponderosa pine and Douglas-fir stands through thinning and created openings.
2. Removal of conifers from aspen stands
3. Enhancement of aspen stands by cutting them to regenerate new stands through suckering
4. Restoration of mixed conifer stands where they are overly dense through thinning and selective cutting
5. Creation of fuel breaks along existing roads

The actual target areas would need to be defined on the ground and the treatments proposed for each area would require collaboration planning as it would likely include both private and public lands. The Spanish Peaks Roadless Area should be evaluated to determine if a case could be made for watershed protection projects. That assessment would need to include a discussion about the direction of the roadless policy within the US Forest Service to determine if those potential treatments would be possible to implement.

The water providers should work with the US Forest Service to develop an information and education plan to inform hikers, mountain bikers, and other visitors to the wilderness and roadless areas about the importance of the area's watersheds and the danger of wildfire to water quality. They should also work with the US Forest Service to develop and implement fire management plans that could allow natural fires of lower intensities to burn within these watersheds to create greater diversity and reduce fuels.

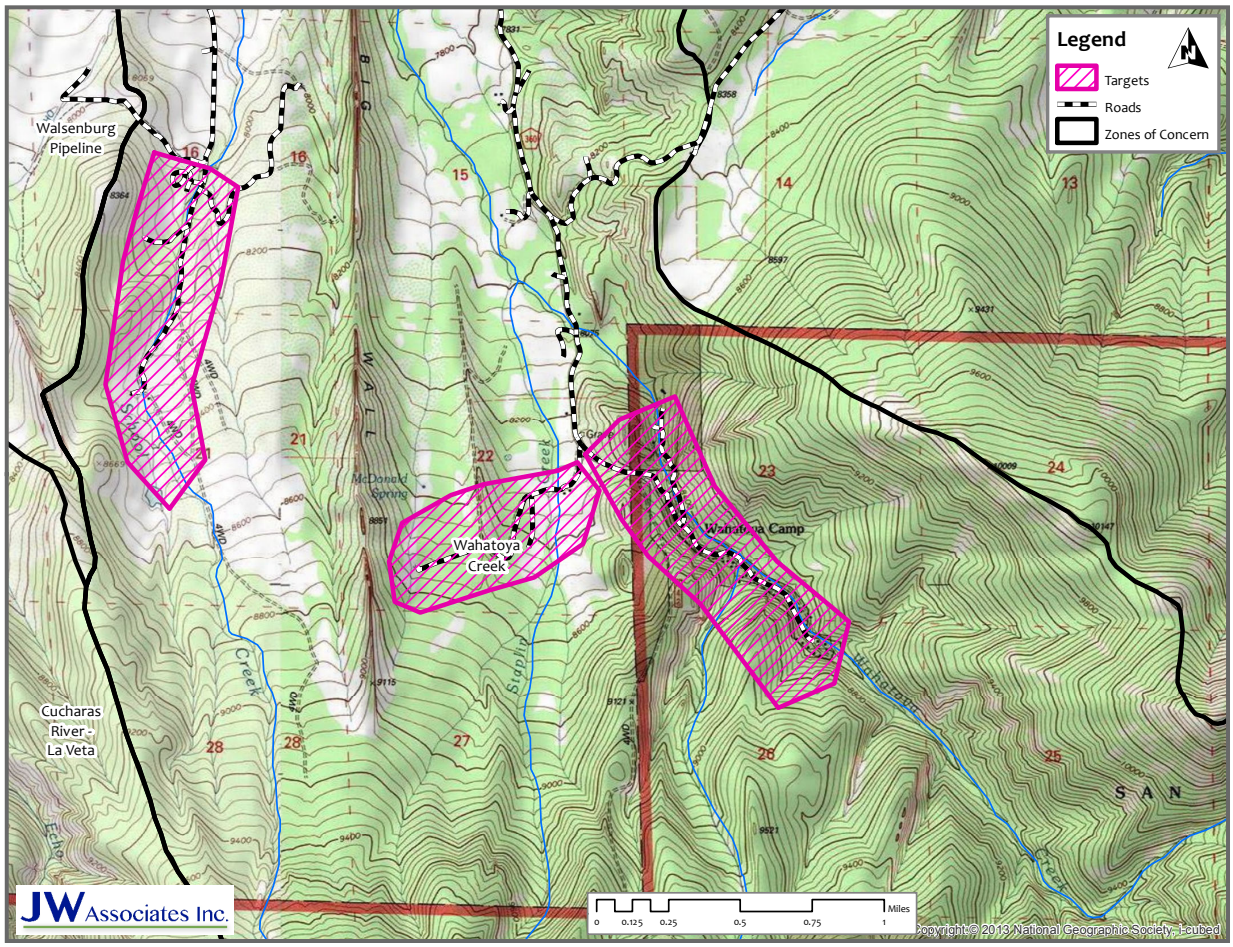

Figure 38. Wahatoya Creek ZoC Potential Treatment Areas

Walsenburg Pipeline ZoC

This section discusses the Walsenburg Pipeline ZoC (Figure 39), which overlaps the Cucharas River-La Veta ZoC. The Cucharas River-La Veta ZoC is discussed in the following section. This ZoC has been extended beyond the initial 5 mile upstream distance. Note that the ZoC are shown here in blue shading, but in the remaining figures the outlines appear as bold black lines with no shading.

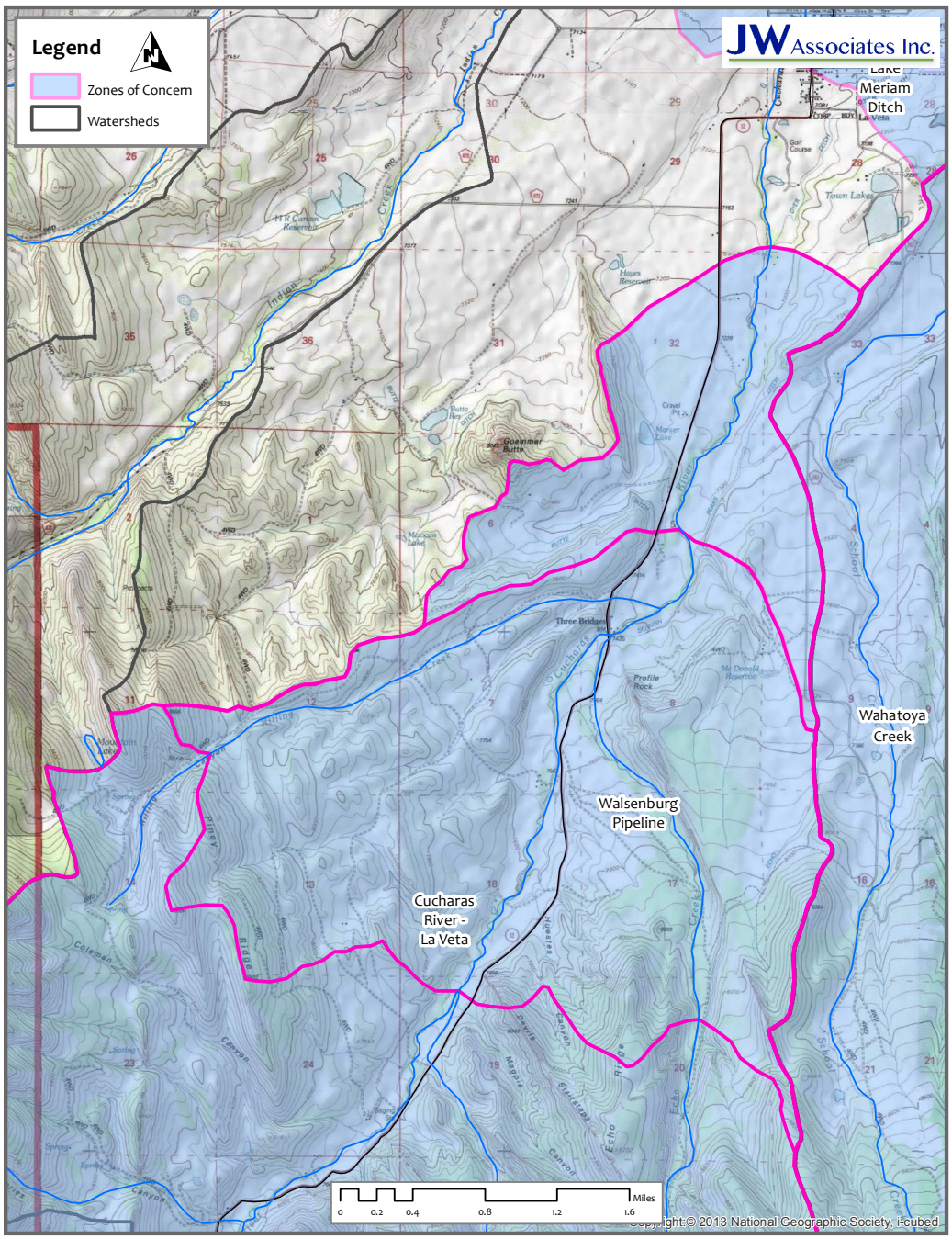

Figure 39. Walsenburg Pipeline ZoC Location

Walsenburg Pipeline ZoC Ownership

The Walsenburg Pipeline ZoC is mostly private lands with one piece of BLM land (Figure 40).

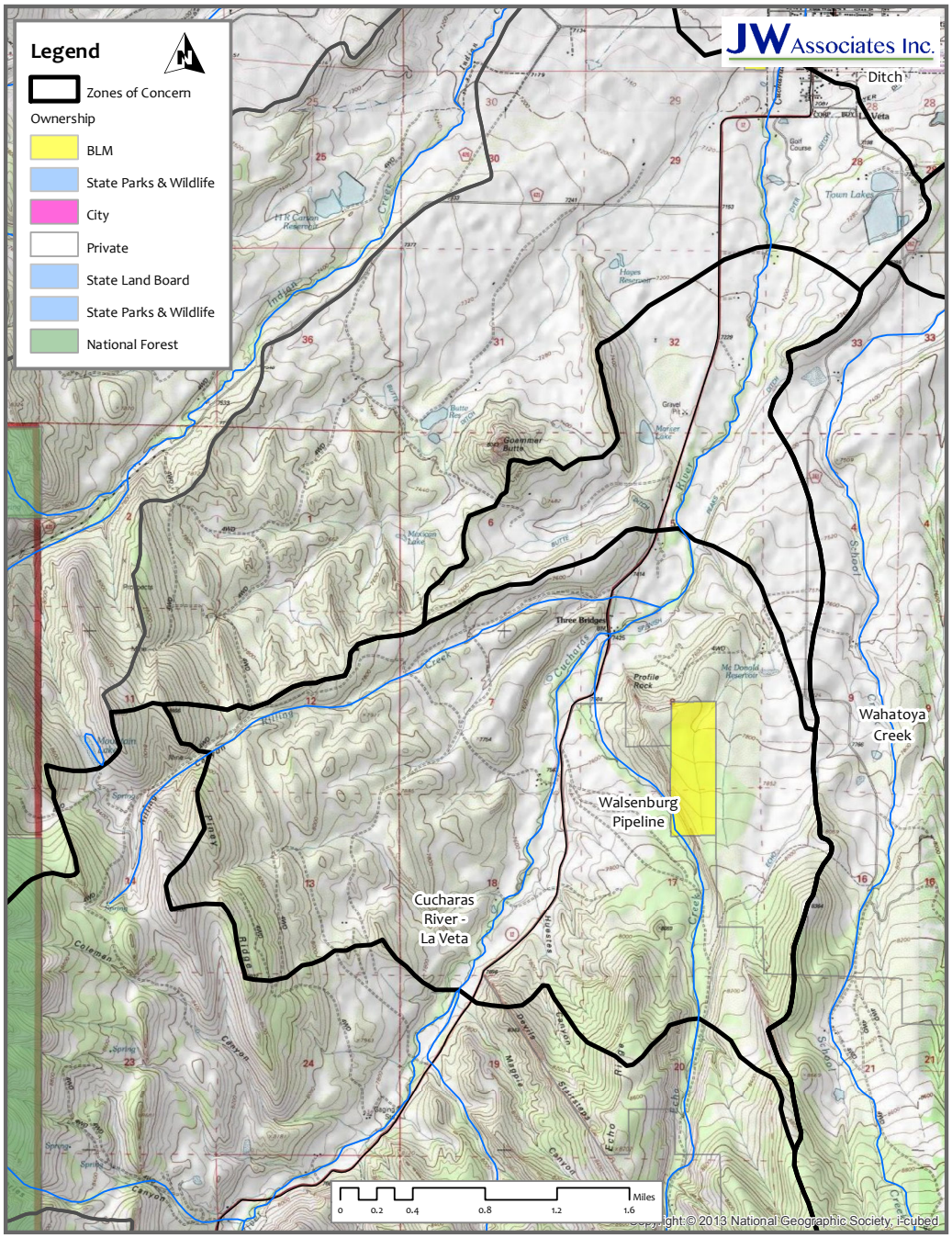

Figure 40. Walsenburg Pipeline ZoC Ownership

Walsenburg Pipeline ZoC Watershed Priority

The Walsenburg Pipeline ZoC is within the Echo Creek-Cucharas River watershed that is ranked Red (Category 5 - Highest) overall (Figure 41). The Echo Creek-Cucharas River watershed is also ranked Red (Category 5 - Highest) for Flooding/Debris Flow Hazard and Composite Hazard.

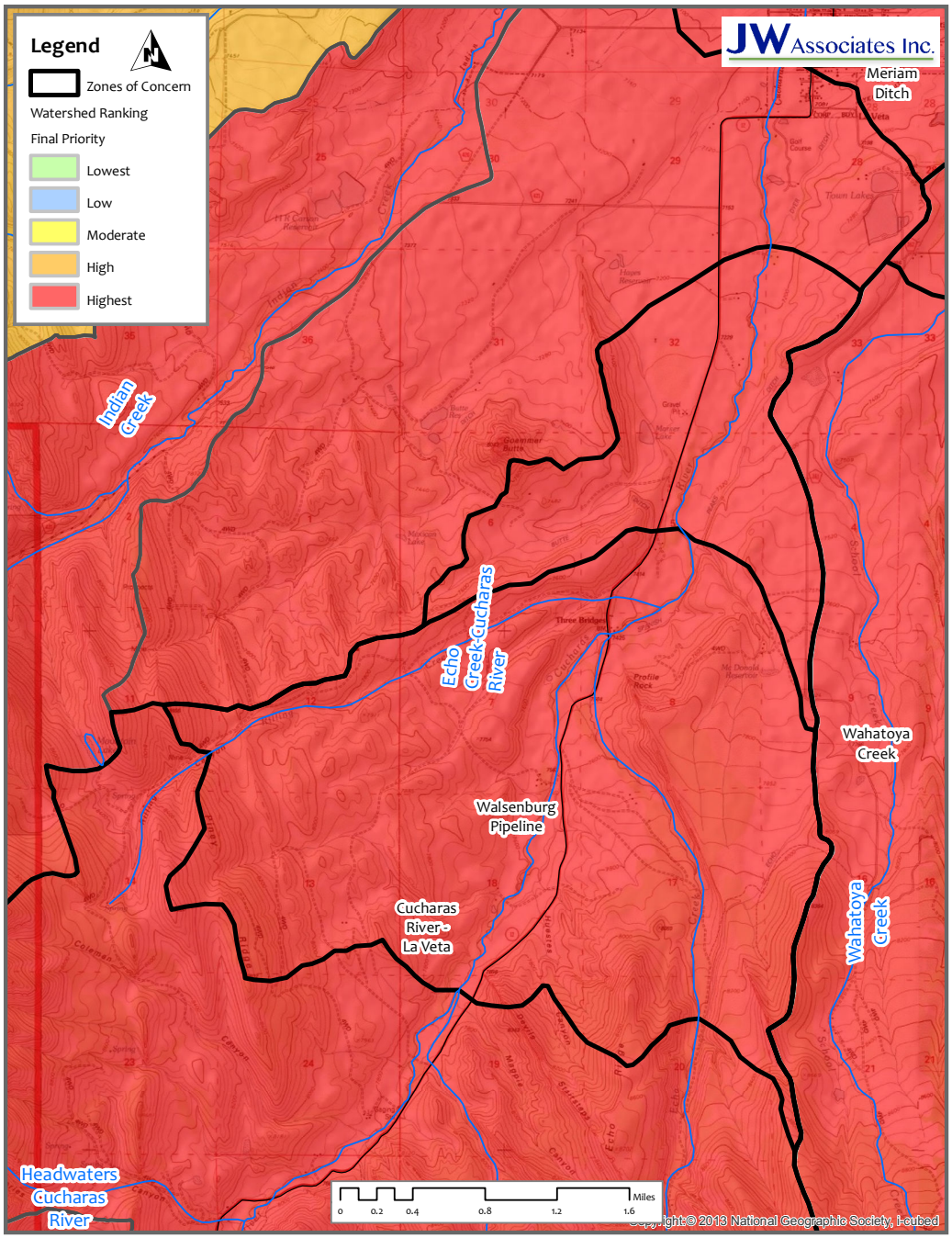

Figure 41. Walsenburg Pipeline ZoC Watershed Priority

Walsenburg Pipeline ZoC Slopes

The Walsenburg Pipeline ZoC has relatively shallow slopes with some small bands of steep slopes (Figure 42).

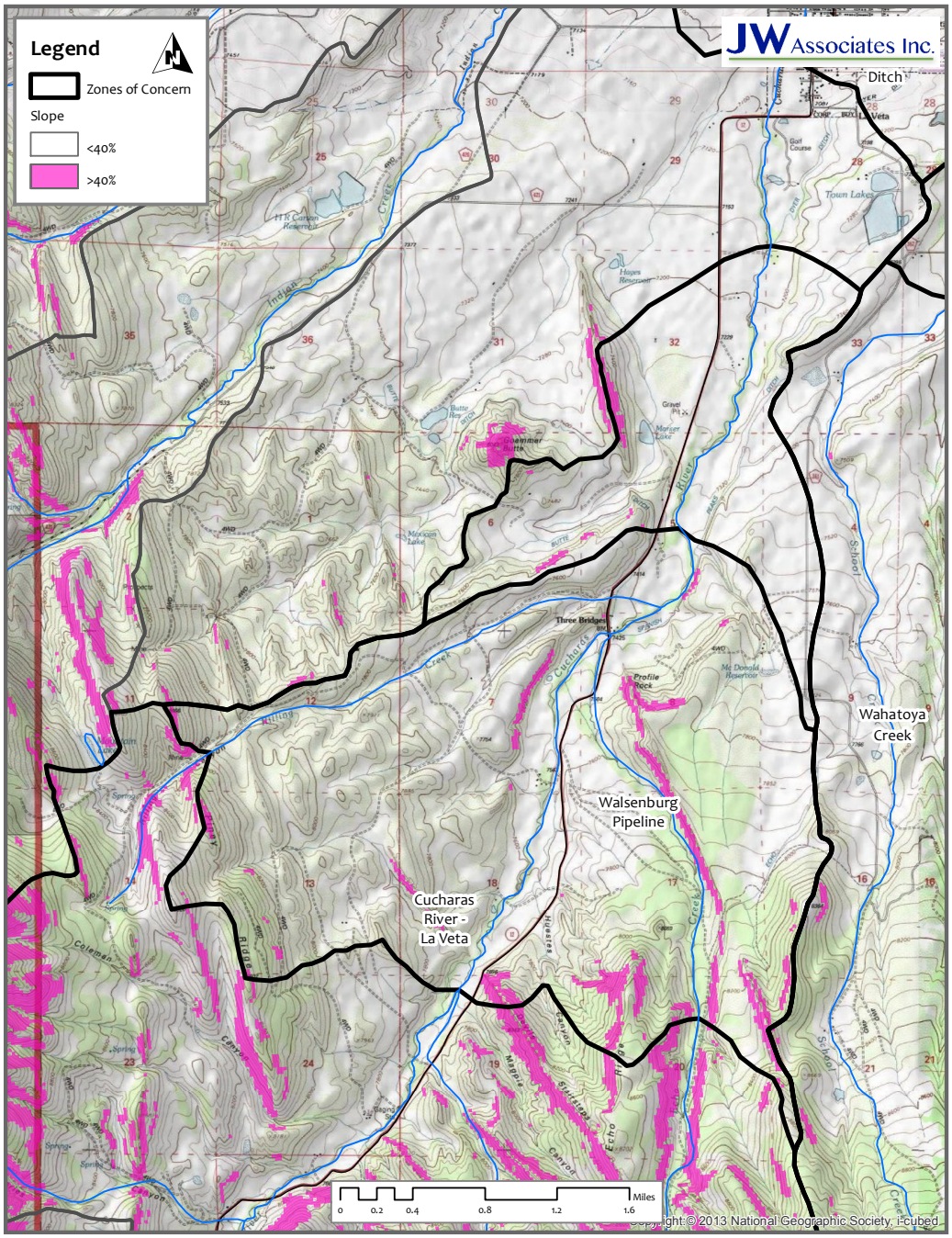

Figure 42. Walsenburg Pipeline ZoC Slope

Walsenburg Pipeline ZoC Special Management Areas

The Walsenburg Pipeline ZoC contains no special management areas (Figure 43).

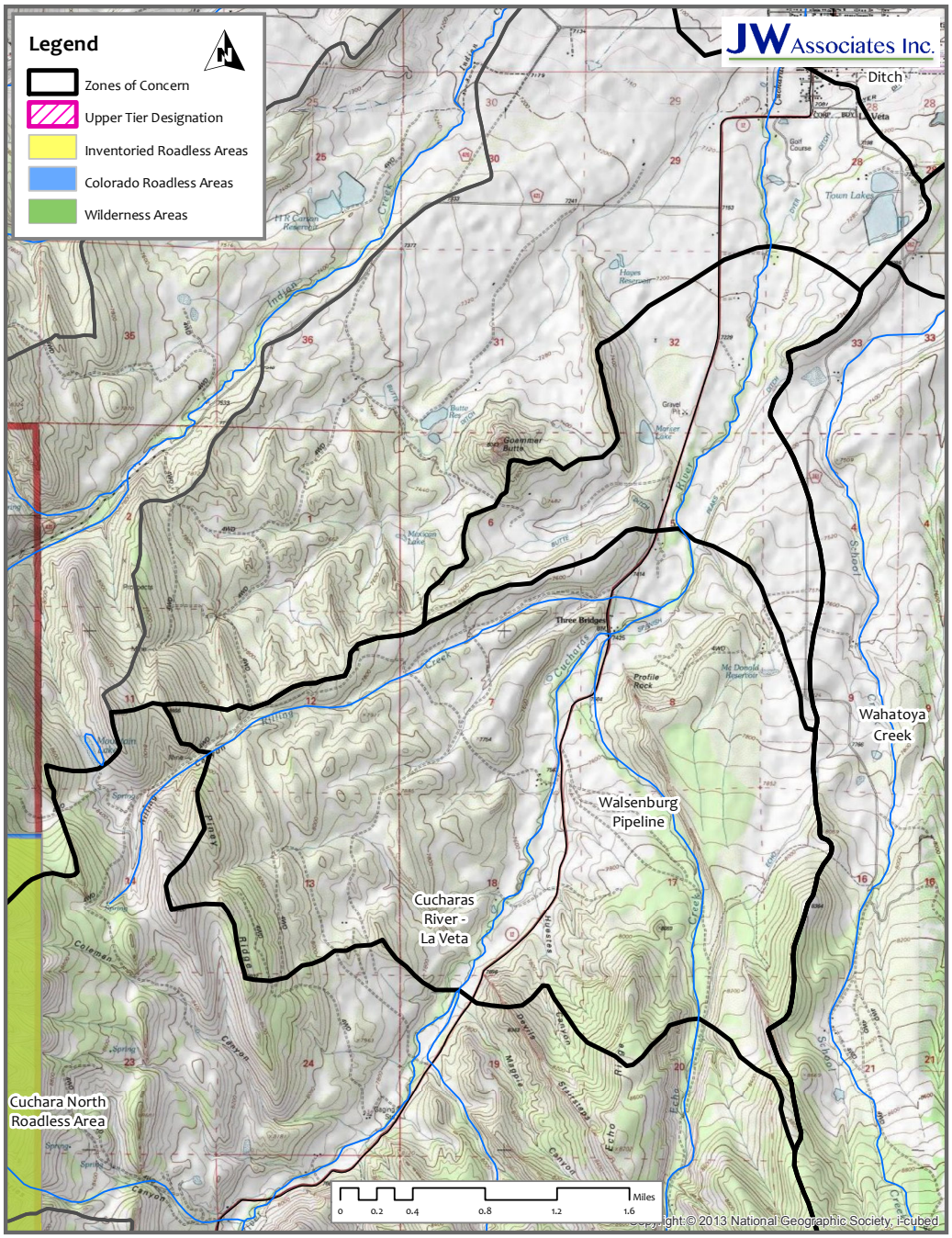

Figure 43. Walsenburg Pipeline ZoC Special Areas

Walsenburg Pipeline ZoC Vegetation

The lower portion of the Walsenburg Pipeline ZoC is dominated by Gambel oak with some smaller areas of grasslands and pinyon-juniper (Figure 44). The vegetation in this ZoC transitions to ponderosa pine mixed with aspen with some areas of mixed conifer at the highest elevations.

