Fremont County Multi-Jurisdictional

Hazard Mitigation Plan - 2021 Update

Contents

Professional planning services for this plan update provided by:

SYNERGY DISASTER RECOVERY

EXECUTIVE SUMMARY

The Disaster Mitigation Act (DMA) is federal legislation that requires proactive, pre-disaster hazard mitigation planning as a prerequisite for some funding available under the Robert T. Stafford Act. The DMA encourages state and local authorities to work together on pre-disaster planning. The planning network called for by the DMA helps local governments articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk reduction projects.

Hazard mitigation is the use of long- and short-term strategies to reduce or alleviate the loss of life, personal injury, and property damage that can result from a disaster. It involves strategies such as planning, policy changes, programs, projects, and other actions that can mitigate the impacts of hazards. It is impossible to predict exactly when and where disasters will occur or the extent to which they will impact an area, but with careful planning and collaboration among public agencies, stakeholders, and citizens, it is possible to minimize losses that disasters can cause. The responsibility for hazard mitigation lies with many, including private property owners; business and industry; and local, state and federal government.

Fremont County and a partnership of local governments and organizations within the county have developed and maintained a hazard mitigation plan (HMP) to reduce risks from natural disasters and to comply with the DMA. This 2021 plan update builds upon the community's previous efforts and identifies the mitigation strategy that Fremont County and its municipalities will follow over the next five years.

Chapter 1: MITIGATION STRATEGY

The updated mitigation strategy for this hazard mitigation plan (HMP) details how mitigation efforts will be directed over the next five years. This strategy was built upon the 2015 plan and has been updated based on community priorities, data from the risk assessment, and the results of the planning process. The Steering Committee continues to recognize a guiding principle for this plan and has updated its set of mitigation goals and objectives.

GUIDING PRINCIPLE

The guiding principle for the Fremont County Multi-Jurisdictional HMP is:

Develop and maintain a disaster-resistant Fremont County and communities within that is more resilient to the physical devastation and resulting economic impacts associated with all natural and human-caused hazard events.

HAZARDS

One of the largest inputs to a successful mitigation strategy is a thorough understanding of those hazards that impact communities and the ultimate risk they present. A large portion of this plan is devoted to a detailed review of these hazards and each community's vulnerabilities. See the Chapter 4: HAZARD IDENTIFICATION & RISK ASSESSMENT and Appendix A: MUNICIPAL ANNEXES sections of this Plan for additional details. An overall countywide hazard risk ranking is provided in Table 1. The top hazards of concern include: flood, pandemic, thunderstorm (including hail, high wind, and lightning) and wildfire.

TABLE 1. FREMONT COUNTY HAZARD RISK RATINGS

	Dam Failure	Debris Flow	Drought / Extreme Heat	Earthquake	Flood	Landslide / Rockfall	Pandemic	Severe Winter Weather	Subsidence / Erosion	Thunderstorm (hail, high wind, lighting)	Tornado	Wildfire	Wildlife-Vehicle Collisions
Fremont County	M	M	M	L	H	L	H	M	L	H	L	H	M

GOALS & OBJECTIVES

The following are the mitigation goals and corresponding objectives for this plan. These were reviewed and updated by the Hazard Mitigation Steering Committee to align with current mitigation priorities.