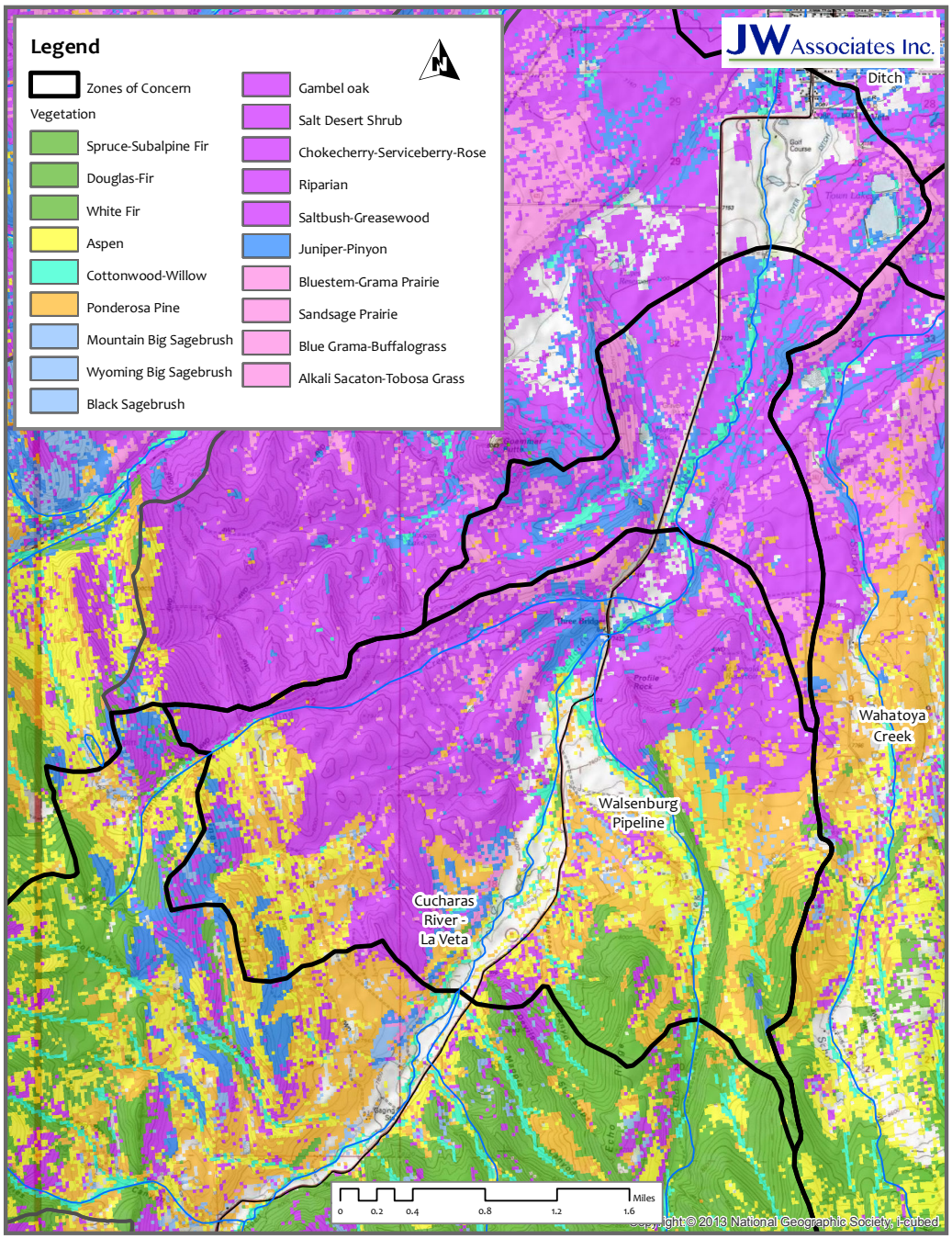

Figure 44. Walsenburg Pipeline ZoC Vegetation

Walsenburg Pipeline ZoC Access

The Walsenburg Pipeline ZoC has several existing roads that provide access throughout the ZoC (Figure 45). Only a few areas appear to not have existing access and it is likely that existing roads on private lands are not all represented on this map.

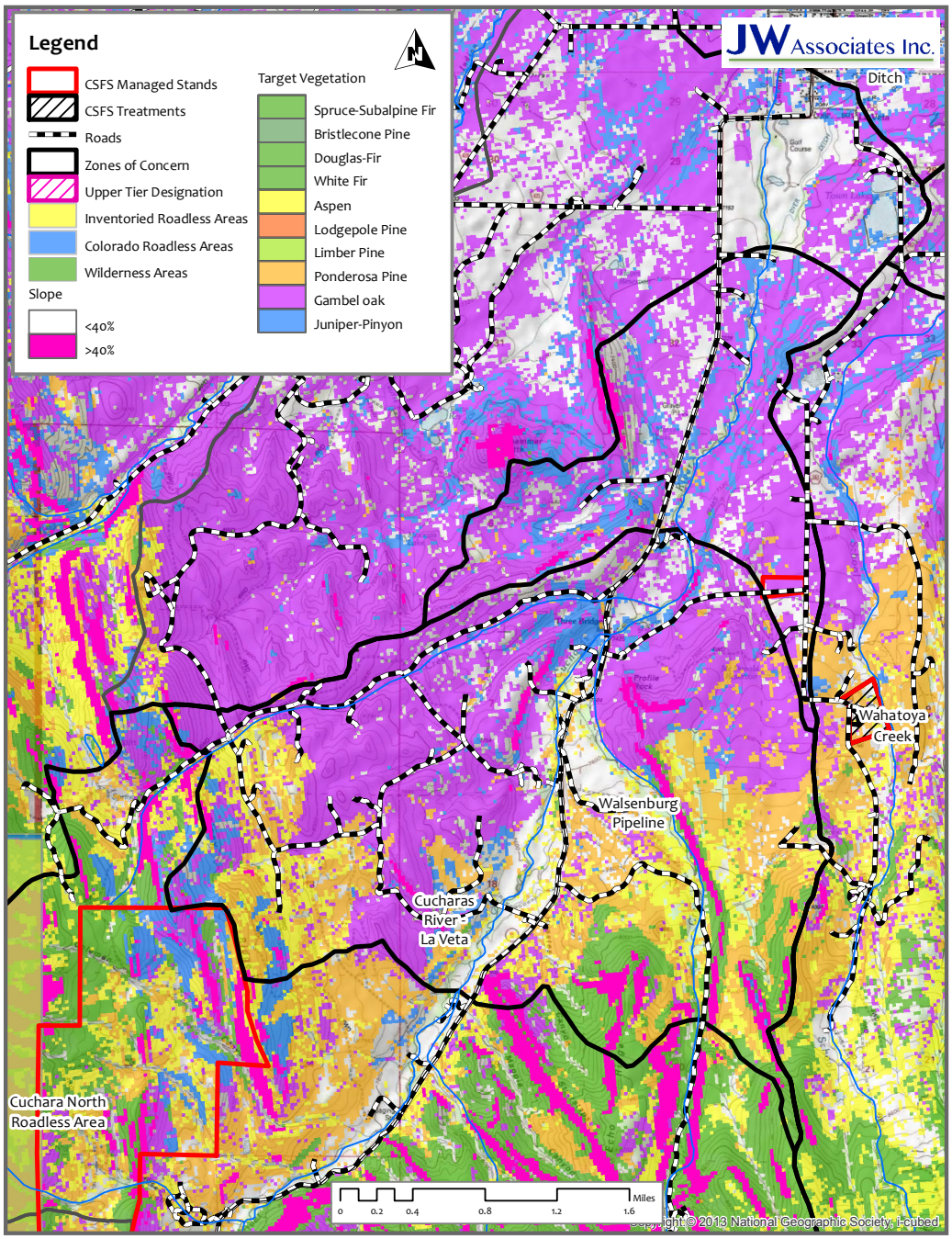

Figure 45. Walsenburg Pipeline ZoC Opportunities

Walsenburg Pipeline ZoC Opportunities

The Walsenburg Pipeline ZoC appears to have some opportunities for forest treatments. The Gambel oak areas need to be ground verified for areas that could provide watershed protection. Gambel oak dominated areas can be periodically masticated, prescribed burned; or on a limited scale, cut by hand crews. Developing a mosaic of different age classes provides important diversity that will keep a larger percentage of these areas in a younger, more succulent condition.

Two areas have been preliminarily identified as potential treatment areas and are displayed on Figure 46. The areas displayed are examples of areas that could have some opportunities for forest management activities. More detailed analysis could refine those areas, identify more opportunity areas, or possibly remove those areas from consideration.

The treatments in these areas could include;

1. Restoration of dense ponderosa pine and Douglas-fir stands through thinning and created openings. In areas dominated by Douglas-fir, favor retention of ponderosa pine, remove most surface and ladder fuels, and prune residual trees to raise canopy height.
2. Removal of conifers from aspen stands
3. Enhancement of aspen stands by cutting them to regenerate new stands through suckering
4. Creation of fuel breaks along existing roads

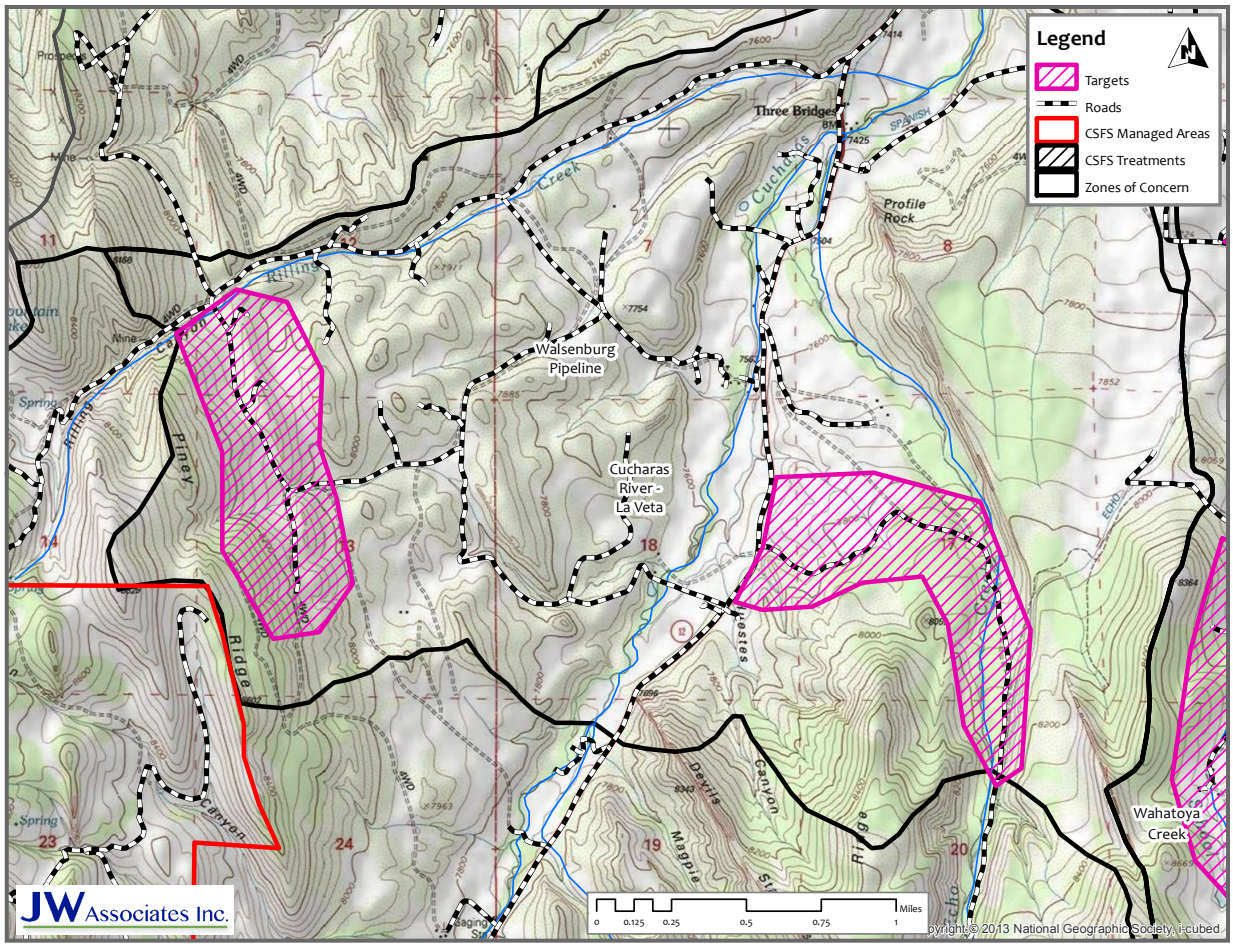

Figure 46. Walsenburg Pipeline ZoC Potential Treatment Areas

Cucharas River-La Veta ZoC

This section discusses the Cucharas River-La Veta ZoC (Figure 47), which overlaps the Walsenburg Pipeline ZoC (discussed in the previous section). The Cucharas River-La Veta ZoC also overlaps the Dodgetown Creek and White Creek Reservoir ZoC, which are discussed in following sections. Note that the ZoC are shown here in blue shading, but in the remaining figures the outlines appear as bold black lines with no shading.

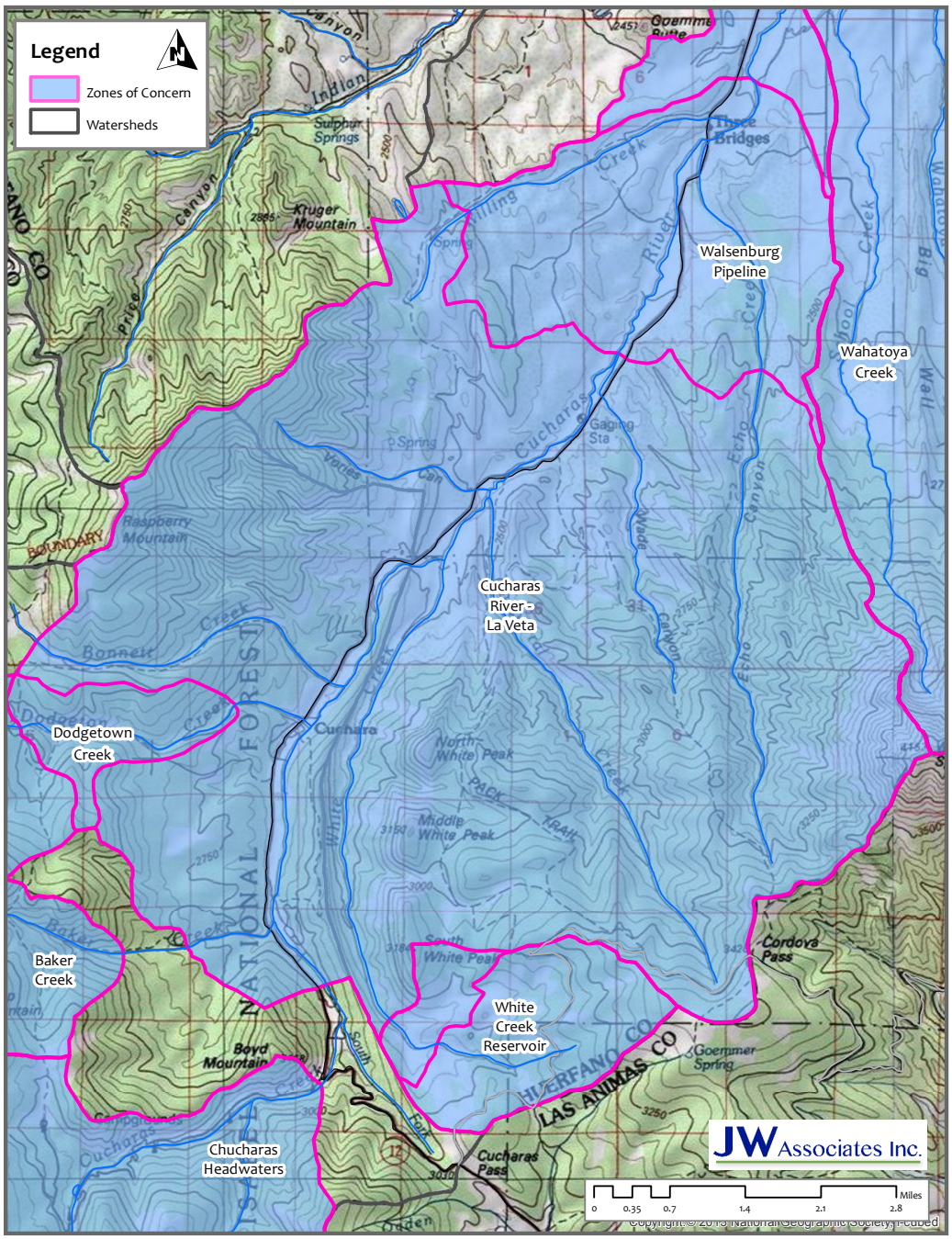

Figure 47. Cucharas River-La Veta ZoC Location

Cucharas River-La Veta ZoC Ownership

The lower portions of the Cucharas River-La Veta ZoC is mostly private lands (Figure 48), with one piece of BLM lands. The upper portions of this ZoC are mostly National Forest lands with some private lands (Figure 48).

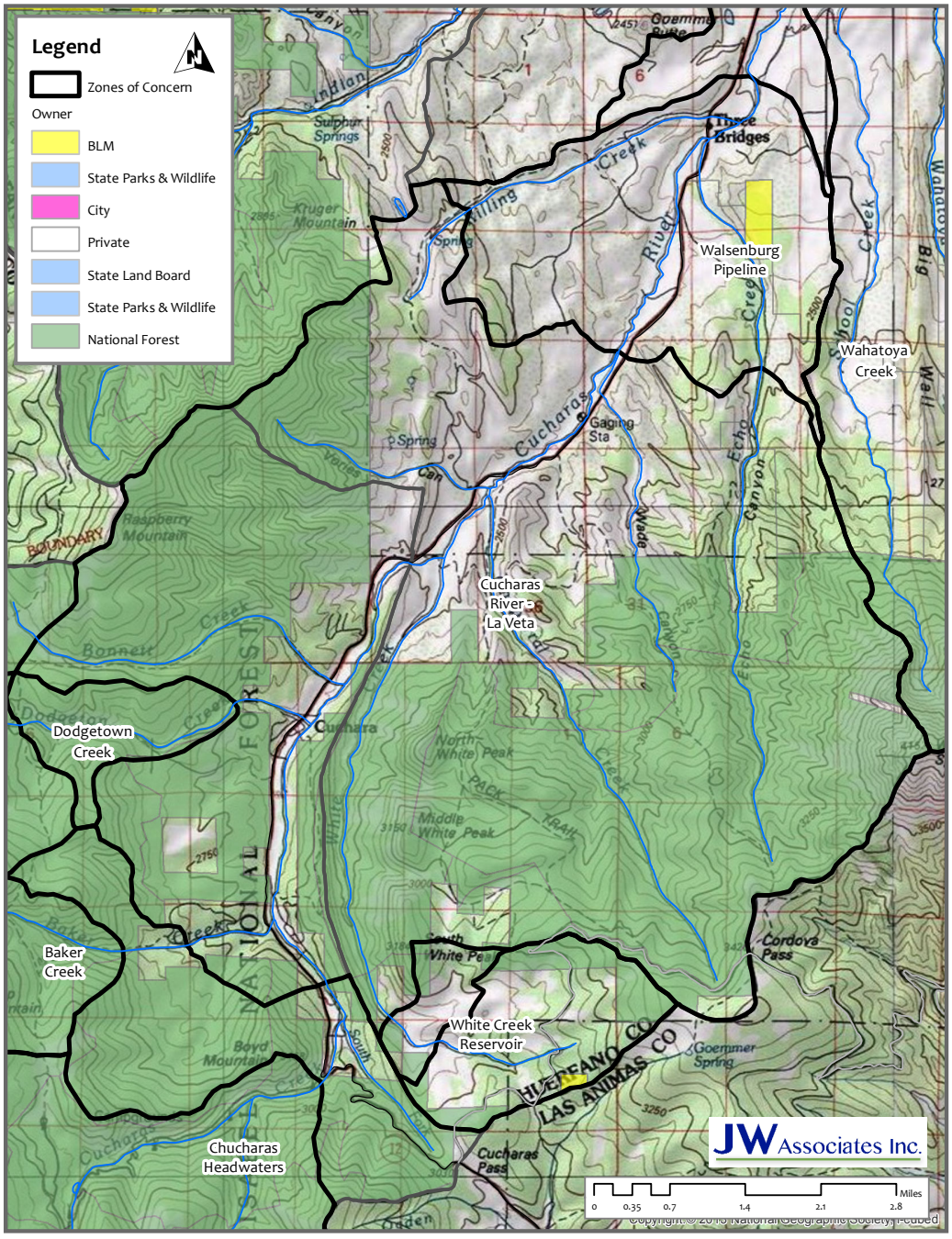

Figure 48. Cucharas River-La Veta ZoC Ownership

Cucharas River-La Veta ZoC Watershed Priority

The Cucharas River-La Veta ZoC is mostly within the Echo Creek-Cucharas River watershed with some of the upper portions of the ZoC within the Headwaters Cucharas River watershed (Figure 49). Both watersheds are ranked Red (Category 5 - Highest) overall. The Echo Creek-Cucharas River watershed is also ranked Red (Category 5 - Highest) for Flooding/Debris Flow Hazard and Composite Hazard. The Headwaters Cucharas River watershed is also ranked Red (Category 5 - Highest) for Wildfire Hazard and Composite Hazard.

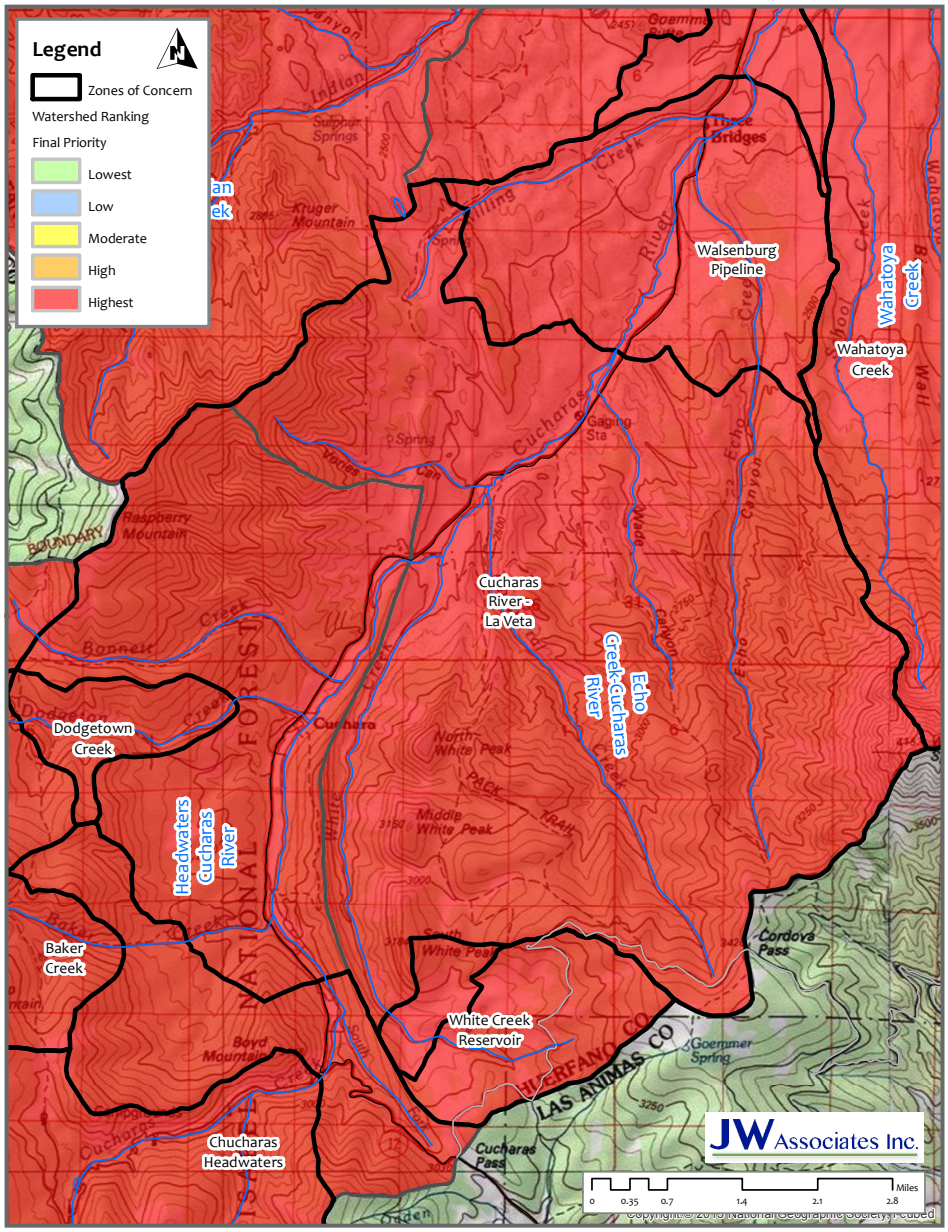

Figure 49. Cucharas River-La Veta ZoC Watershed Priority

Cucharas River-La Veta ZoC Slopes

The Cucharas River-La Veta ZoC has some large areas of relatively shallow slopes with some areas of steep slopes in portions of the ZoC (Figure 50).

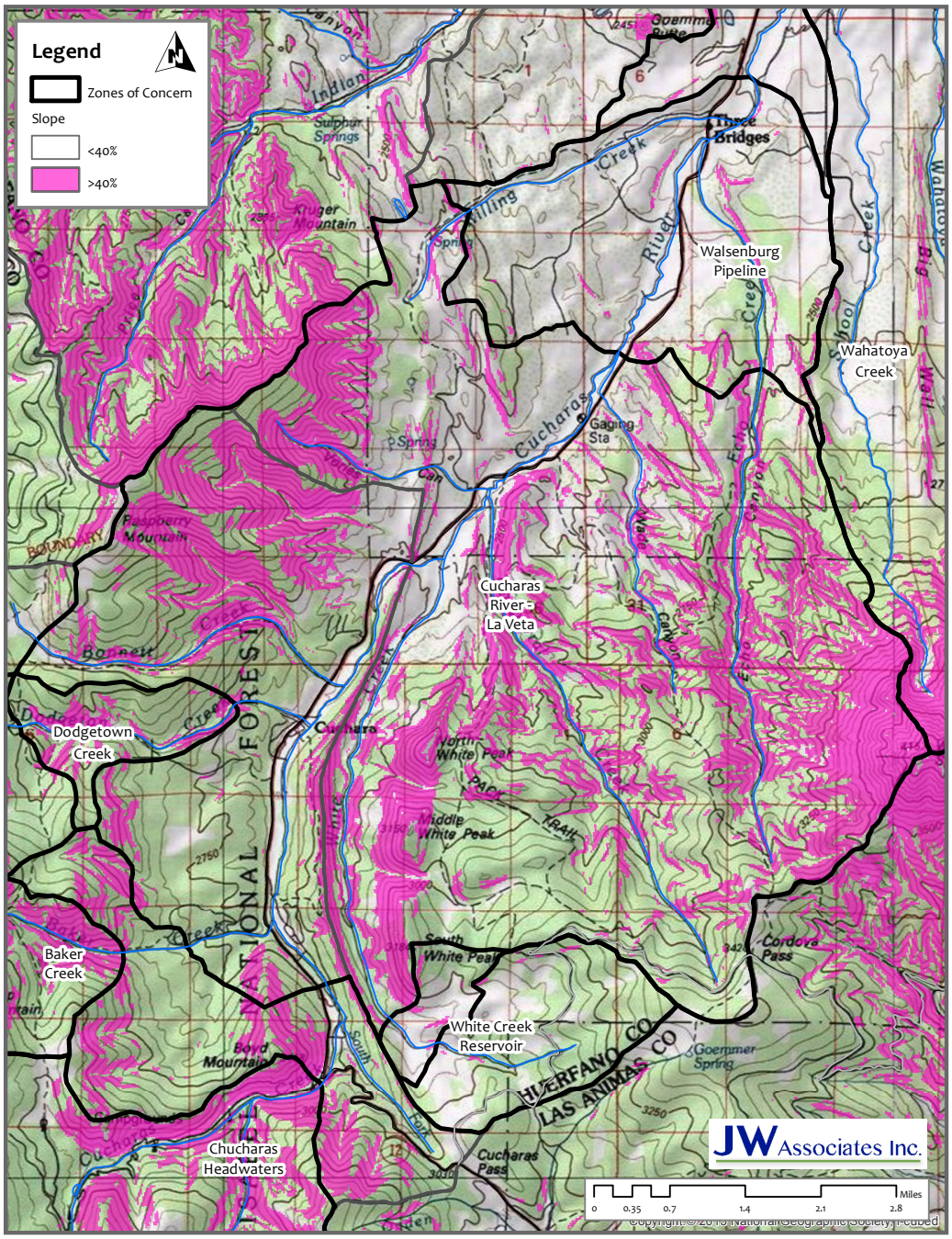

Figure 50. Cucharas River-La Veta ZoC Slope

Cucharas River-La Veta ZoC Special Management Areas

The Spanish Peaks Wilderness Area covers a large area in the Cucharas River-La Veta ZoC (Figure 51). The Spanish Peaks Roadless Area basically surrounds the Spanish Peaks Wilderness Area including one area that has Upper Tier designation. The Cuchara North and South Roadless Areas cover a large portion of the ZoC west of the Cucharas River (Figure 51).

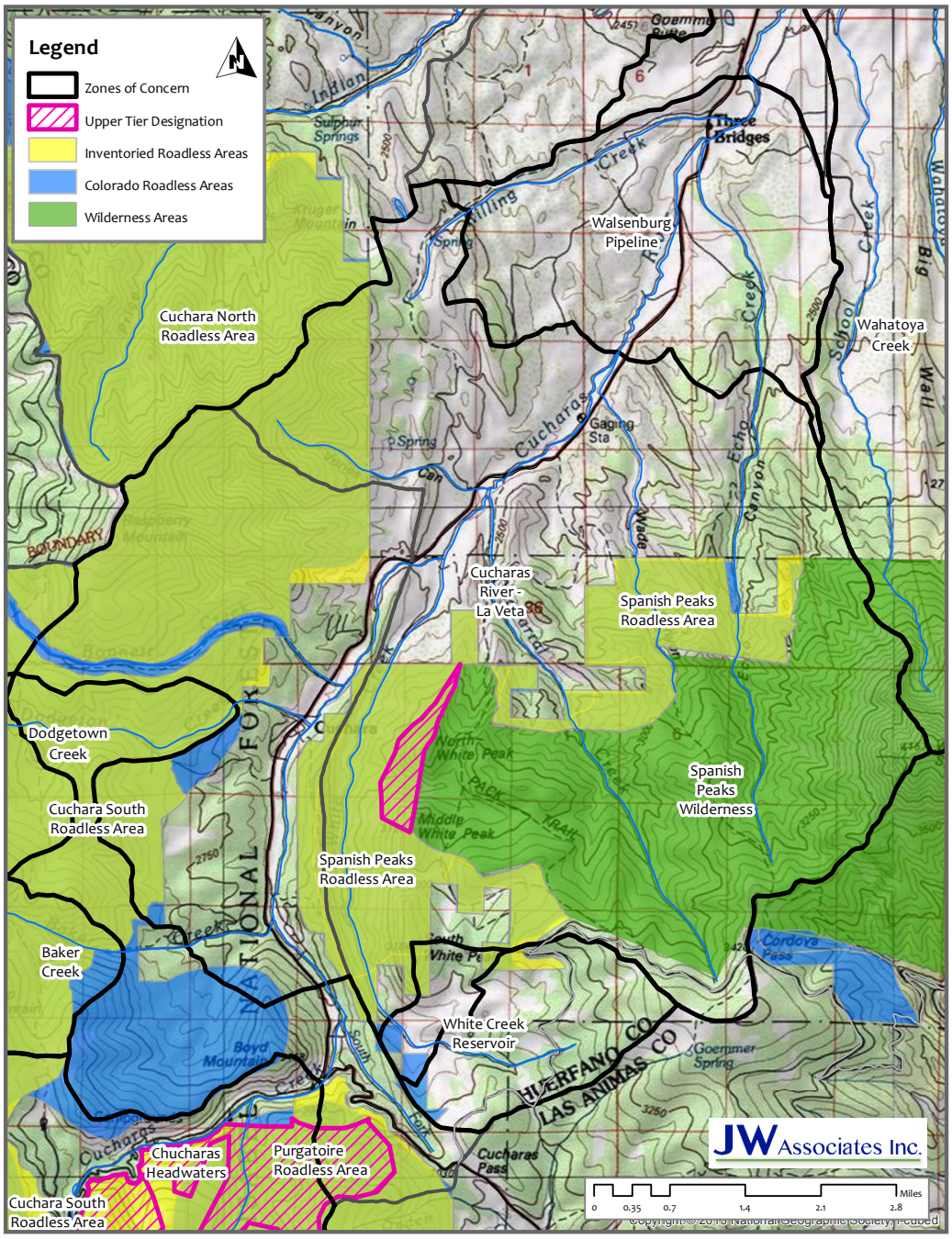

Figure 51. Cucharas River-La Veta ZoC Special Areas

Cucharas River-La Veta ZoC Vegetation

The lowest portion of the Cucharas River-La Veta ZoC is dominated by Gambel oak (Figure 52). There is a small transition area of ponderosa pine mixed with aspen and Douglas-fir and some small areas of pinyon-juniper. The majority of this ZoC are covered with mixed conifer and aspen with some spruce-fir at the highest elevations (Figure 52).

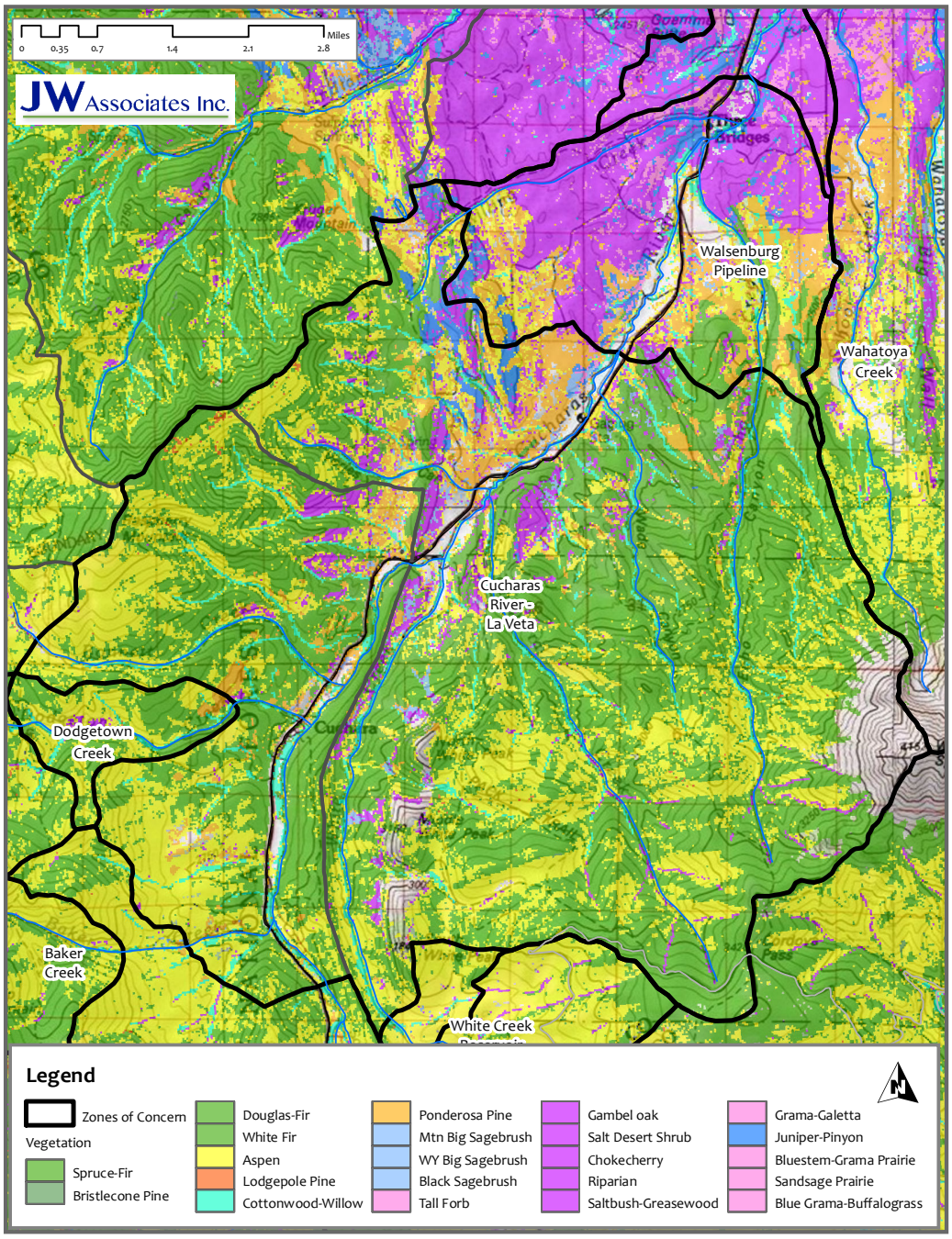

Figure 52. Cucharas River-La Veta ZoC Vegetation

Cucharas River-La Veta ZoC Access

The Cucharas River-La Veta ZoC has some existing road access and it is likely that there are more roads than those shown on Figure 53. However, large areas that are within wilderness and roadless areas have no access. There are also some large areas outside of wilderness and roadless that lack access. One example is the area between Highway 12 and Echo Canyon Road.

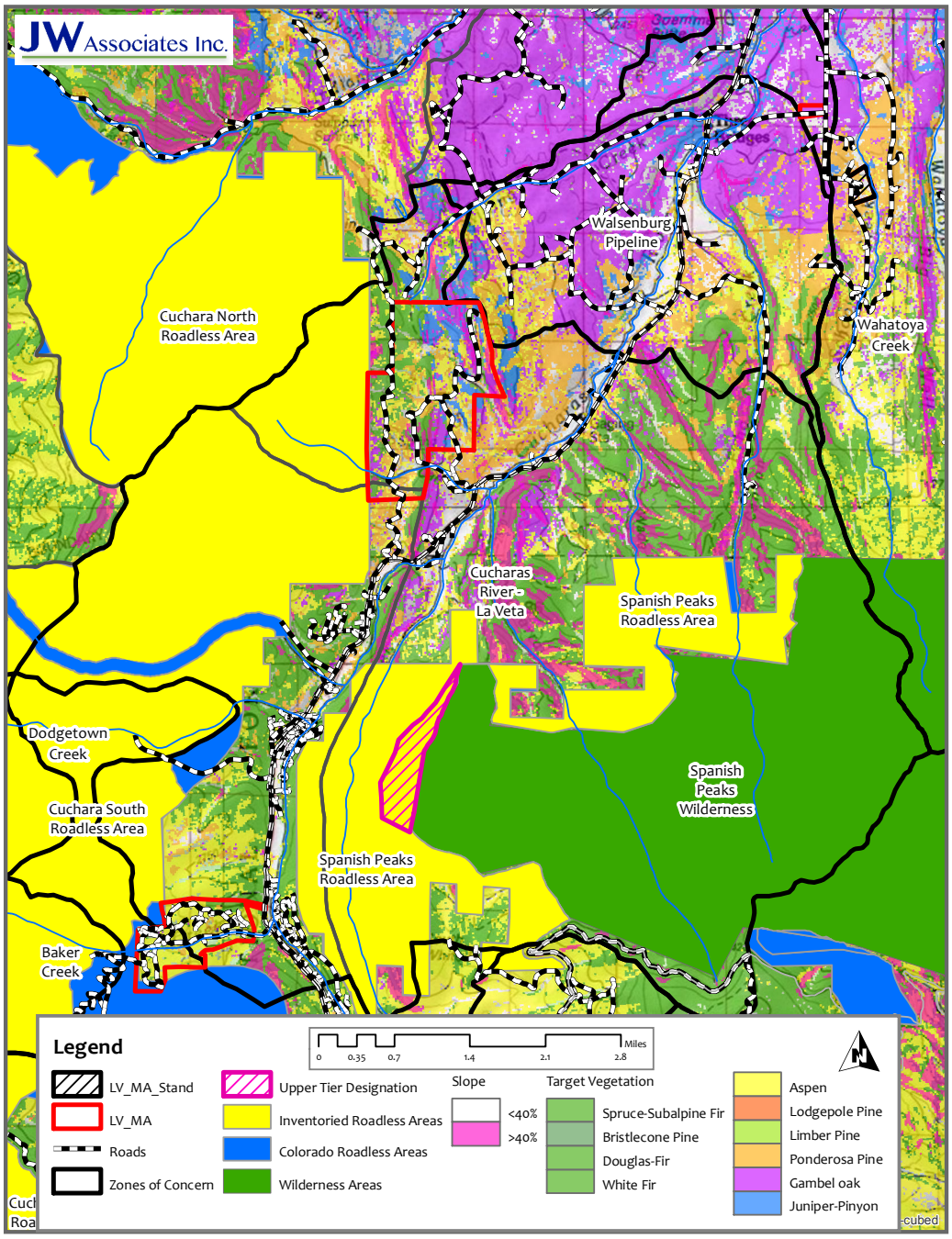

Figure 53. Cucharas River-La Veta ZoC Opportunities

Cucharas River-La Veta ZoC Opportunities

The Cucharas River-La Veta has several areas that present treatment opportunities. However, potential treatments in this ZoC are substantially limited by the presence of the Spanish Peaks Wilderness Area, several roadless areas and lack of existing road access (Figure 53). There are two Colorado State Forest Service managed areas in this ZoC. These areas appear to be in good locations for watershed protection treatments. The managed areas should be examined to determine if additional treatments could be completed. The La Veta Fire Protection District has a number of WUI projects identified in this ZoC. Those projects should be evaluated to determine if they could be used as watershed protection or additional project implemented adjacent to them.

In addition to the opportunities identified above, there are a number of opportunities throughout this ZoC including;

1. Highway 12 corridor and private developments close to the highway
2. Echo Canyon Road should be examined to determine if fuels breaks could be implemented along the road.
3. Road 364 (located near the ridge above the Spanish Peaks Wilderness) should be examined to determine if fuels breaks could be implemented along the road.
4. The road coming from the southeast into lower Dodgetown Creek should be examined to determine if fuels breaks could be implemented along the road.

The treatments in these areas could include;

1. Restoration of dense ponderosa pine and Douglas-fir stands through thinning and created openings.
2. Removal of conifers from aspen stands
3. Enhancement of aspen stands by cutting them to regenerate new stands through suckering
4. Restoration of mixed conifer stands where they are overly dense through thinning and selective cutting
5. Creation of fuel breaks along existing roads

The actual target areas would need to be defined on the ground and the treatments proposed for each area would require collaboration planning as it would likely include both private and public lands. The roadless areas should be examined to determine if a case could be made for watershed protection projects. That assessment would need to include a discussion about the direction of the roadless policy within the US Forest Service to determine if those potential treatments would be possible to implement.

The water providers should work with the US Forest Service to develop an information and education plan to inform hikers, mountain bikers, and other visitors to the wilderness and roadless areas about the importance of the area's watersheds and the danger of wildfire to water quality. They should also work with the US Forest Service to develop and implement fire management plans that could allow natural fires of lower intensities to burn within these watersheds to create greater diversity and reduce fuels.

White Creek Reservoir ZoC

This section discusses the White Creek Reservoir ZoC (Figure 54). The White Creek Reservoir ZoC overlaps the Cucharas River-La Veta ZoC, which is discussed in previous section. Note that the ZoC are shown here in blue shading, but in the remaining figures the outlines appear as bold black lines with no shading.

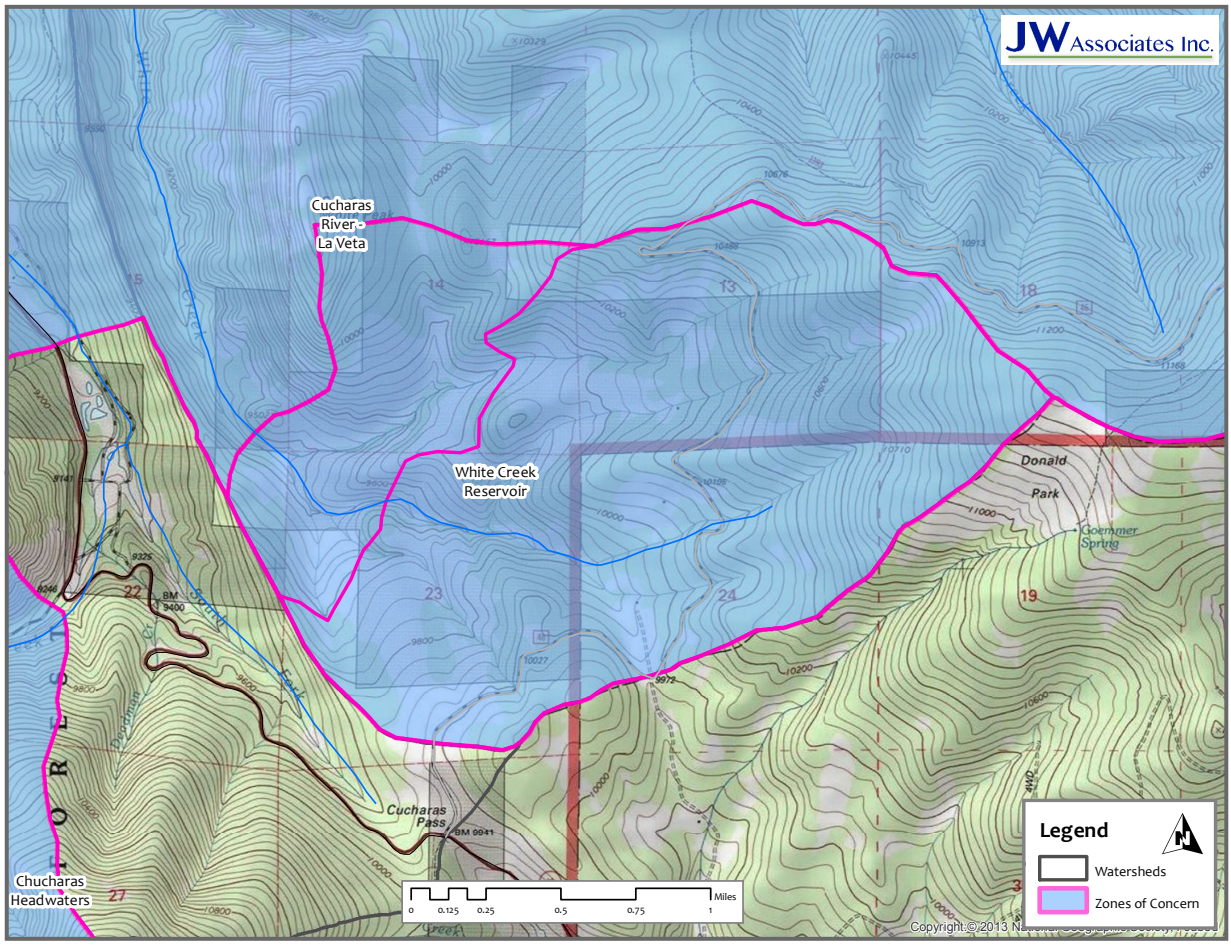

Figure 54. White Creek Reservoir ZoC Location

White Creek Reservoir ZoC Ownership

The majority of the White Creek Reservoir ZoC is private lands (Figure 55). There are some National Forest lands within this ZoC as well as a small piece of BLM land.

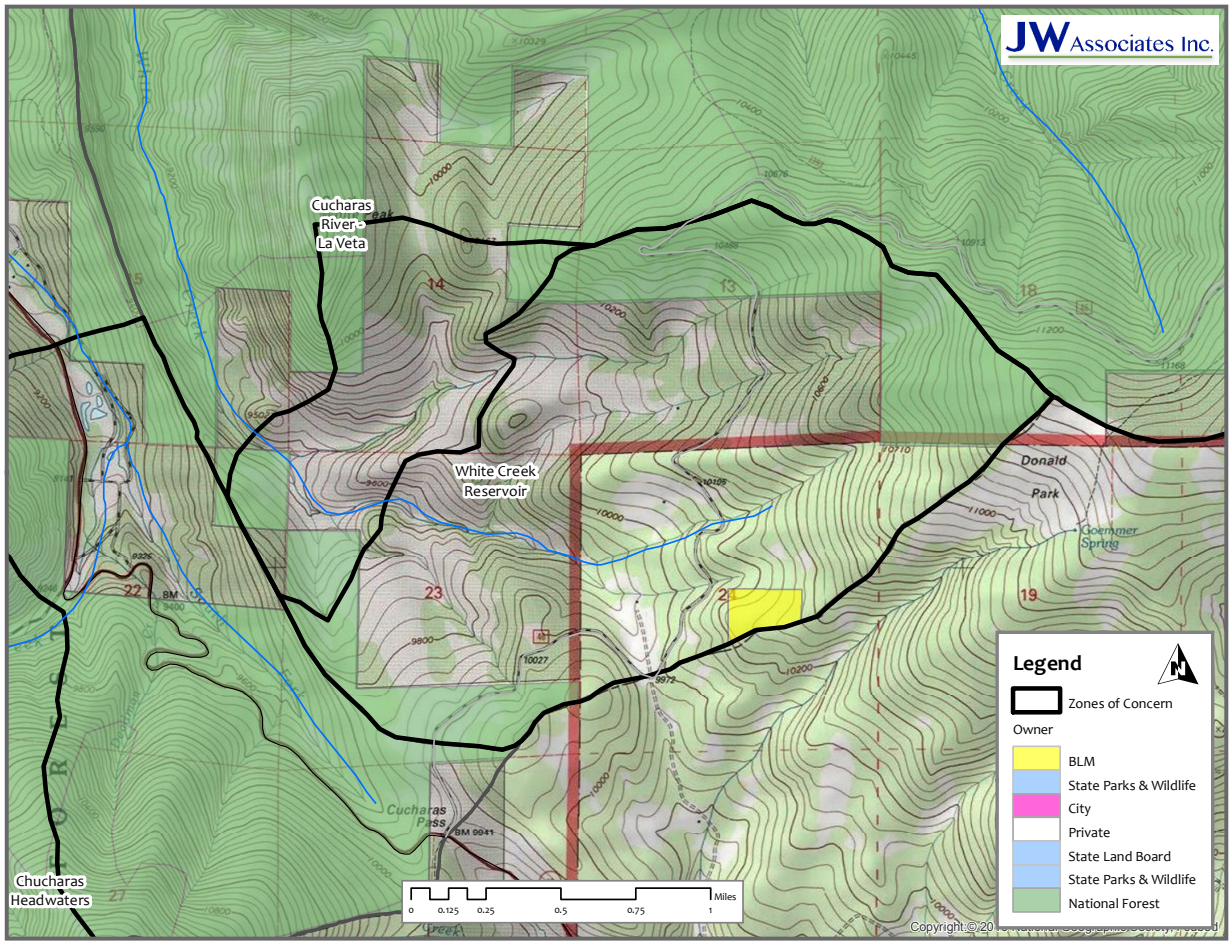

Figure 55. White Creek Reservoir ZoC Ownership

White Creek Reservoir ZoC Watershed Priority

The White Creek Reservoir ZoC is in the Echo Creek-Cucharas River watershed that is ranked Red (Category 5 - Highest) overall (Figure 56). The Echo Creek-Cucharas River watershed is also ranked Red (Category 5 - Highest) for Flooding/Debris Flow Hazard and Composite Hazard.

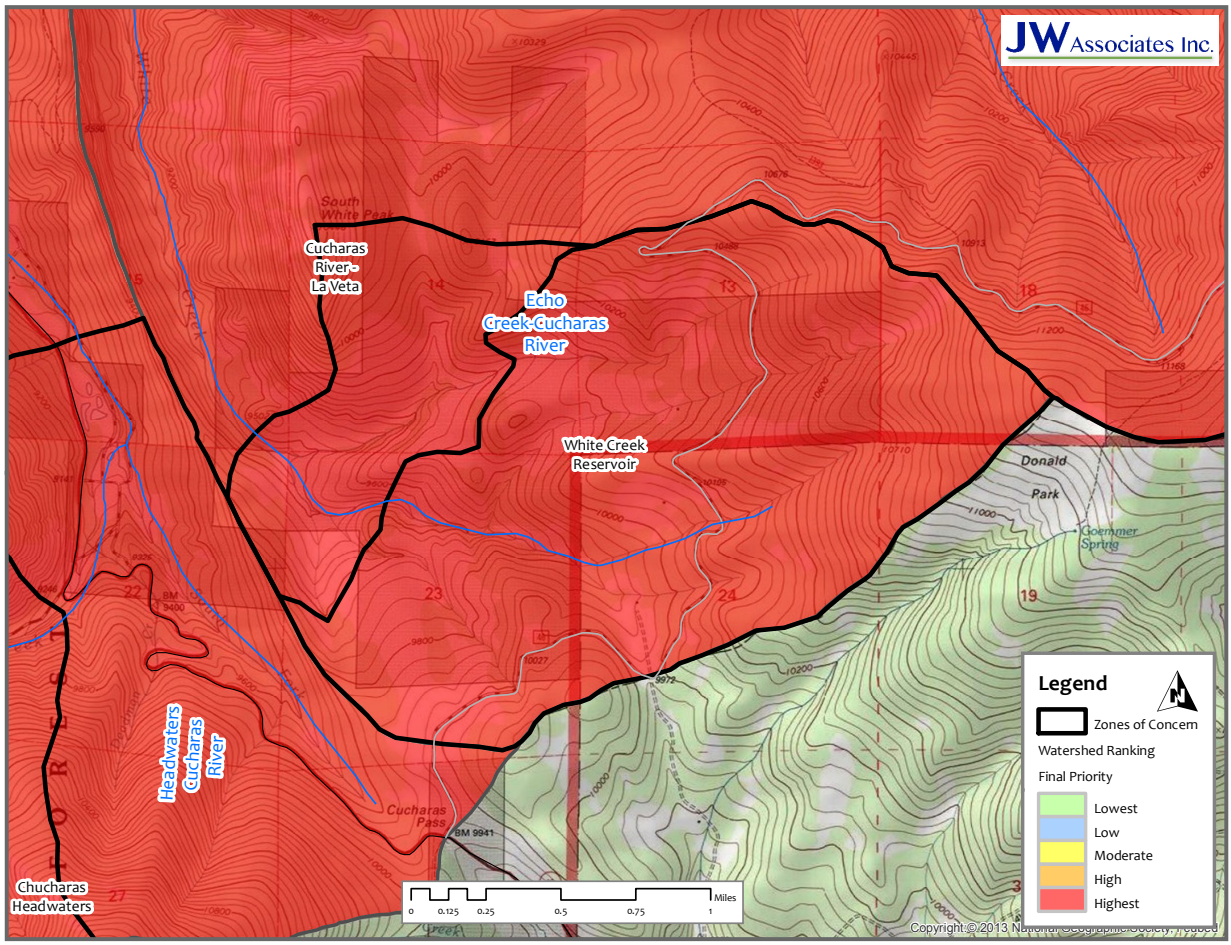

Figure 56. White Creek Reservoir ZoC Watershed Priority

White Creek Reservoir ZoC Slopes

The White Creek Reservoir ZoC has mostly relatively shallow slopes with some small areas of steep slopes (Figure 57).

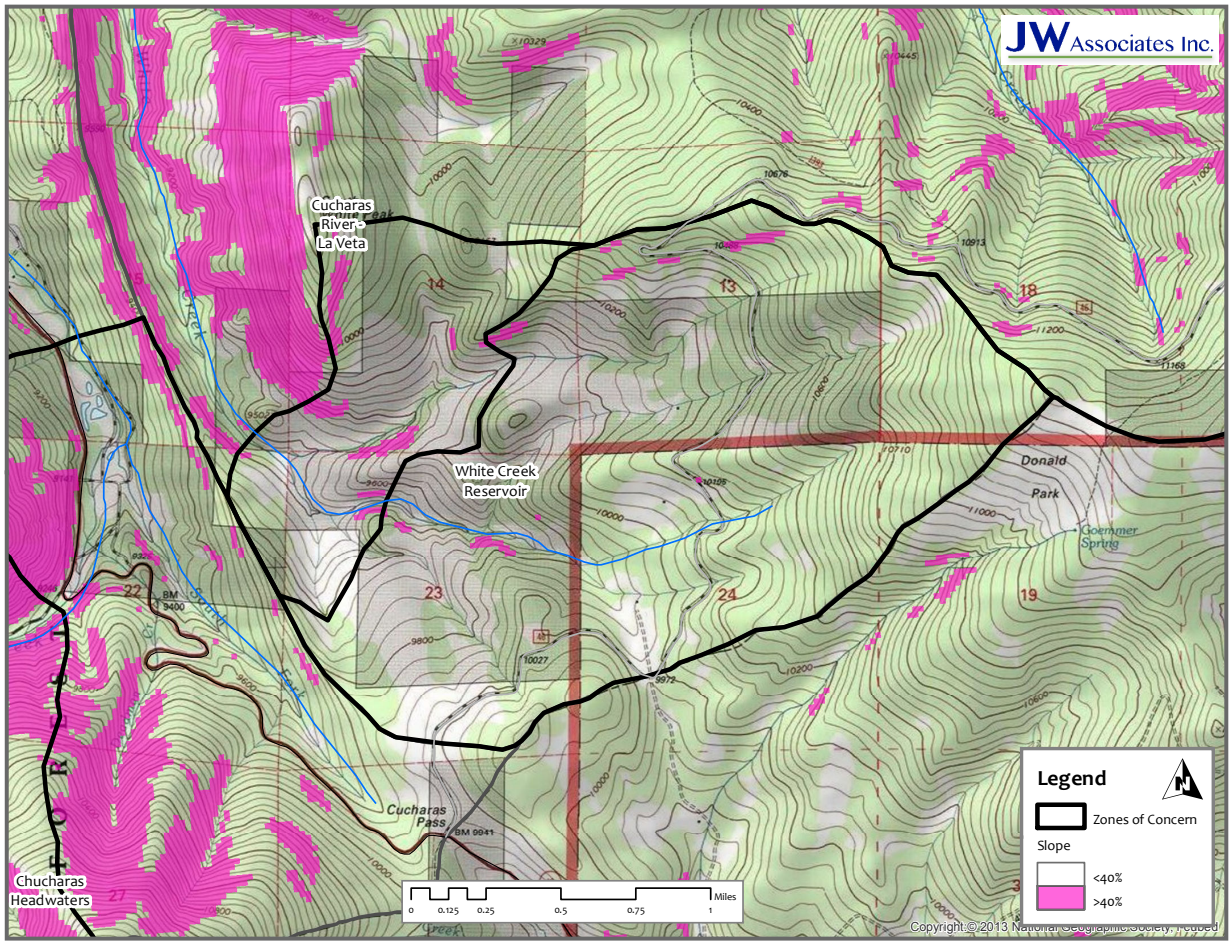

Figure 57. White Creek Reservoir ZoC Slope

White Creek Reservoir ZoC Special Management Areas

There are no wilderness areas in the White Creek Reservoir ZoC (Figure 58). The Spanish Peaks Roadless Area covers some small areas in this ZoC. There are no Upper Tier designations for roadless areas in this ZoC.

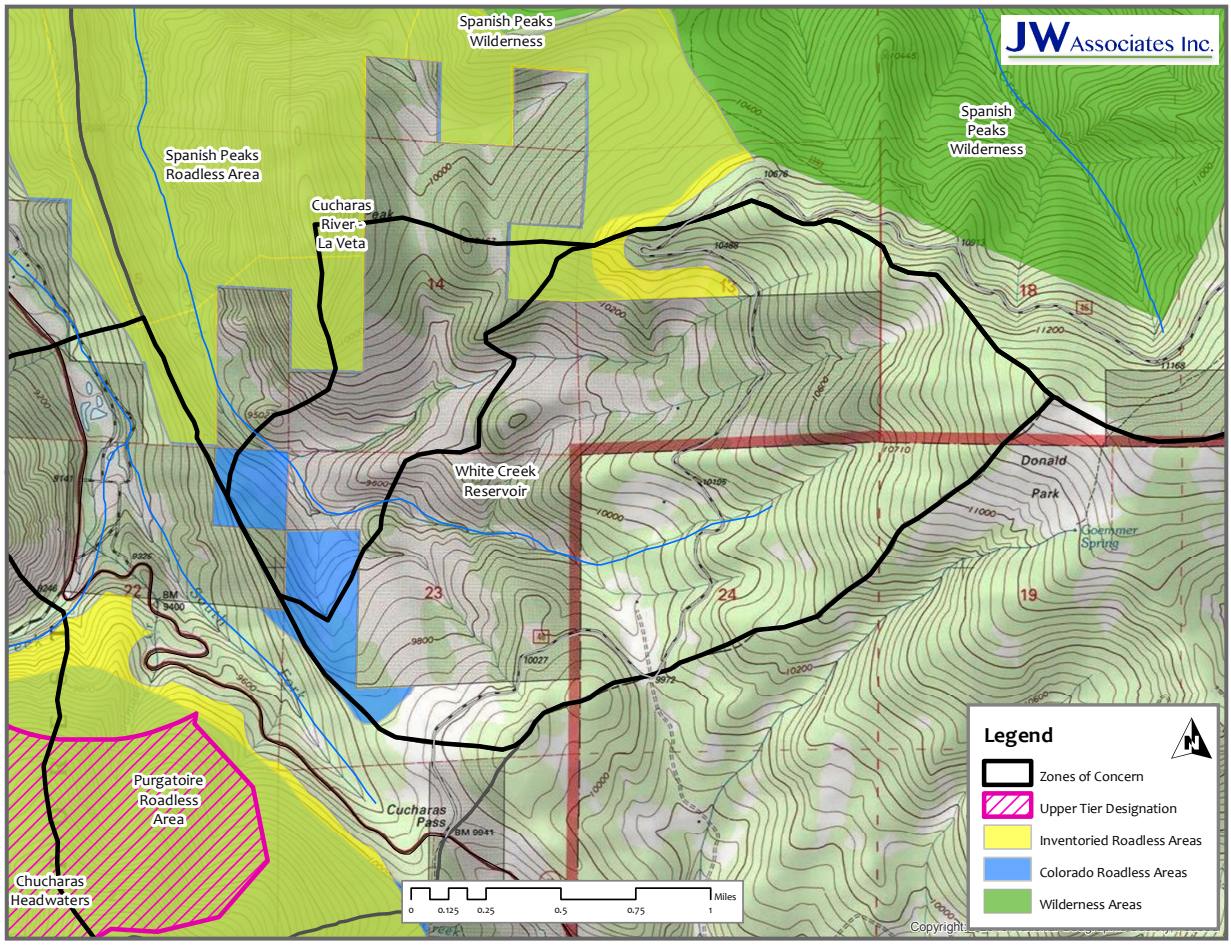

Figure 58. White Creek Reservoir ZoC Special Areas

White Creek Reservoir ZoC Vegetation

The White Creek Reservoir ZoC is mostly donated by aspen (Figure 59) with some mixed conifer scattered throughout. The highest elevations transition to spruce-fir.

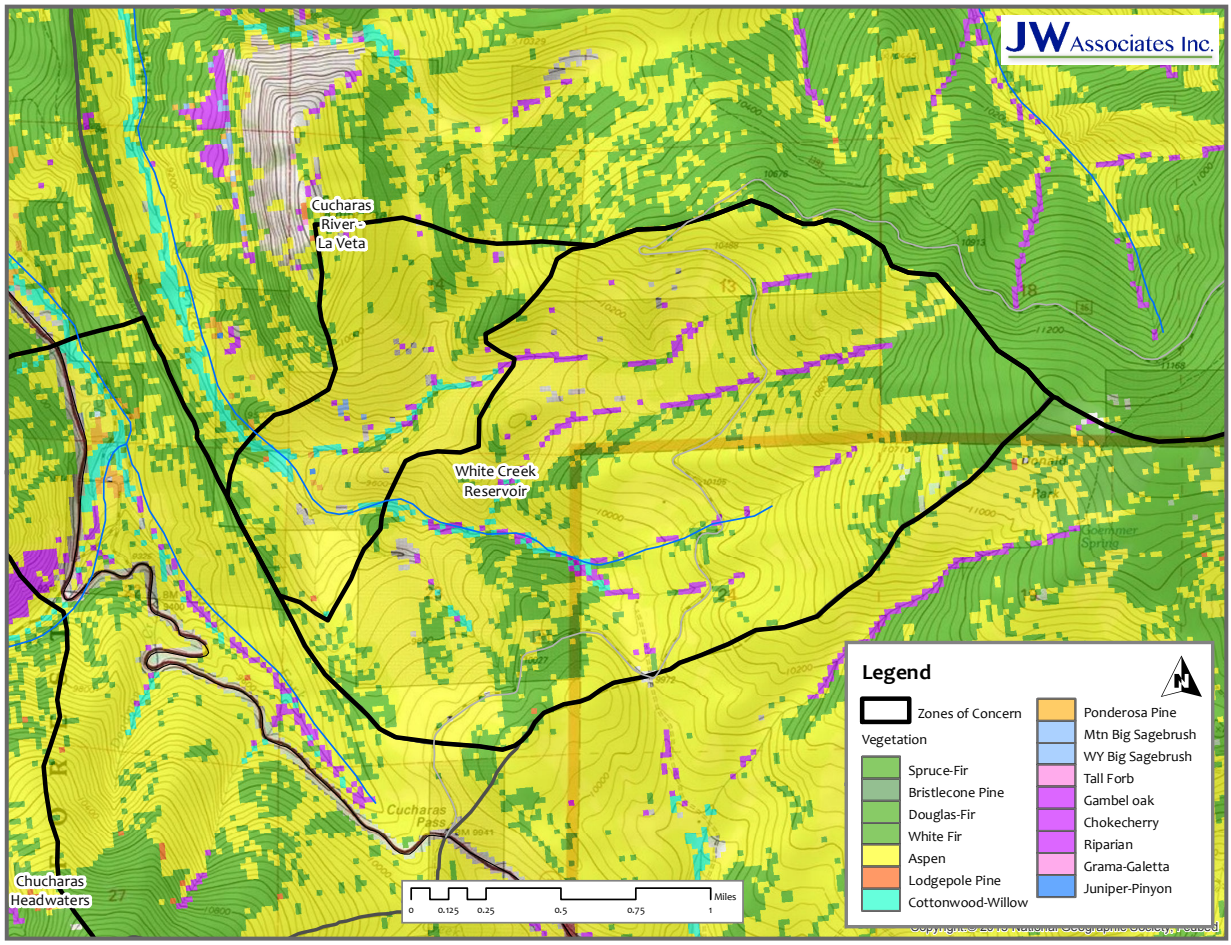

Figure 59. White Creek Reservoir ZoC Vegetation

White Creek Reservoir ZoC Access

The White Creek Reservoir ZoC has several existing road that provide access to many of the higher elevation forested areas Figure 60. The lower portions of the White Creek Reservoir ZoC appears to lack existing road access.

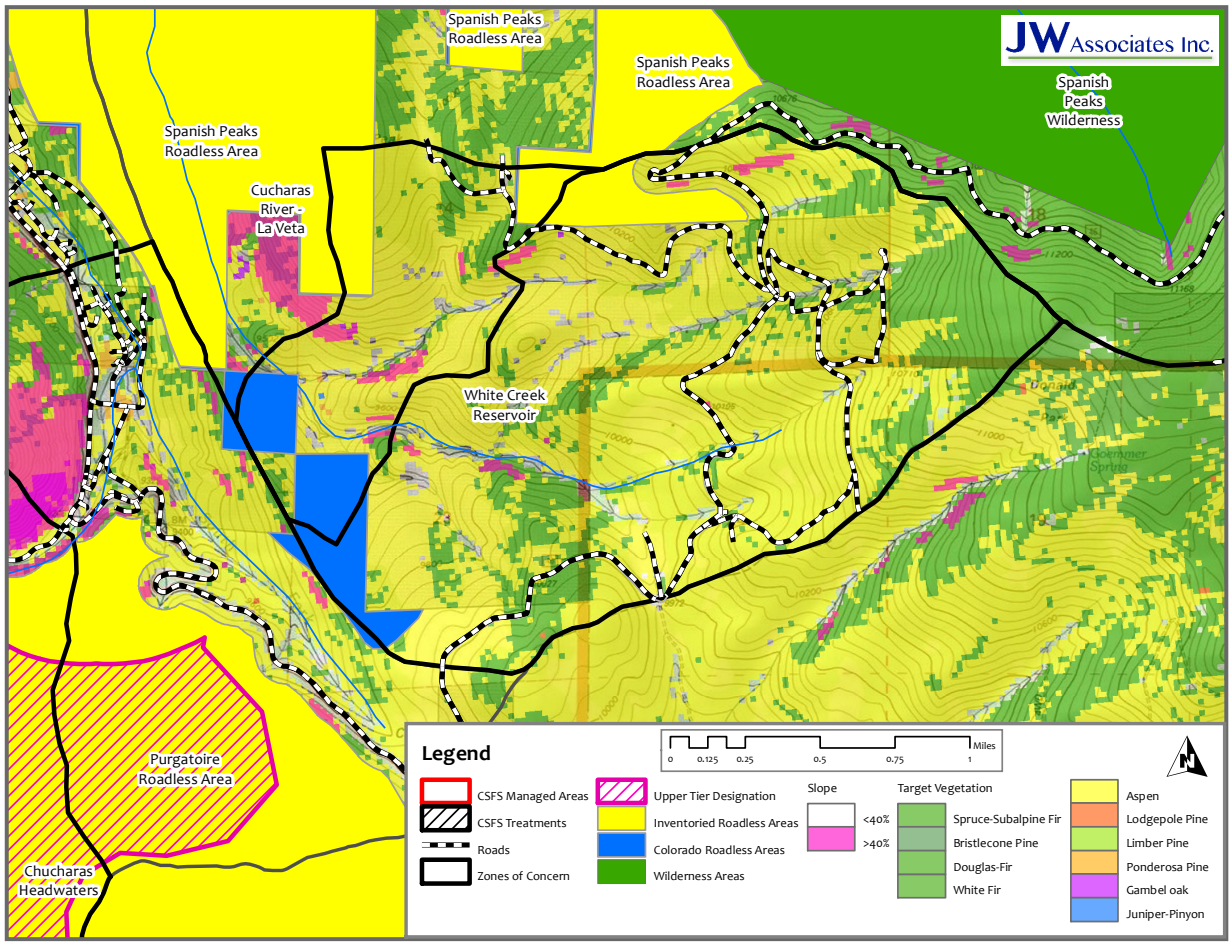

Figure 60. White Creek Reservoir ZoC Opportunities

White Creek Reservoir ZoC Opportunities

The White Creek Reservoir ZoC has some good treatment opportunities. The existing road that runs through the upper ZoC appears to be a good place to create fuels breaks on both sides of the road (Figure 60). There might also be some broader scale treatments within that area in addition to the fuel breaks. It is likely that there would be some opportunities for removing conifers that are encroaching into aspen stands, as well as enhancing or regenerating existing aspen stands.

Dodgetown and Baker Creek ZoC

The Dodgetown and Baker Creek ZoC are combined in this discussion (Figure 61). The Dodgetown Creek ZoC overlaps the Cucharas River-La Veta ZoC that is discussed in another section above. Note that the ZoC are shown here in blue shading, but in the remaining figures the outlines appear as bold black lines with no shading.

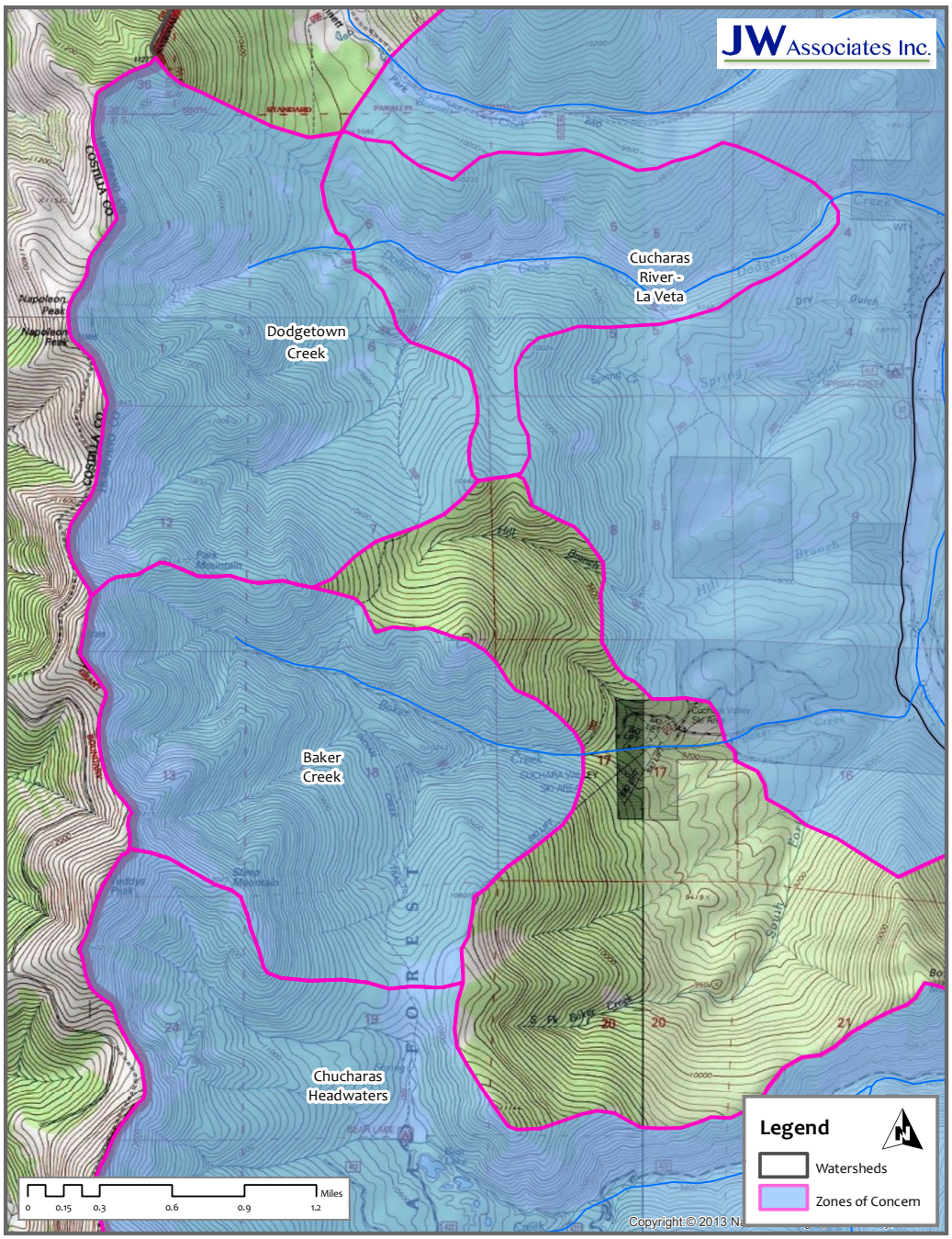

Figure 61. Dodgetown and Baker Creek ZoC Location

Dodgetown and Baker Creek Ownership

The Dodgetown and Baker Creek ZoC are entirely on National Forest lands (Figure 62).

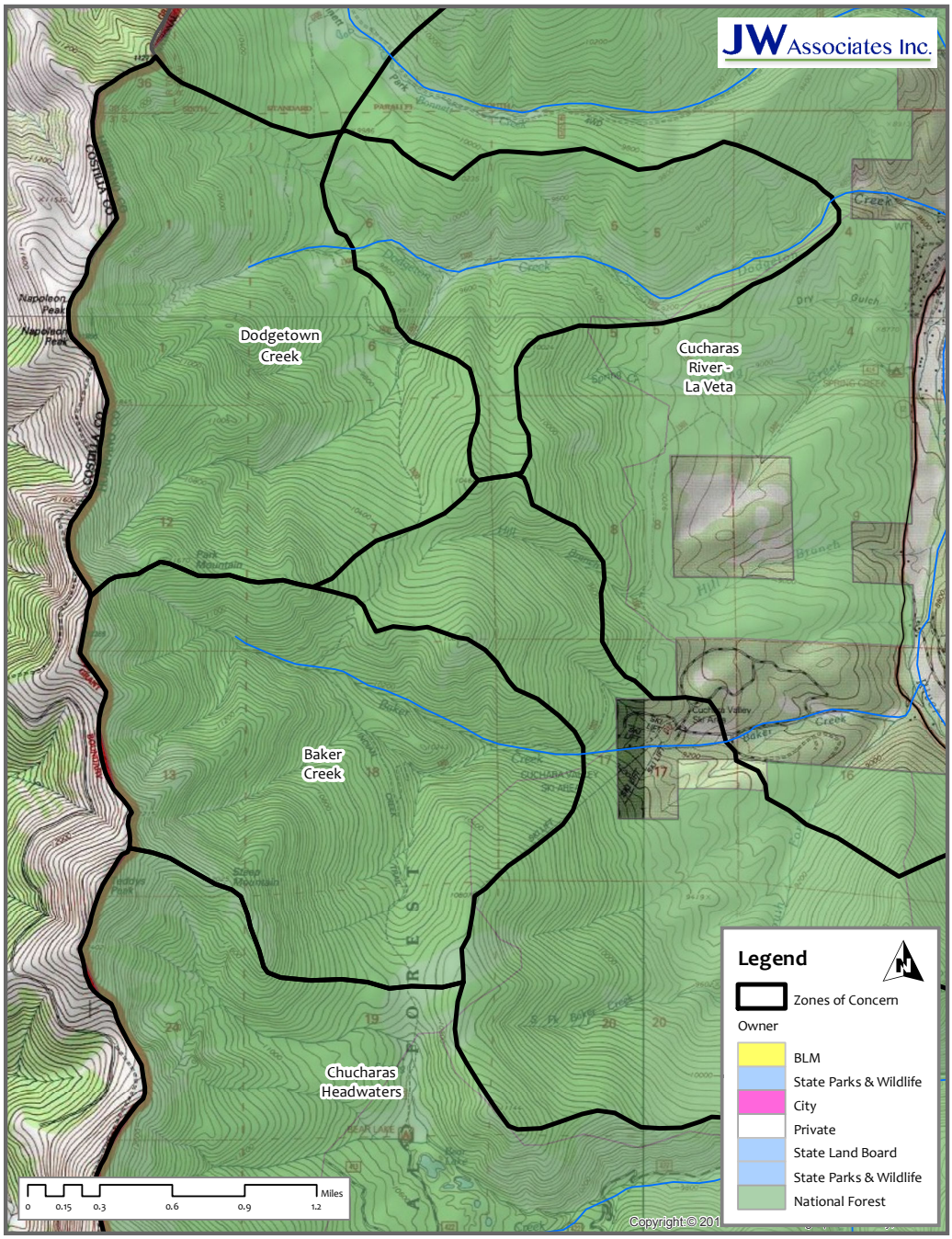

Figure 62. Dodgetown and Baker Creek ZoC Ownership

Dodgetown and Baker Creek Watershed Priority

The Dodgetown and Baker Creek ZoC are both within the Headwaters Cucharas River watershed which is ranked Red (Category 5 - Highest) overall (Figure 63). The Headwaters Cucharas River watershed is also ranked Red (Category 5 - Highest) for Wildfire Hazard and Composite Hazard.

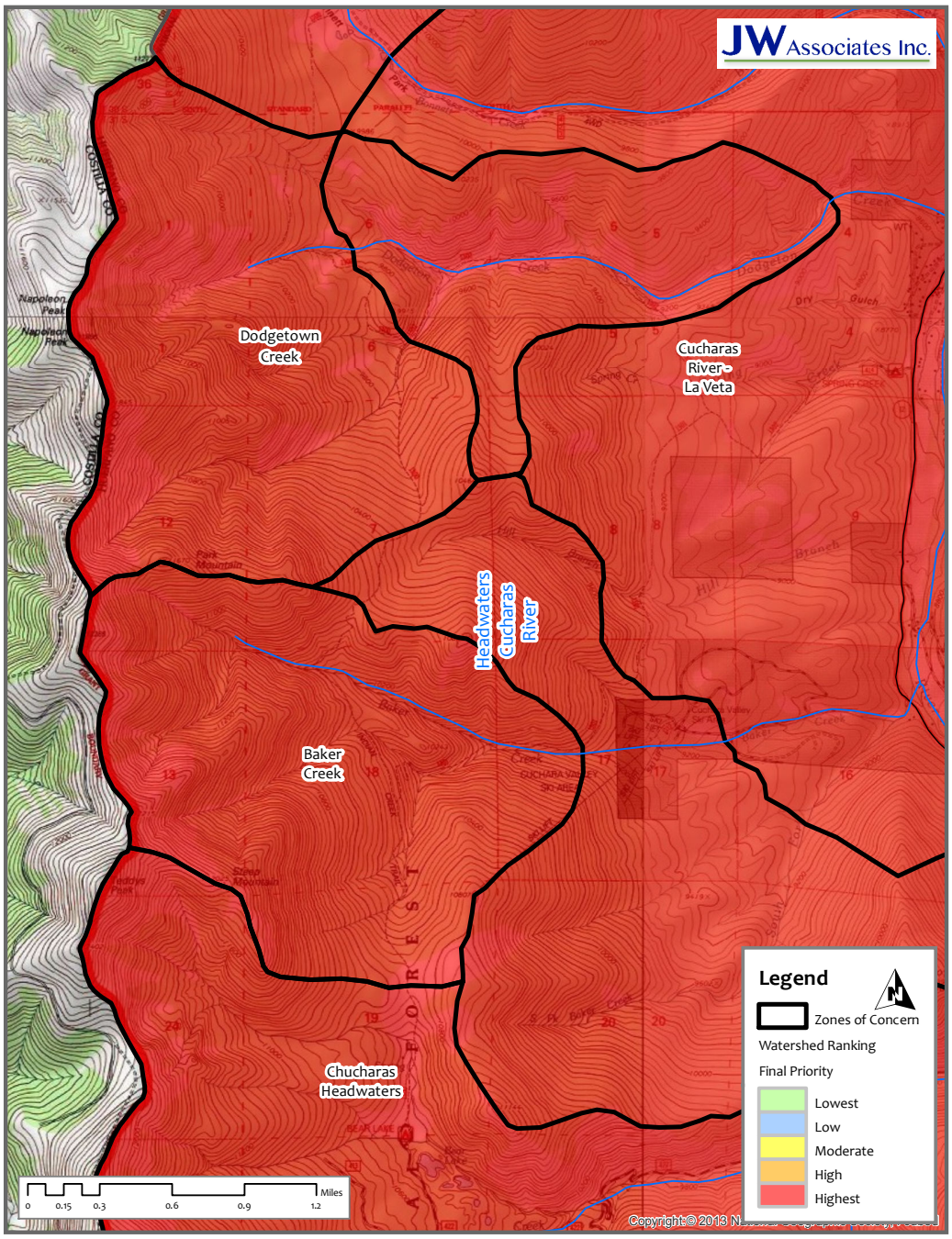

Figure 63. Dodgetown and Baker Creek ZoC Watershed Priority

Dodgetown and Baker Creek Slopes

The Dodgetown Creek ZoC has some large areas of relatively shallow slopes throughout most of the lower ZoC (Figure 64), with some areas along the creek with steep slopes. The higher elevations of the Dodgetown Creek ZoC are dominated by steep slopes. The Baker Creek ZoC is dominated by steep slopes (Figure 64) with an area of relatively shallow slopes in the southeastern portion of the ZoC.

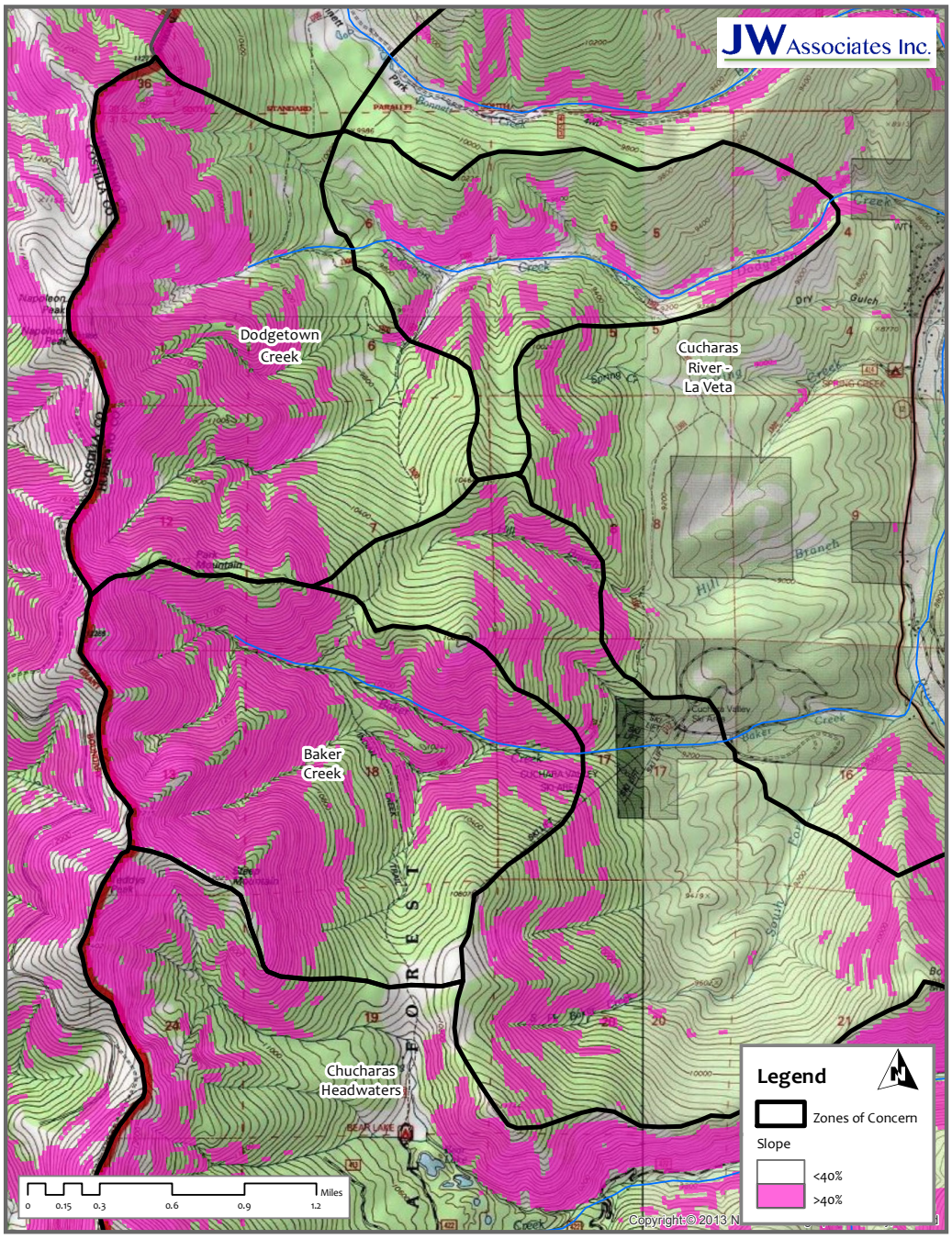

Figure 64. Dodgetown and Baker Creek ZoC Slope

Dodgetown and Baker Creek Special Management Areas

The Dodgetown and Baker Creek ZoC are entirely within the Cuchara South Roadless Area (Figure 65). This roadless area is not designated as Upper Tier.

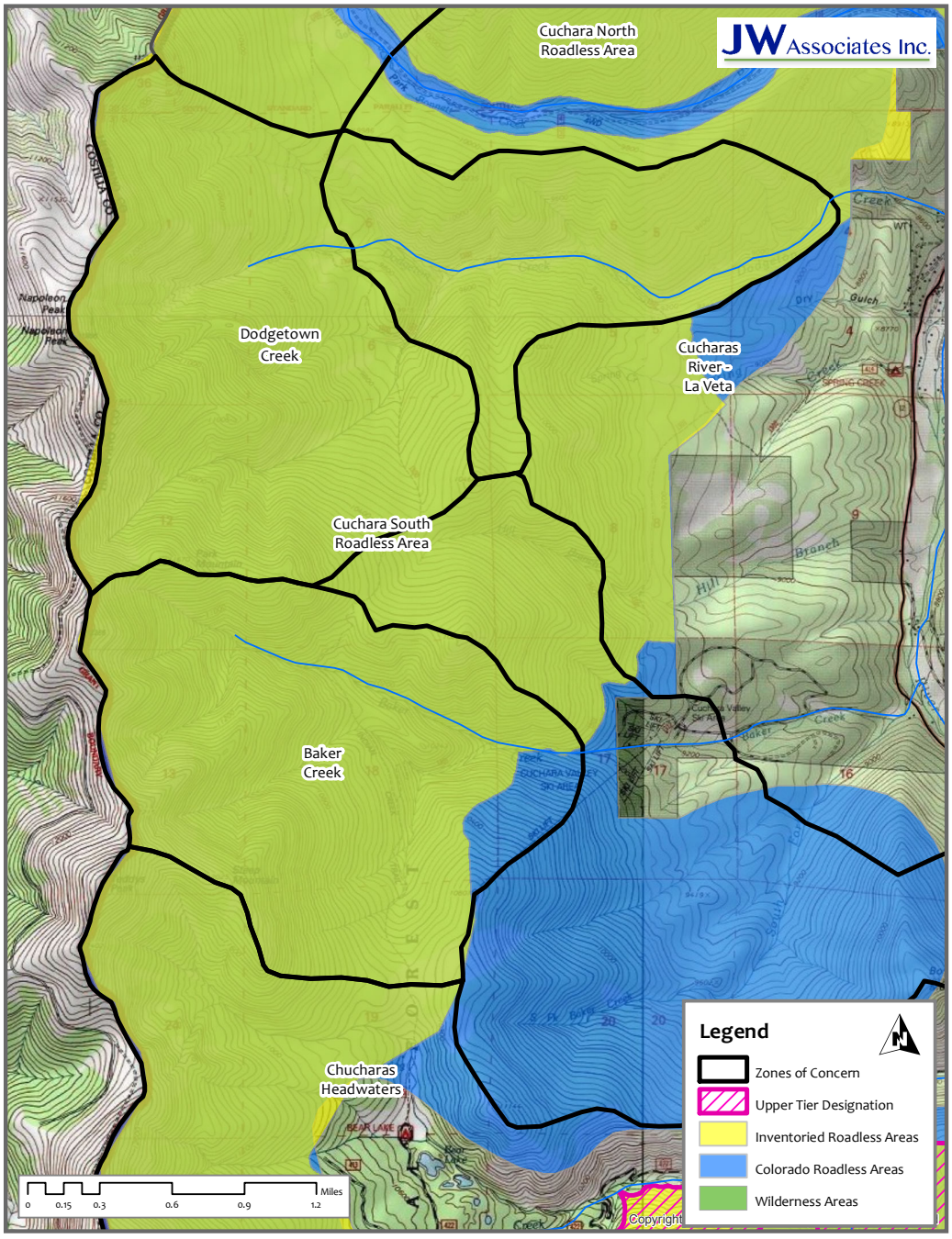

Figure 65. Dodgetown and Baker Creek ZoC Special Areas

Dodgetown and Baker Creek Vegetation

The Dodgetown Creek ZoC has large areas of aspen (Figure 66). The aspen areas are interspersed with mixed conifer at lower elevations and spruce-fir at higher elevations. There are some smaller areas of ponderosa pine near the eastern boundary and some Gambel oak just north of Dodgetown Creek. The Baker Creek ZoC has some large areas of aspen with a smaller component of mixed conifer at lower elevations and a larger component of spruce-fir at higher elevations (Figure 66).

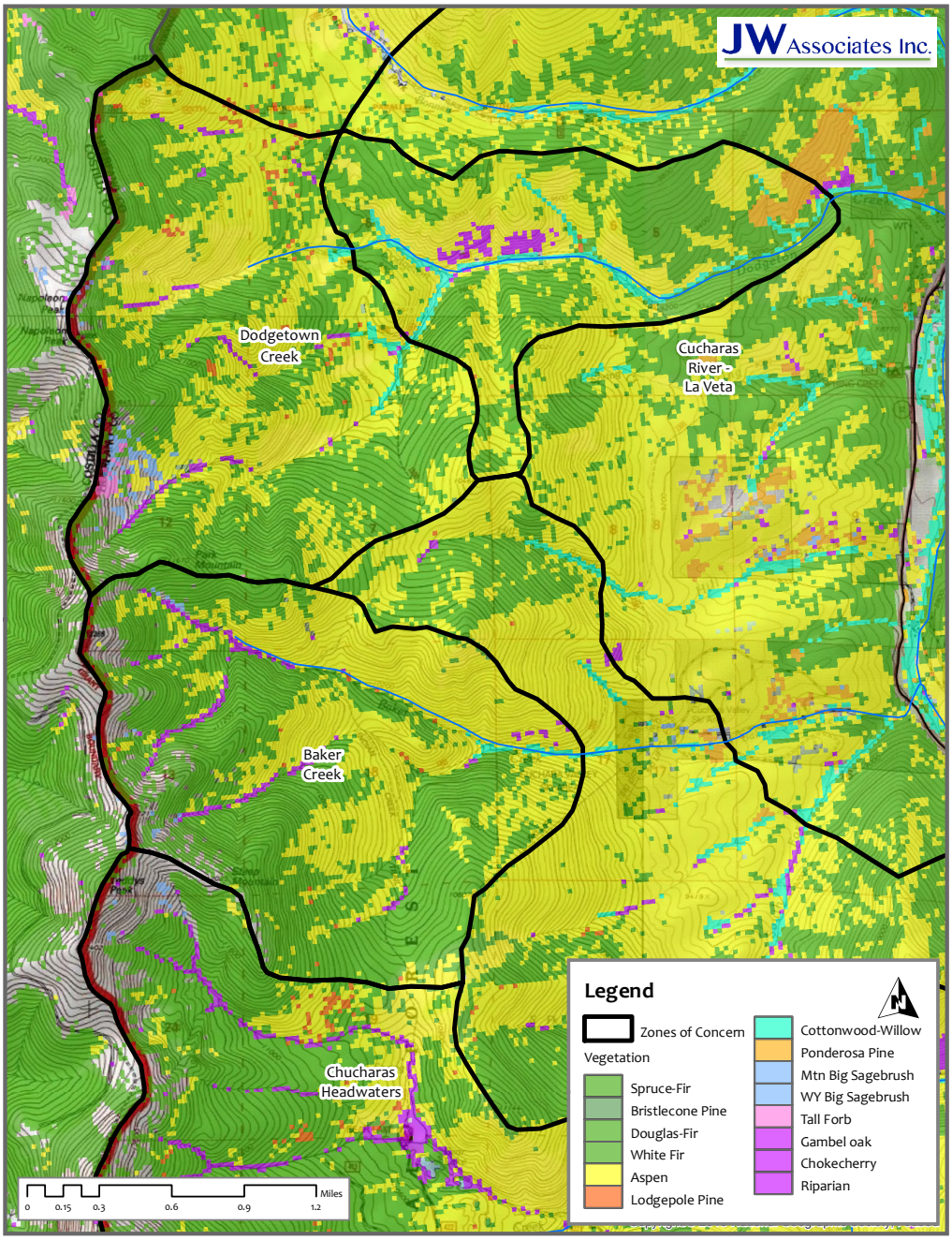

Figure 66. Dodgetown and Baker Creek ZoC Vegetation

Dodgetown and Baker Creek Access

Existing roads only provide access to one small portion of the Dodgetown Creek ZoC (Figure 67). The Baker Creek ZoC also lacks road access except for the lower portion of the ZoC within the Cucharas Ski Area.

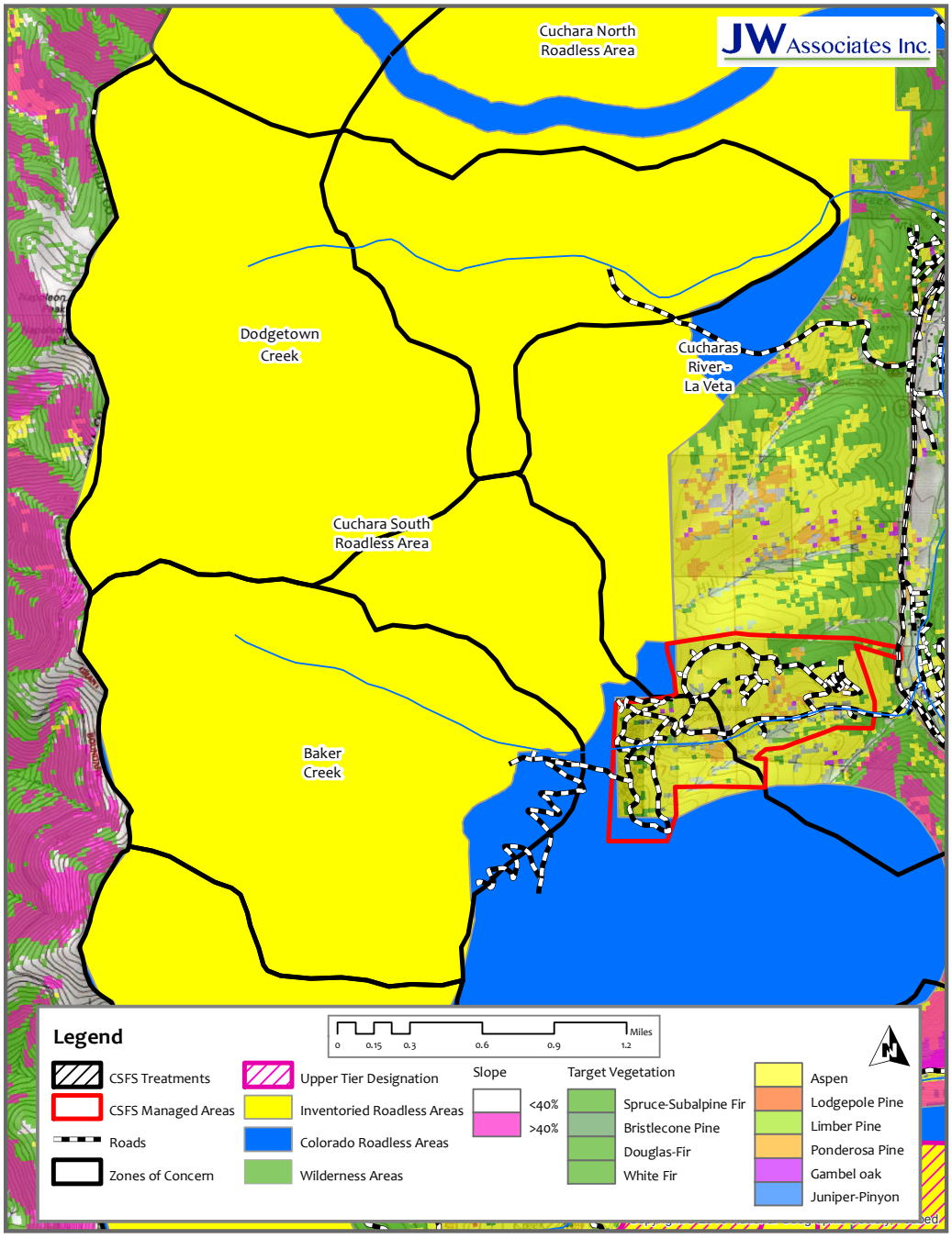

Figure 67. Dodgetown and Baker Creek ZoC Opportunities

Dodgetown and Baker Creek Opportunities

The Dodgetown Creek ZoC appears to have very limited opportunities. The entire ZoC is a within a roadless area and there appears to be only one small road that would provide access to only a small portion of this ZoC (Figure 67). A fuel break along that road would be one potential opportunity but it would not cover a large area. It is possible that fuel reduction treatments could be beneficial just below the ZoC to the east.

The Baker Creek ZoC has very limited opportunities because it is nearly all within a roadless area and does not have access. The area with road access on the eastern portion is within the ski area and the ski runs already provide some good fuelbreaks. There may be an opportunity to provide some protection for this ZoC from fires moving from the east by looking for treatments in the Colorado State Forest Service managed area on private lands below the ZoC.

For these two ZoC, the water providers should develop an information and education plan in conjunction with the US Forest Service to inform hikers, mountain bikers, and other visitors to the roadless areas about the importance of the area's watersheds and the danger of wildfire to water quality. They should also work with the US Forest Service to develop and implement fire management plans that could allow natural fires of lower intensities to burn within these watersheds to create greater diversity and reduce fuels.

Cucharas Headwaters ZoC

This section discusses the Cucharas Headwaters ZoC (Figure 68). Note that the ZoC are shown here in blue shading, but in the remaining figures the outlines appear as bold black lines with no shading.

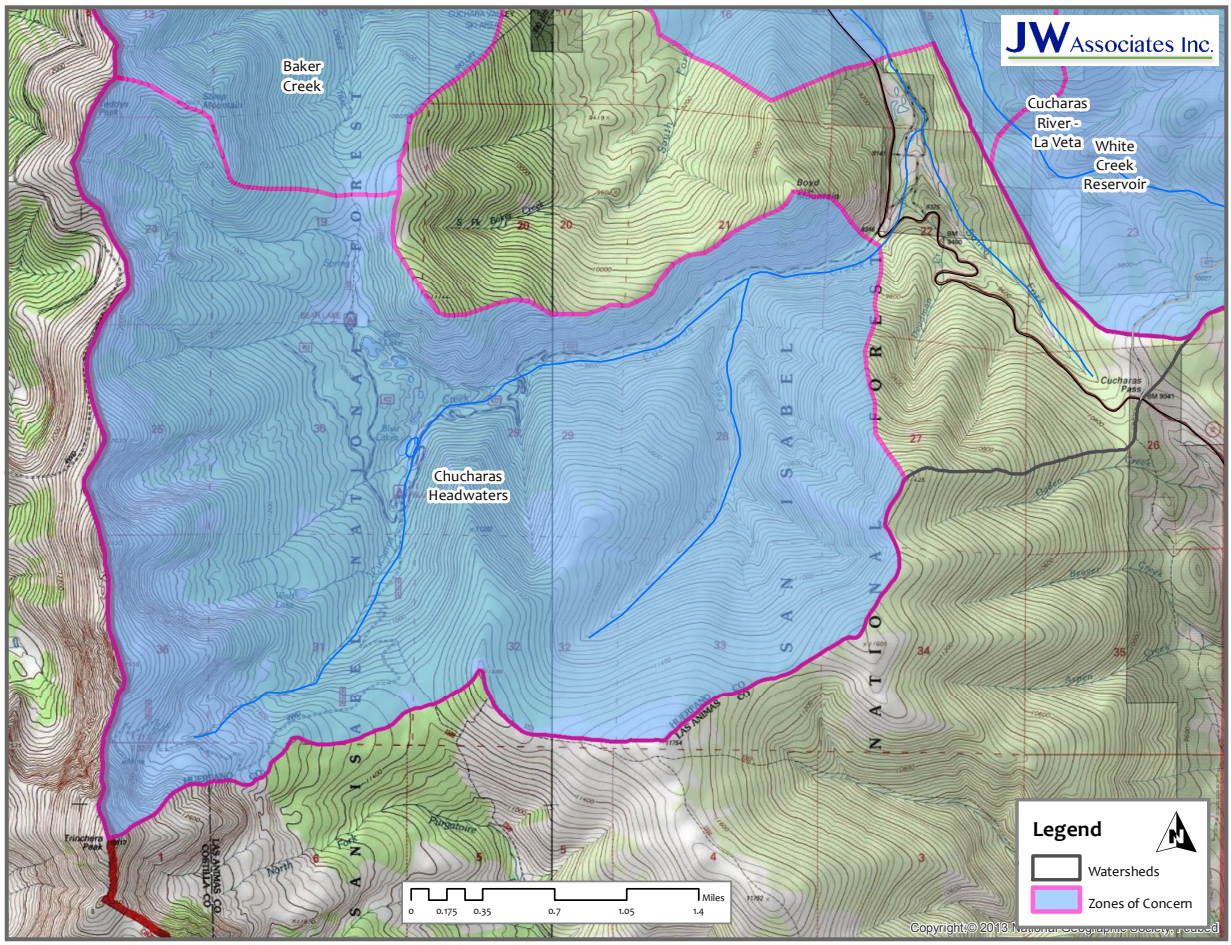

Figure 68. Cucharas Headwaters ZoC Location

Cucharas Headwaters Ownership

The Cucharas Headwaters ZoC is entirely on National Forest lands (Figure 69).

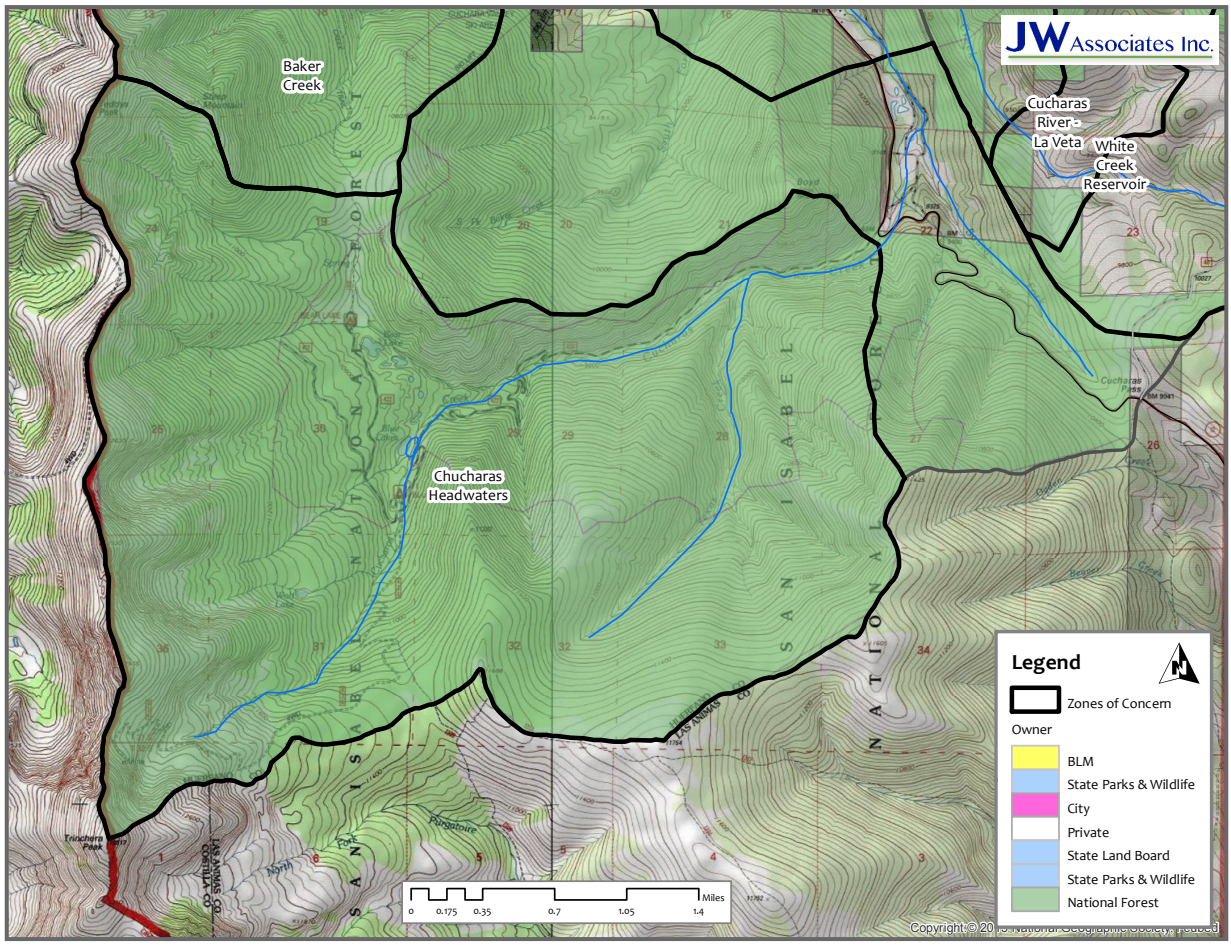

Figure 69. Cucharas Headwaters ZoC Ownership

Cucharas Headwaters Watershed Priority

The Cucharas Headwaters ZoC is in the Headwaters Cucharas River watershed (Figure 70) that is ranked Red (Category 5 - Highest) overall. The Headwaters Cucharas River watershed is also ranked Red (Category 5 - Highest) for Wildfire Hazard and Composite Hazard.

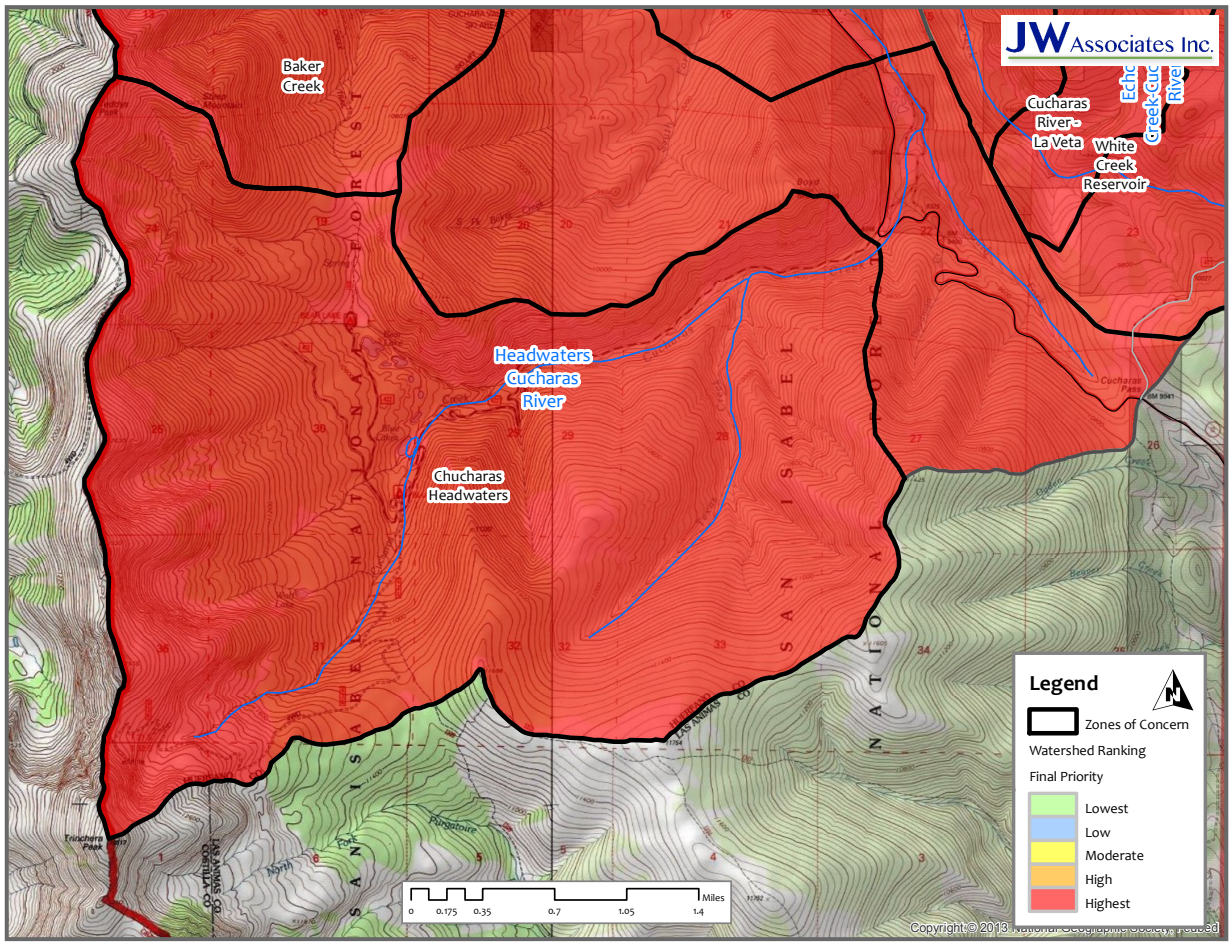

Figure 70. Cucharas Headwaters ZoC Watershed Priority

Cucharas Headwaters Slopes

The Cucharas Headwaters ZoC has some large areas of relatively shallow slopes (Figure 71). There are some large areas of steep slopes including locations north of the river and at the highest elevations in the western portion of the ZoC.

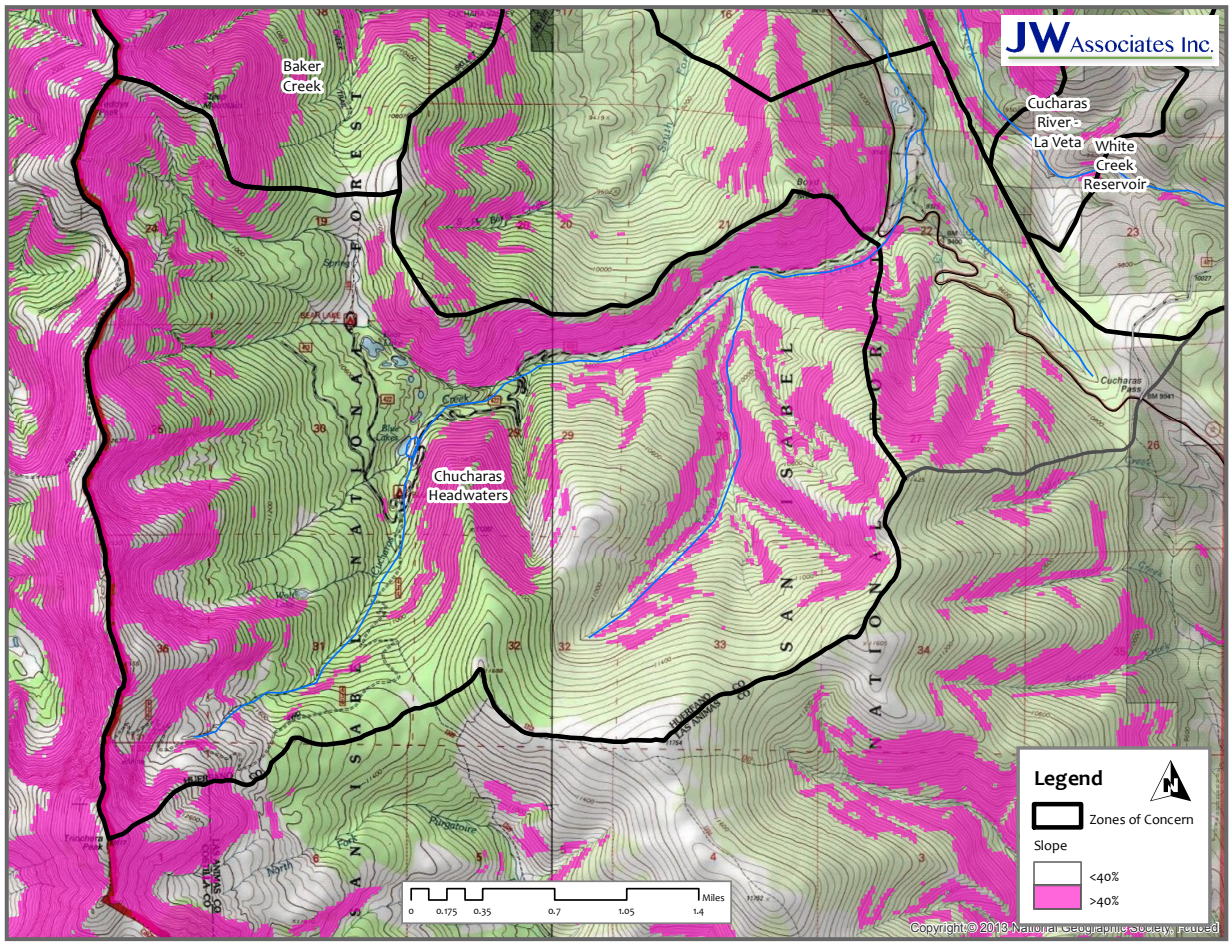

Figure 71. Cucharas Headwaters ZoC Slope

Cucharas Headwaters Special Management Areas

There are two roadless areas, Cuchara South and Purgatoire, covering most of the Cucharas Headwaters ZoC (Figure 72). A large portion of the Purgatoire Roadless Area is also designated as Upper Tier.

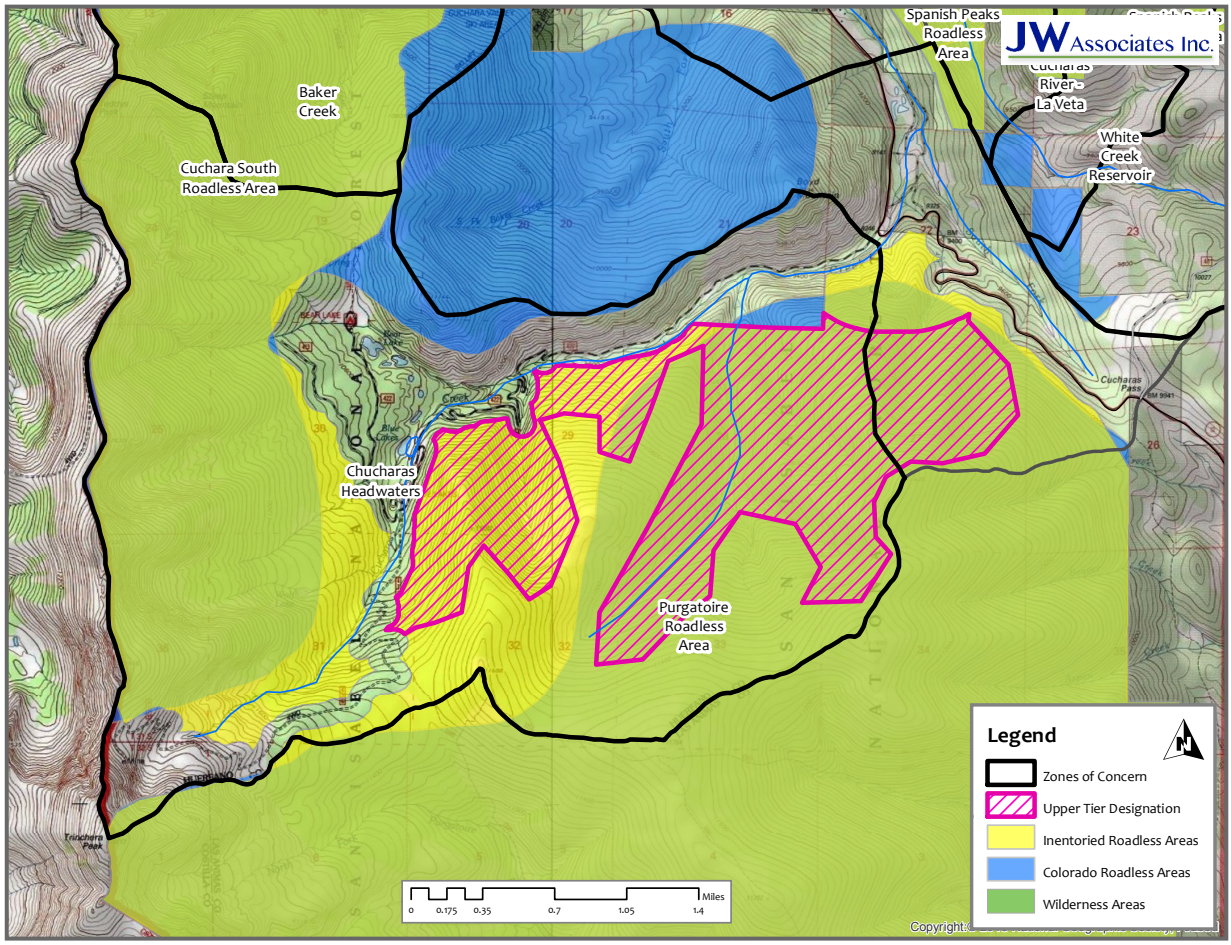

Figure 72. Cucharas Headwaters ZoC Special Areas

Cucharas Headwaters Vegetation

The Cucharas Headwaters ZoC has some large areas of aspen at lower elevations which are interspersed with mixed conifer (Figure 73). However, the Cucharas Headwaters ZoC is dominated by spruce-fir covering most of the upper elevations.

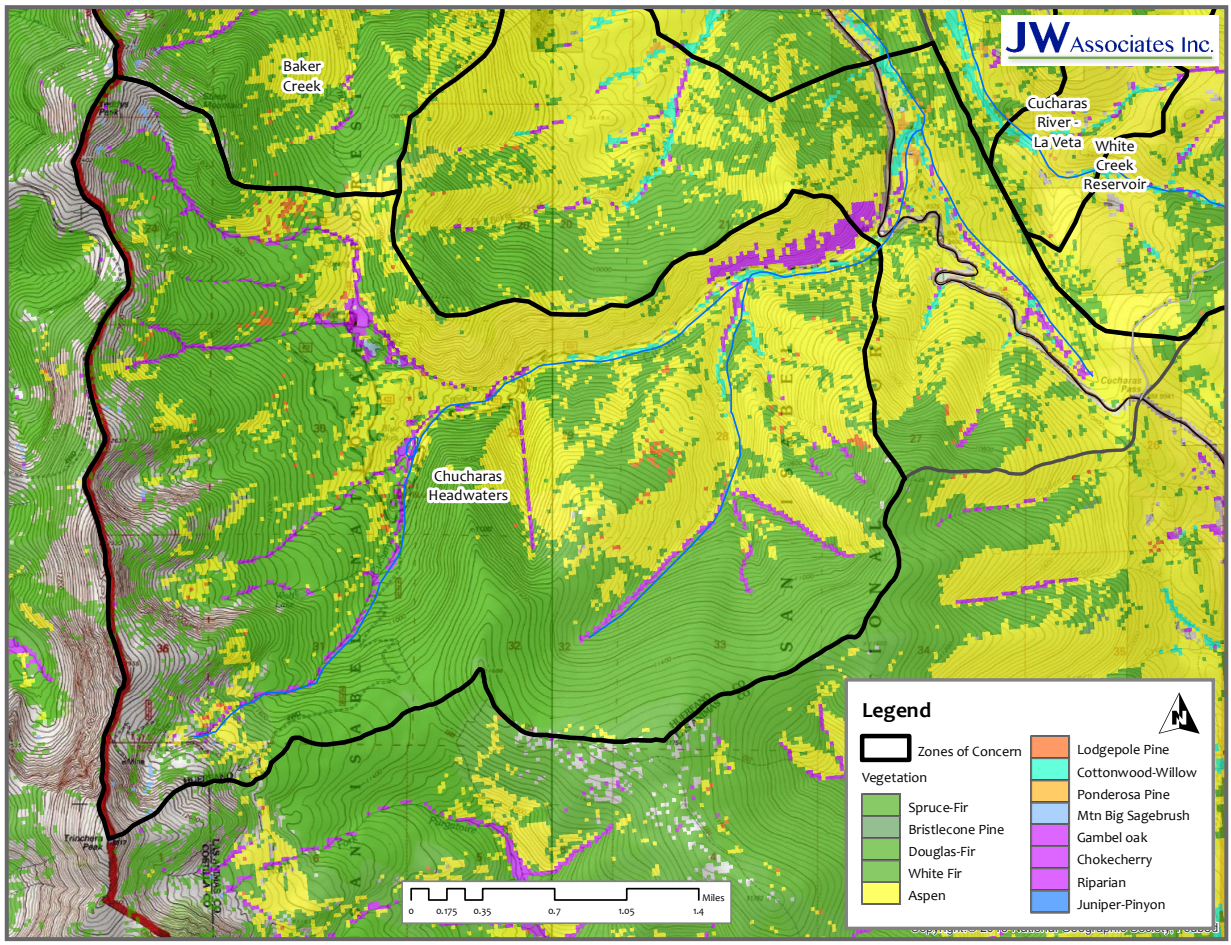

Figure 73. Cucharas Headwaters ZoC Vegetation

Cucharas Headwaters Access

The only access to the Cucharas Headwaters ZoC is an existing road that runs along the Cucharas River (Figure 74).

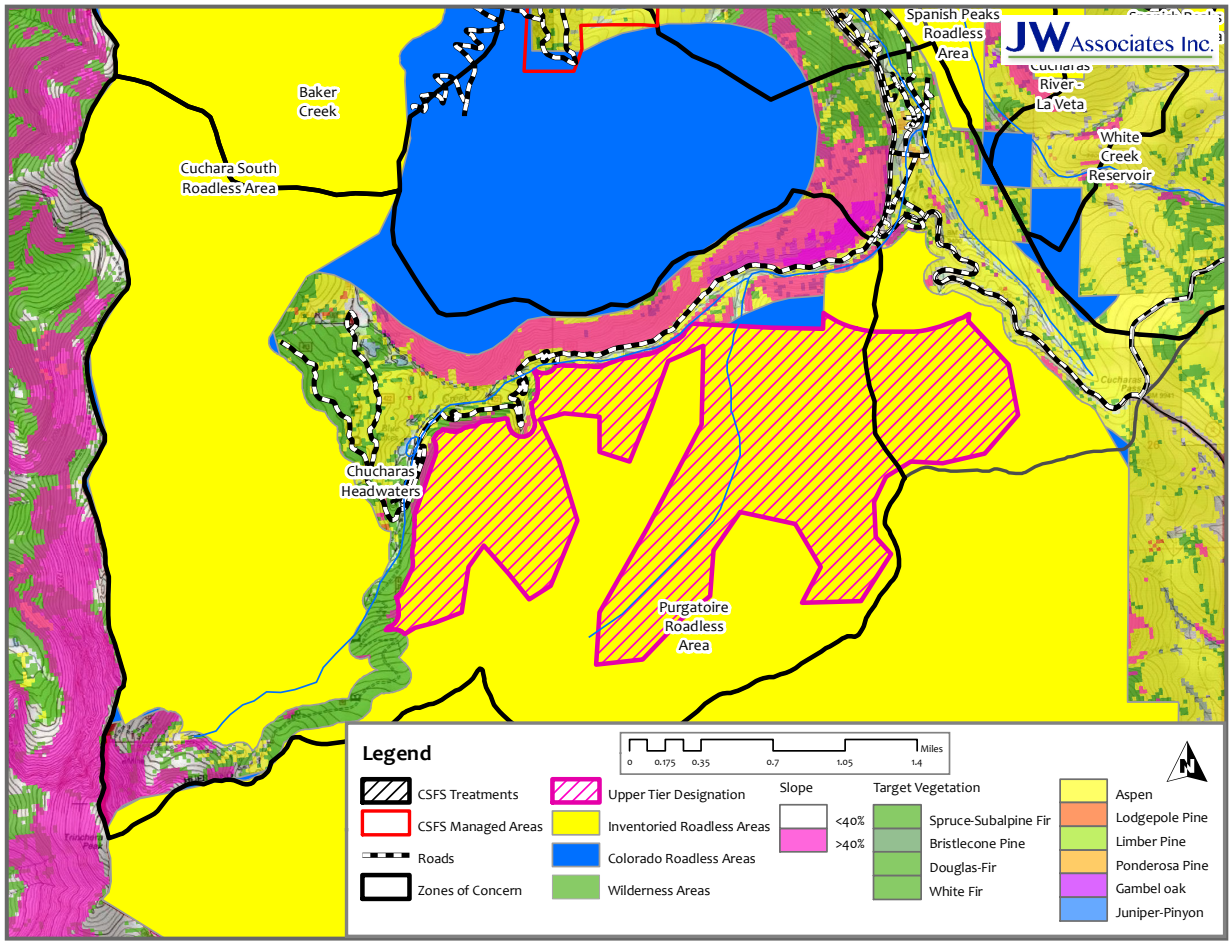

Figure 74. Cucharas Headwaters ZoC Opportunities

Cucharas Headwaters Opportunities

The Cucharas Headwaters ZoC has some limited opportunities. The ZoC is mostly within roadless areas but there is a road that runs along the creek that provides some access (Figure 74). The first section of the road runs along an Upper Tier designation to the south that prevents treatments in that area, and a steep section to the north that appears to be very open. However, the road turns to the north and divides which creates an area of possible treatment. The forest appears to be quite dense along both of those roads and a fuel break or broader-scale treatments would be possible in that area. It is also possible that treatments could extent into the Cuchara South Roadless Area to the west, if those treatments could be justified under the roadless area rules.

For this ZoC, the water provider should develop an information and education plan in conjunction with the US Forest Service to inform hikers, mountain bikers, users of off-road vehicles and other visitors to the roadless areas about the importance of the area's watersheds and the danger of wildfire to water quality. They should also work with the US Forest Service to develop and implement fire management plans that could allow natural fires of lower intensities to burn within these watersheds to create greater diversity and reduce fuels.

South Abeyta Creek ZoC

This section discusses the South Abeyta Creek and Etzell Arroyo ZoC (Figure 75). This ZoC has been extended beyond the initial 5 mile upstream distance. Note that the ZoC are shown here in blue shading, but in the remaining figures the outlines appear as bold black lines with no shading.

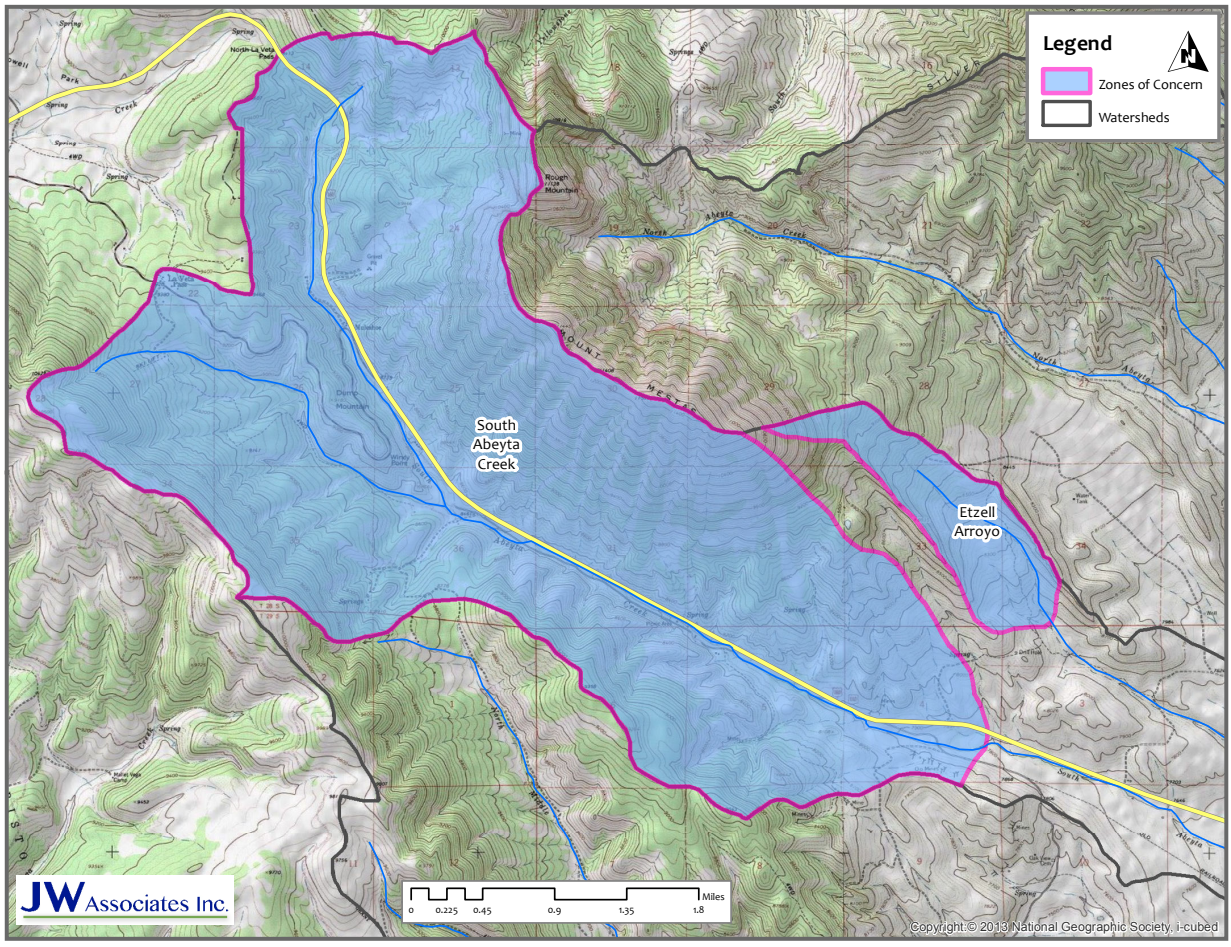

Figure 75. South Abeyta Creek ZoC Location

South Abeyta Creek Ownership

The South Abeyta Creek ZoC in mostly private lands with one large area of BLM land (Figure 76). The Etzell Arroyo ZoC is also mostly private lands with only a small area of BLM lands at the highest elevation to the west (Figure 76).

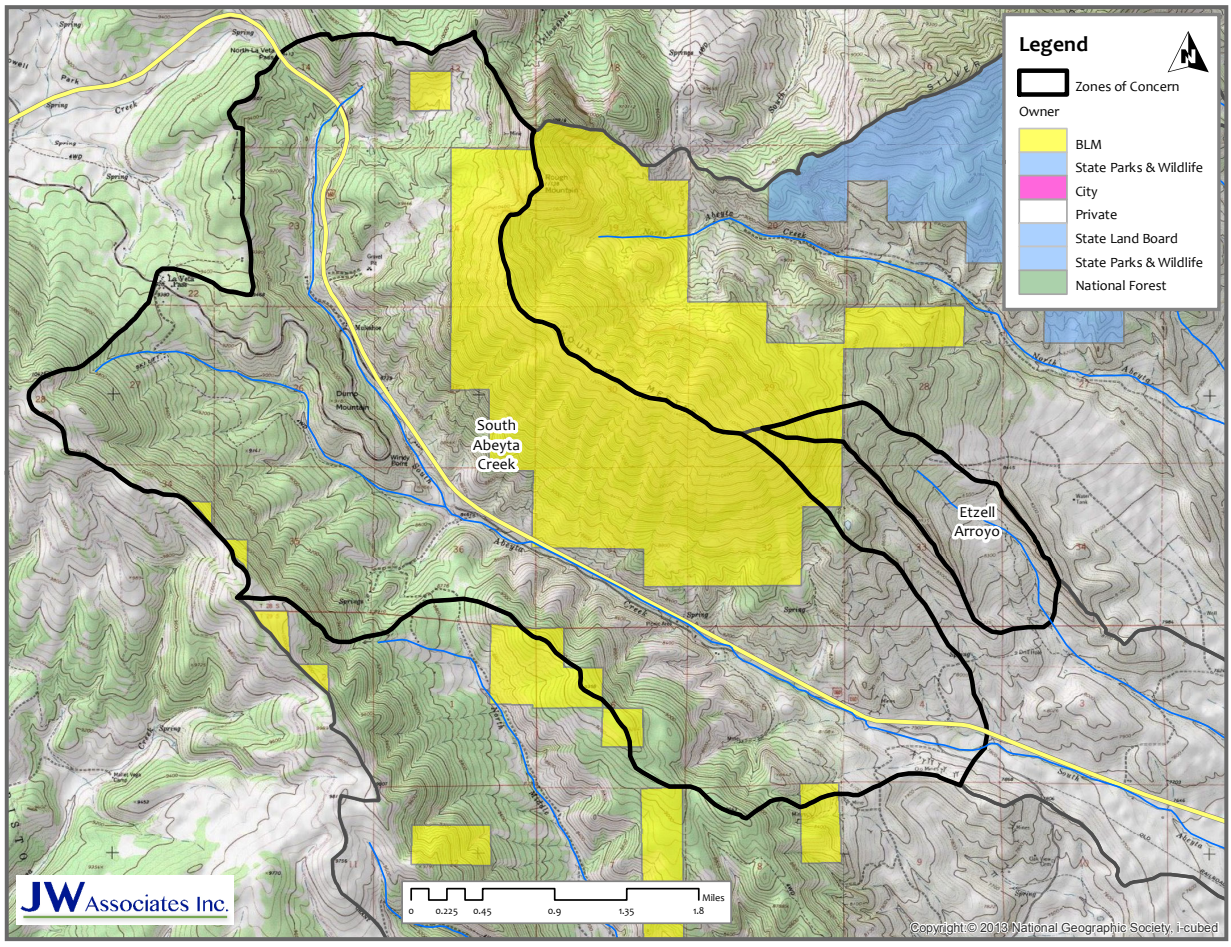

Figure 76. South Abeyta Creek ZoC Ownership

South Abeyta Creek Watershed Priority

The South Abeyta Creek and Etzell Arroyo ZoC are in the South Abeyta Creek watershed (Figure 77) that is ranked Red overall (Category 5-highest). The South Abeyta Creek watershed is also ranked Red (Category 5-highest) for Flooding/Debris Flow Hazard, Soil Erodibility and Composite Hazard.

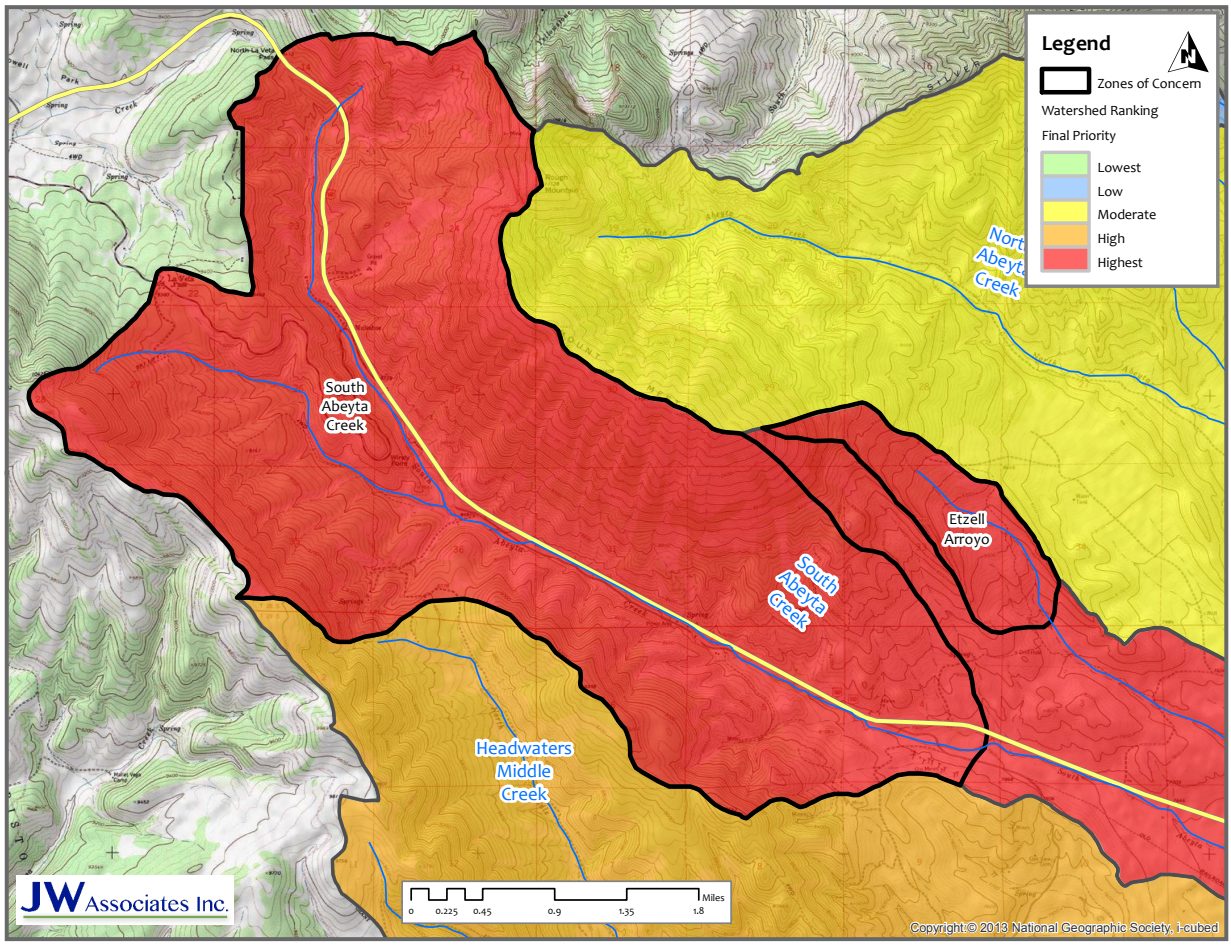

Figure 77. South Abeyta Creek ZoC Watershed Priority

South Abeyta Creek Slopes

The South Abeyta Creek ZoC has some large areas of relatively steep slope with the largest one on the slopes of Mount Mestas (Figure 78). There are some areas that have relatively shallow slopes within the South Abeyta Creek ZoC. The Etzell Arroyo ZoC has relatively shallow slopes throughout most of the area.

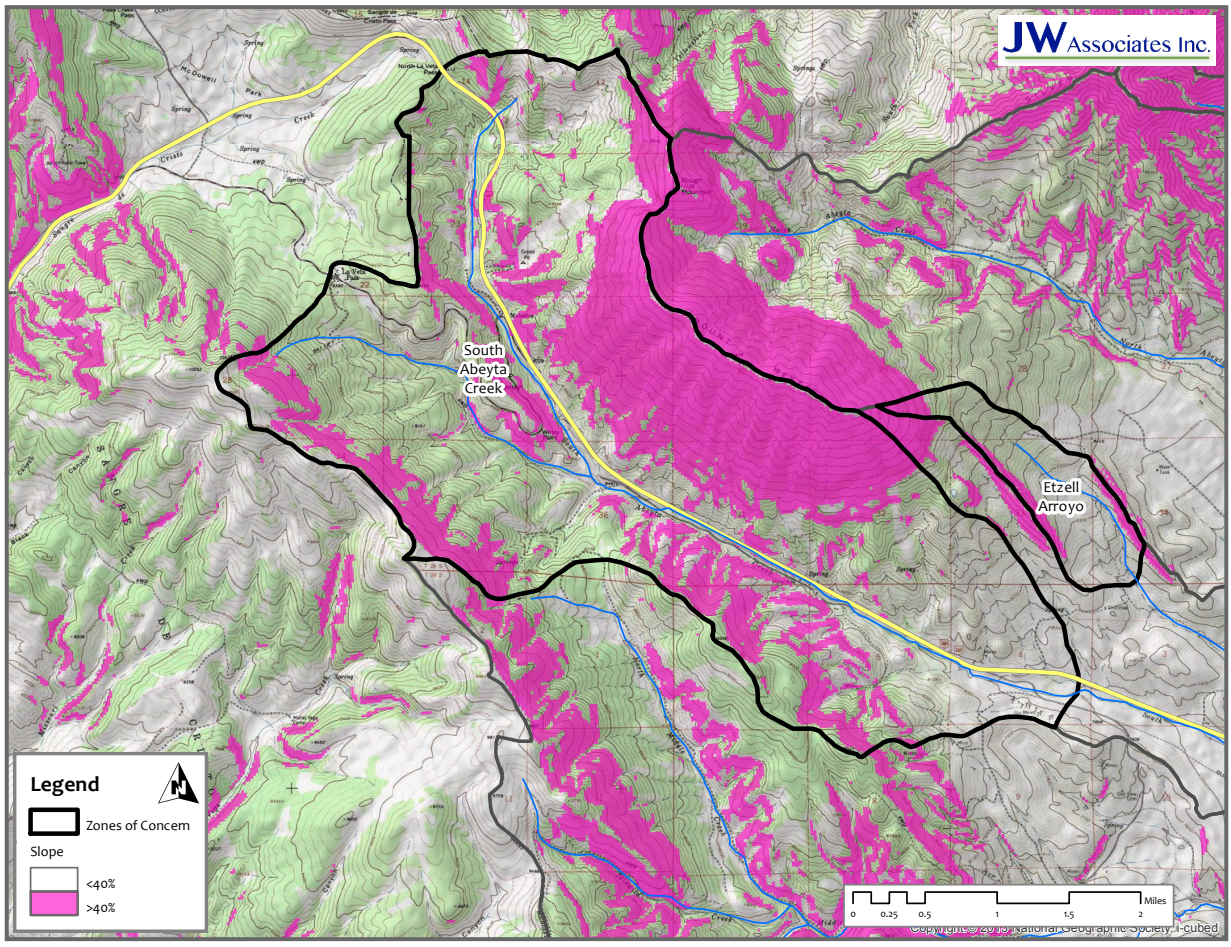

Figure 77. South Abeyta Creek ZoC Slope

South Abeyta Creek Special Management Areas

The South Abeyta Creek and Etzell Arroyo ZoC have no special management area designations (Figure 79).

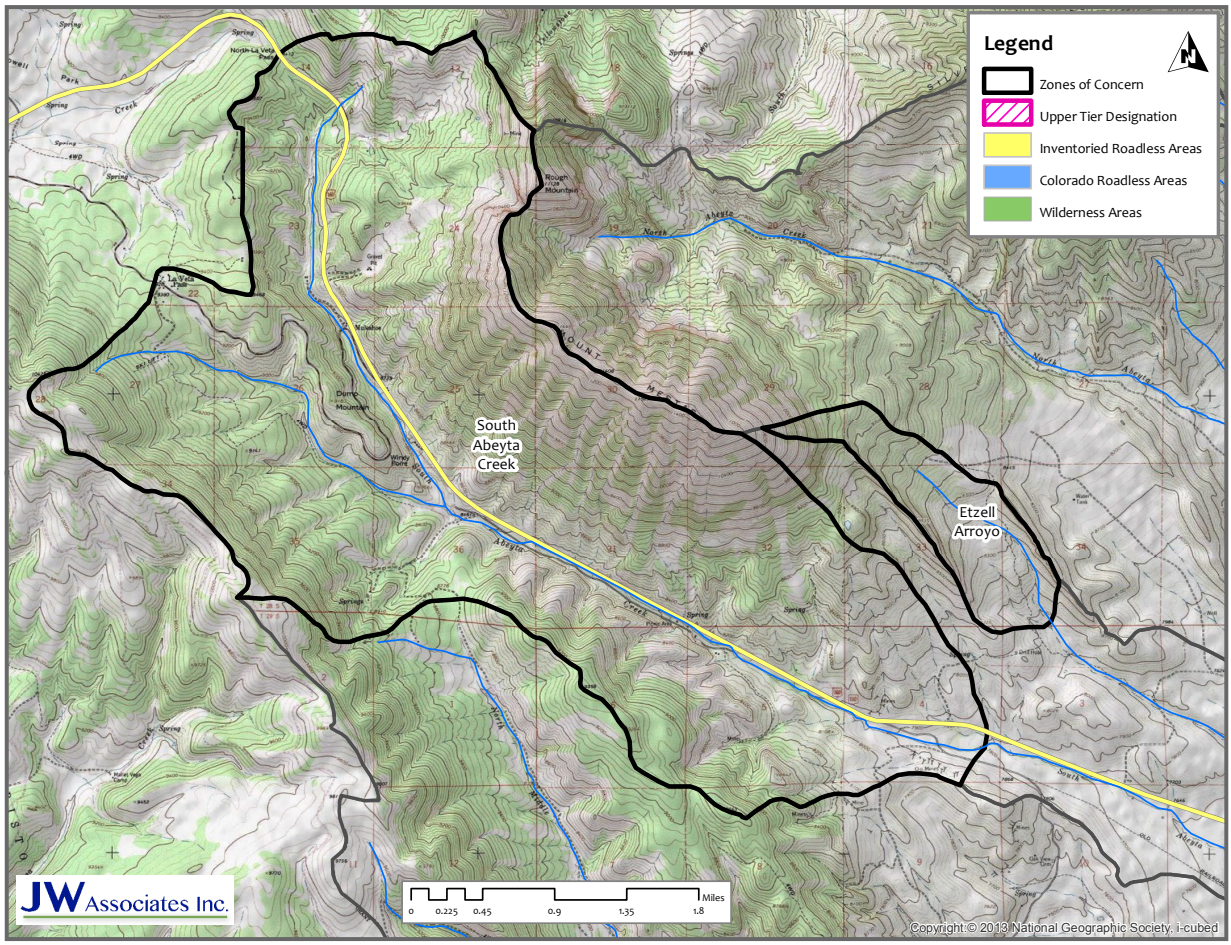

Figure 79. South Abeyta Creek ZoC Special Areas

South Abeyta Creek Vegetation

The lower elevations of the South Abeyta Creek ZoC are comprised of a combination of sagebrush, ponderosa pine, Gambel oak and pinyon-juniper (Figure 80). The majority of the South Abeyta Creek ZoC is covered by mixed conifer and aspen, with aspen becoming more prevalent at higher elevations. The Etzell Arroyo ZoC has a combination of sagebrush, Gambel oak and pinyon-juniper at lower elevations. The vegetation transitions to a combination of ponderosa pine and aspen, and then to mixed conifer and aspen (Figure 80).

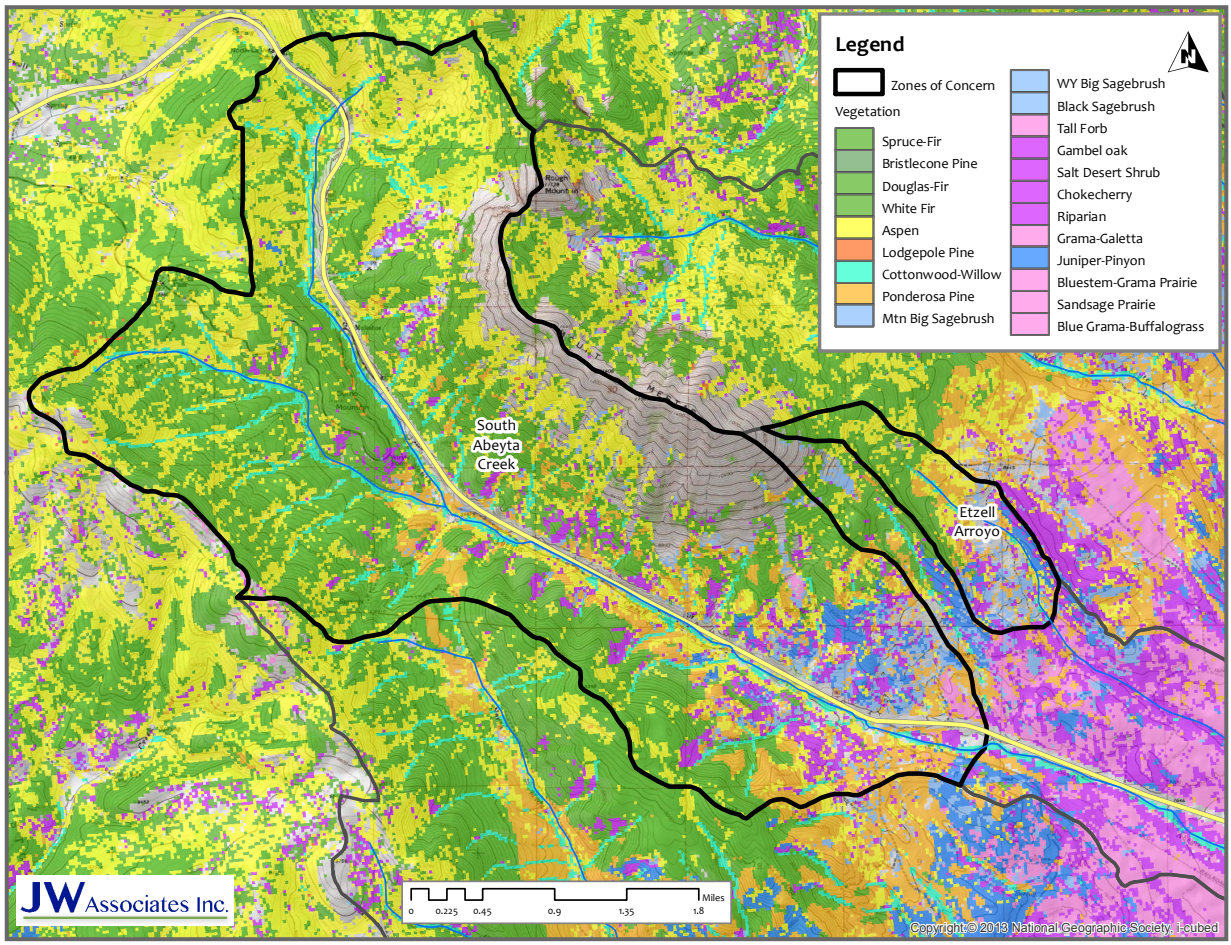

Figure 80. South Abeyta Creek ZoC Vegetation

South Abeyta Creek Access

US Highway 160 runs the length of the South Abeyta Creek ZoC which provides some access along with several other existing smaller roads (Figure 81). Several forested areas that are on shallower slopes have existing road access but some large areas lack access.

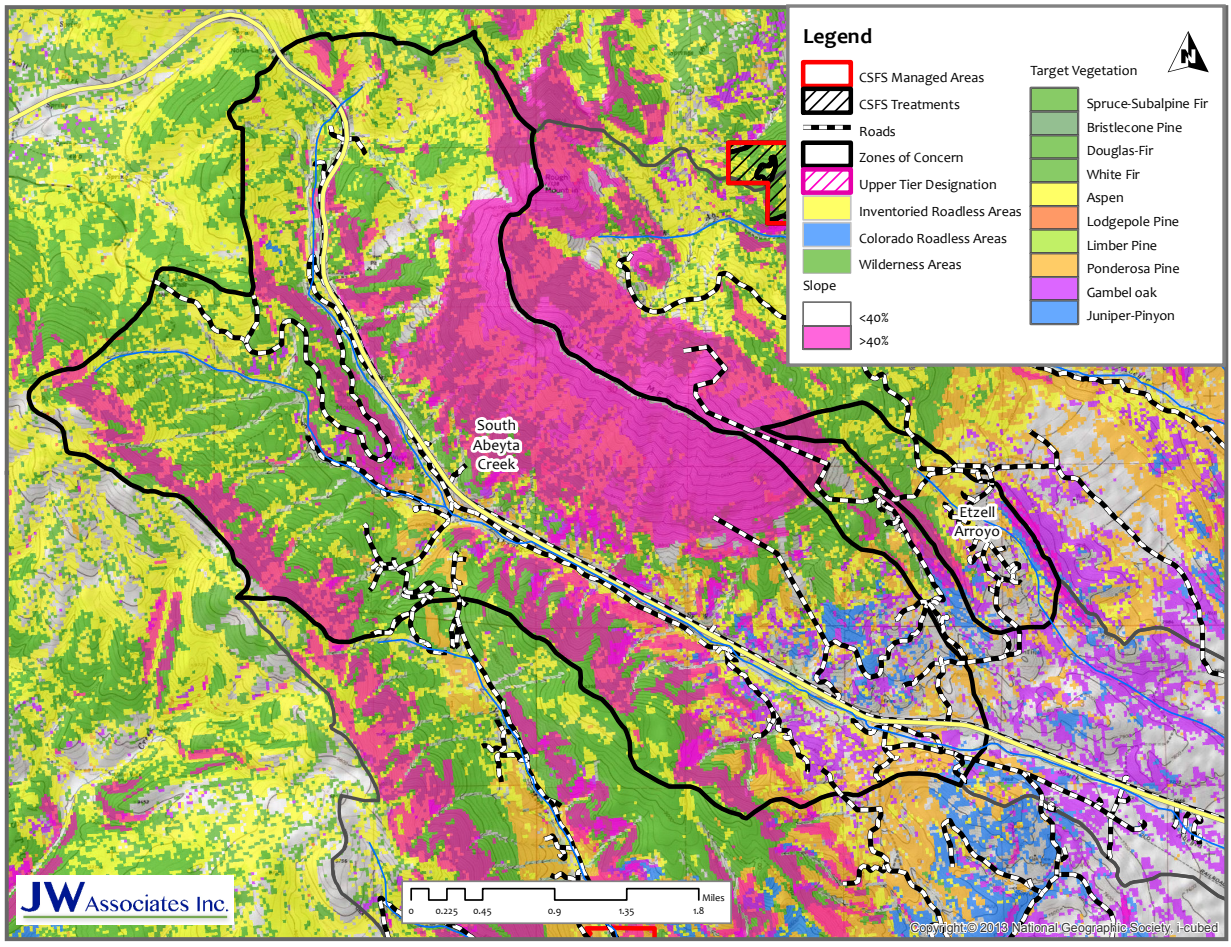

Figure 81. South Abeyta Creek ZoC Opportunities

South Abeyta Creek Opportunities

There are some treatment opportunities within the South Abeyta Creek ZoC. The existing roads provide access to some large areas of target vegetation on relatively shallow slopes (Figure 81). The La Veta Fire Protection District has a number of WUI projects identified in this ZoC. Those projects should be evaluated to determine if they could be used as watershed protection or additional project implemented adjacent to them. The area west of US Highway 160 that has some private roads southwest of Mount Mestas appears to have some treatment potential. Those areas are comprised of mixed conifer with aspen. There might be some opportunities to remove conifers from aspen stands and enhance aspen stands. The northern most portion of this ZoC might also have some treatment potential. Access is somewhat limited, but the target vegetation is present and the slopes are relatively shallow.

The Etzell Arroyo ZoC has some treatment opportunities. Roads provide access to most of the target vegetation within the ZoC (Figure 81). Fuel breaks along those roads could be quite effective in this small ZoC.

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APPENDIX A

LIST OF CUCHARAS RIVER WATERSHED GROUP MEMBERS

Table A-1. Cucharas River Watershed Stakeholders List

Organization	First	Last	Work phone	Mobile phone	email
American Red Cross	Dennis	Hoyt	(719) 890-0275		dennis.hoyt@gmail.com
Aspen Leaf Condos	Don	Scott			dcscott0642@charter.net
Bruce Domestic and Irrigation	Maurice	Heikes	(719) 989-8134		irene.heikes@gmail.com
City of Walsenburg	Dave	Johnston	(719) 738-1048		
City of Walsenburg	Jim	Eccher	(719) 738-1048		
Colorado State Forest Service	CK	Morey	(719) 742-3588		Clarence.Morey@colostate.edu
Colorado State Forest Service	Mark	Loveall	(719) 742-3588	(719) 989-7205	Mark.Loveall@colostate.edu
Colorado State Forest Service	Rich	Edwards	(970) 491-8036	(970) 213-8619	rich.edwards@colostate.edu
Colorado Water Conservation Board	Chris	Sturm	(303) 866-3441	(720) 219-4384	Chris.Sturm@state.co.us
Corsentino Dairy Farm	Joe	Corsentino	(719) 738-3848		
Cuchara Association	Hillary	Anderson	(719) 742-3237	(512) 426-9909	hillaryanderson@me.com
Cuchara Association	Larry	Brooks	(719) 742-6636		lbrooks3@mindspring.com
Cuchara Homeowner	Ken	Clark	(719) 742-0223		kkclark@cox.net
Cuchara Mountain Resort	Bruce	Cantrell	(719) 742-3013		abc@energyctrl.com
Cuchara Water & Sanitation District	Art	Pierce	(719) 742-3243	(404) 932-7818	artpierce@att.net
Cuchara Water & Sanitation District	Bob	Northup	(719) 742-3108		cswd@centurytel.net
Davis Ranch	Gaye	Davis	(719) 680-3247		cgayedavis@gmail.com
Division of Water Resources	Doug	Brgoch	(719) 742-3030	(719) 859-0122	Doug.Brgoch@state.co.us
Division of Water Resources	Steve	Witte	(719) 542-3368		Steve.Witte@state.co.us
Edminsten	John	Moore	(719) 742-5770		jmoore@ptsi.net
Gomez	Marc	Welch	(806) 333-2100		mwelch@welchgrain.com
Gomez and Romero Ditch	T.I.	Welch	(719) 660-4746		
Grandote Peaks Golf Club	Randy	Briggs	(505) 730-9170		randy@briggsnm.com
Hole in the Wall Ranch POA	Mary	White	(719) 742-6164		lavetalaw@gmail.com
Huerfano County	Art	Bobian	(719) 738-2029		artbobian@hotmail.com
Huerfano County	John	Galusha	(719) 248-4541		john@huerfano.us
Huerfano County	Max	Vezzani	(719) 738-6034	(719) 680-1976	vezzani28co@aol.com
Huerfano County	Ray	Garcia	(719) 746-2362		ergarcia69@hotmail.com
Huerfano County	Steve	Channel	(719) 989-8043		schannel@huerfano.us
Huerfano County Communication Coalition	Debbie	Channel	(719) 738-5178	(719) 250-9367	dchannel@amigo.net
Huerfano County Fire Protection District	Gerald	Jerant	(719) 738-1877		geraldj15@bresnan.net
Huerfano County Water Conservancy District	Al	Garcia			aljoegarcia@wildblue.net
Huerfano County Water Conservancy District	Beaver	Edmundson	(719) 738-2488		beranch3@yahoo.com
Huerfano County Water Conservancy District	Carol	Dunn	(719) 742-5581		cdunn@cad-1.com
Huerfano County Water Conservancy District	Kent	Mace	(719) 746-2413	(719) 989-1221	KentMace@cswoods.com
Huerfano County Water Conservancy District	Sandy	White	(719) 742-6164		sandyw@white-jankowski.com
Huerfano County Water Conservancy District	Scott	King	(719) 742-3124		slking@centurylink.net
Huerfano World Journal	Brian	Orr	(719) 738-1415		huerfanojournal@gmail.com
Huerfano World Journal	Gretchen	Sporleder Orr	(719) 738-1415		editor@huerfanojournal.com
JD Partners	John	Davis	(719) 742-3118	(719) 859-0123	cowdoc@fnbtrinidad.com
La Veta Fire Protection District	Mark	Brunner	(303) 263-1733		director.brunner@gmail.com
La Veta Fire Protection District	Paul	Branson	(719) 859-4678		cathartesaura@aol.com
LVFPD Auxiliary	Peggy	Littlefield	(719) 742-3735		peggylittlefield@gmail.com
LVFPD Auxuliary	Michele	Appel	(719) 989-1023		appel2us@yahoo.com
Martin Reservoir	Dale	Davis	(719) 742-3547		elads1012@centurylink.net

Table A-1. Cucharas River Watershed Stakeholders List Continued

Organization	First	Last	Work phone	Mobile phone	email
NRCS	Tony	Arnhold			Anthony.Arnhold@co.usda.gov
Panadero POA	Jim	Berg	(719) 742-3565	(303) 475-1109	jimhberg@centurytel.net
Panadero POA	Jim	Littlefield	(719) 742-3735		Jim.Littlefield@usccg.com
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Romero	Ernie	Reynolds	(719) 738-3208		ernsongdog@yahoo.com
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APPENDIX B

DETAILED CUCHARAS RIVER WATERSHED ASSESSMENT RESULTS

Table B-1. Cucharas River Watershed Wildfire Hazard Ranking

Sixth-Level Watershed	Flame Length Value	Fire Intensity Value	Wildfire Value	Watershed Area (acres)	Wildfire Hazard Rank
Headwaters Cucharas River	243.7%	210.7%	454.35%	20,849	5.5
Indian Creek	203.8%	206.9%	410.72%	11,196	4.6
Echo Creek-Cucharas River	163.6%	195.0%	358.54%	34,039	3.6
Wahatoya Creek	163.5%	181.4%	344.88%	13,554	3.3
Headwaters Middle Creek	156.7%	186.5%	343.18%	20,107	3.2
South Abeyta Creek	150.2%	171.6%	321.80%	11,709	2.8
North Abeyta Creek	67.6%	188.0%	255.54%	19,092	1.5
South Santa Clara Creek	112.0%	135.9%	247.92%	17,187	1.3
Bear Creek	63.5%	172.8%	236.22%	28,603	1.1
Walsen Arroyo	27.4%	201.5%	228.90%	29,579	0.9
Chavez Arroyo	22.0%	200.7%	222.69%	12,623	0.8
City of Walsenburg-Cucharas River	26.4%	192.8%	219.13%	34,858	0.7
Pictou Arroyo	17.6%	196.8%	214.39%	19,140	0.6
Saliba Lake-Santa Clara Creek	27.5%	183.1%	210.63%	33,660	0.6
North Santa Clara Creek	60.1%	149.3%	209.45%	16,716	0.5
Gordon Arroyo	15.1%	192.9%	208.01%	16,306	0.5

Table B-2. Cucharas River Watershed Ruggedness Ranking[1, 2]

Sixth-Level Watershed	Watershed Area (sq. ft.)	Maximum Elevation	Minimum Elevation	Difference Elevation	Ruggedness	Ruggedness Rank
Wahatoya Creek	590,424,001	13,626	6,801	6,825	0.2809	5.5
Echo Creek-Cucharas River	1,186,207,799	13,626	6,801	6,825	0.2477	4.8
North Santa Clara Creek	728,148,524	12,690	6,621	6,070	0.2249	4.3
South Abeyta Creek	510,024,438	11,565	7,103	4,462	0.1976	3.7
South Santa Clara Creek	748,673,996	11,832	6,621	5,211	0.1905	3.6
Indian Creek	487,714,313	11,270	7,083	4,186	0.1896	3.6
Headwaters Cucharas River	908,166,758	13,514	8,136	5,377	0.1784	3.3
Chavez Arroyo	549,845,248	10,525	6,398	4,127	0.1760	3.3
North Abeyta Creek	831,630,967	11,552	6,542	5,010	0.1737	3.2
Bear Creek	1,245,962,362	12,198	6,106	6,093	0.1726	3.2
Headwaters Middle Creek	700,687,342	10,174	7,083	3,091	0.1459	2.7
City of Walsenburg-Cucharas River	1,012,275,739	8,205	6,106	2,100	0.0990	1.7
Saliba Lake-Santa Clara Creek	977,495,983	7,425	6,030	1,394	0.0669	1.0
Gordon Arroyo	710,303,299	7,247	5,906	1,342	0.0503	0.7
Pictou Arroyo	833,741,449	7,198	5,906	1,293	0.0448	0.5
Walsen Arroyo	1,288,476,922	7,480	5,932	1,549	0.0431	0.5

[1] Ruggedness is based on Melton (1957)

[2] The watersheds highlighted in gray were manually adjusted because they do not accurately reflect the ruggedness in those watersheds.

Table B-3. Cucharas River Watershed Road Density Ranking[3]

Sixth-Level Watershed	Roads (miles)	Roads Adjusted (miles)	Watershed Area (sq. mi.)	Road density (miles per sq. mi.)	Road Density Rank
Pictou Arroyo	120.1	95.7	29.91	3.20	5.5
Chavez Arroyo	62.8	62.8	19.72	3.18	5.5
City of Walsenburg-Cucharas River	212.9	156.7	54.47	2.88	4.9
South Abeyta Creek	43.8	43.8	18.29	2.40	3.9
Bear Creek	90.4	82.7	44.69	1.85	2.8
Saliba Lake-Santa Clara Creek	134.1	93.9	52.59	1.78	2.7
Walsen Arroyo	126.4	77.7	46.22	1.68	2.5
Gordon Arroyo	64.8	41.9	25.48	1.64	2.4
South Santa Clara Creek	44.0	44.0	26.85	1.64	2.4
Headwaters Cucharas River	49.9	49.9	32.58	1.53	2.2
North Abeyta Creek	44.1	44.1	29.83	1.48	2.1
Echo Creek-Cucharas River	107.1	78.0	53.19	1.47	2.1
North Santa Clara Creek	37.0	37.0	26.12	1.42	2.0
Wahatoya Creek	33.1	28.2	21.18	1.33	1.8
Headwaters Middle Creek	39.7	39.7	31.42	1.26	1.7
Indian Creek	11.5	11.5	17.49	0.66	0.5
Totals	**1,221.6**	**987.6**	**530.03**		

[3] In the watersheds shaded in gray, the road density was adjusted based upon the procedure discussed in the report.

Table B-4. Cucharas River Watershed Flooding/Debris Flow Hazard Ranking

Sixth-Level Watershed	Watershed Area (acres)	Ruggedness	Ruggedness Rank	Road density (mi per sq. mi.)	Road Density Rank	Combined Ranking
Wahatoya Creek	13,554	0.2809	5.5	1.33	1.8	5.5
Chavez Arroyo	12,623	0.1760	3.3	3.18	5.5	5.1
Echo Creek-Cucharas River	34,039	0.2477	4.8	1.47	2.1	4.9
South Abeyta Creek	11,709	0.1976	3.7	2.40	3.9	4.7
North Santa Clara Creek	16,716	0.2249	4.3	1.42	2.0	4.3
South Santa Clara Creek	17,187	0.1905	3.6	1.64	2.4	3.8
Bear Creek	28,603	0.1726	3.2	1.85	2.8	3.6
Headwaters Cucharas River	20,849	0.1784	3.3	1.53	2.2	3.4
North Abeyta Creek	19,092	0.1737	3.2	1.48	2.1	3.2
City of Walsenburg-Cucharas River	34,858	0.0990	1.7	2.88	4.9	3.0
Indian Creek	11,196	0.1896	3.6	0.66	0.5	2.7
Headwaters Middle Creek	20,107	0.1459	2.7	1.26	1.7	2.4
Pictou Arroyo	19,140	0.0448	0.5	3.20	5.5	2.1
Saliba Lake-Santa Clara Creek	33,660	0.0669	1.0	1.78	2.7	1.1
Gordon Arroyo	16,306	0.0503	0.7	1.64	2.4	0.6
Walsen Arroyo	29,579	0.0431	0.5	1.68	2.5	0.5

Table B-5. Cucharas River Watershed Soil Erodibility Ranking[4]

Sixth-Level Watershed	Severe (acres)	Severe (%)	Very Severe (acres)	Very Severe (%)	Soil Erodibility Value	Watershed Area	Soil Erodibility Rank
Headwaters Middle Creek	3,078.6	15.3%	992.3	4.9%	0.252	20,107	5.5
South Abeyta Creek	1,260.6	10.8%	650.1	5.6%	0.219	11,709	4.8
Indian Creek	2,154.8	19.2%	64.4	0.6%	0.204	11,196	4.5
Headwaters Cucharas River	3,625.9	17.4%	78.3	0.4%	0.181	20,849	4.1
Wahatoya Creek	1,923.5	14.2%	115.4	0.9%	0.159	13,554	3.7
Echo Creek-Cucharas River	3,544.8	10.4%	300.9	0.9%	0.122	34,039	2.9
North Abeyta Creek	701.0	3.7%	512.7	2.7%	0.090	19,092	2.3
South Santa Clara Creek	801.2	4.7%	311.3	1.8%	0.083	17,187	2.1
Bear Creek	1,430.4	5.0%	122.8	0.4%	0.059	28,603	1.7
North Santa Clara Creek	325.6	1.9%	9.0	0.1%	0.021	16,716	0.9
City of Walsenburg-Cucharas River	397.6	1.1%	60.5	0.2%	0.015	34,858	0.8
Chavez Arroyo	123.8	1.0%	9.7	0.1%	0.011	12,623	0.7
Saliba Lake-Santa Clara Creek	218.9	0.7%	6.8	0.0%	0.007	33,660	0.6
Walsen Arroyo	153.6	0.5%	20.7	0.1%	0.007	29,579	0.6
Pictou Arroyo	8.6	0.0%	0.0	0.0%	0.000	19,140	0.5
Gordon Arroyo	4.7	0.0%	0.0	0.0%	0.000	16,306	0.5

[4] Soil Erodibility Value is percentage of Severe plus 2 times the percentage of Very Severe.

Table B-6. Cucharas River Watershed Composite Hazard Ranking

Sixth-Level Watershed	Wildfire Hazard Rank	Flooding/Debris Flow Rank	Soil Erodibility Rank	Composite Numeric Rank	Composite Hazard Rank
Headwaters Cucharas River	5.5	3.4	4.1	13.0	5.5
Wahatoya Creek	3.3	5.5	3.7	12.4	5.3
South Abeyta Creek	2.8	4.7	4.8	12.4	5.2
Indian Creek	4.6	2.7	4.5	11.9	5.0
Echo Creek-Cucharas River	3.6	4.9	2.9	11.4	4.8
Headwaters Middle Creek	3.2	2.4	5.5	11.1	4.7
South Santa Clara Creek	1.5	3.8	2.1	7.5	3.1
Bear Creek	2.0	3.6	1.7	7.2	3.0
North Santa Clara Creek	2.0	4.3	0.9	7.2	2.9
North Abeyta Creek	1.5	3.2	2.3	7.0	2.9
Chavez Arroyo	0.8	5.1	0.7	6.6	2.7
City of Walsenburg-Cucharas River	0.7	3.0	0.8	4.5	1.8
Pictou Arroyo	0.6	2.1	0.5	3.3	1.2
Saliba Lake-Santa Clara Creek	0.6	1.1	0.6	2.3	0.8
Walsen Arroyo	0.9	0.5	0.6	2.0	0.7
Gordon Arroyo	0.5	0.6	0.5	1.6	0.5

Table B-7. Cucharas River Watershed Water Supply Ranking

Sixth-level Watershed	Water Supply Type	Watershed Area	Water Supply Rank
Headwaters Cucharas River	Municipal	20,849	1.0
South Abeyta Creek	Municipal	11,709	1.0
Indian Creek	Irrigation	11,196	0.5
Headwaters Middle Creek	Irrigation	20,107	0.5
Wahatoya Creek	Municipal	13,554	1.0
Echo Creek-Cucharas River	Municipal	34,039	1.0
North Abeyta Creek	Irrigation	19,092	0.5
Chavez Arroyo	None	12,623	0.0
Bear Creek	None	28,603	0.0
City of Walsenburg-Cucharas River	Municipal	34,858	1.0
Walsen Arroyo	None	29,579	0.0
North Santa Clara Creek	None	16,716	0.0
South Santa Clara Creek	None	17,187	0.0
Saliba Lake-Santa Clara Creek	None	33,660	0.0
Gordon Arroyo	None	16,306	0.0
Pictou Arroyo	None	19,140	0.0

Table B-8. Cucharas River Final Watershed Ranking

Sixth-Level Watershed	Wildfire Hazard	Flooding/ Debris Flow Hazard	Soil Erodibility	Composite Hazard	Water Supply	Final Priority Numeric Rank	Combined Ranking
Headwaters Cucharas River	5.5	3.4	4.1	5.5	1.0	6.50	5.5
Wahatoya Creek	3.3	5.5	3.7	5.3	1.0	6.25	5.3
South Abeyta Creek	2.8	4.7	4.8	5.2	1.0	6.23	5.3
Echo Creek-Cucharas River	3.6	4.9	2.9	4.8	1.0	5.78	4.9
Indian Creek	4.6	2.7	4.5	5.0	0.5	5.51	4.7
Headwaters Middle Creek	3.2	2.4	5.5	4.7	0.5	5.18	4.4
North Abeyta Creek	1.5	3.2	2.3	2.9	0.5	3.36	2.9
South Santa Clara Creek	1.3	3.8	2.1	3.0	0.0	2.97	2.6
City of Walsenburg-Cucharas River	0.7	3.0	0.8	1.8	1.0	2.78	2.4
Chavez Arroyo	0.8	5.1	0.7	2.7	0.0	2.69	2.3
Bear Creek	1.1	3.6	1.7	2.6	0.0	2.57	2.2
North Santa Clara Creek	0.5	4.3	0.9	2.3	0.0	2.32	2.0
Pictou Arroyo	0.6	2.1	0.5	1.2	0.0	1.22	1.1
Saliba Lake-Santa Clara Creek	0.6	1.1	0.6	0.8	0.0	0.81	0.8
Walsen Arroyo	0.9	0.5	0.6	0.7	0.0	0.69	0.7
Gordon Arroyo	0.5	0.6	0.5	0.5	0.0	0.50	0.5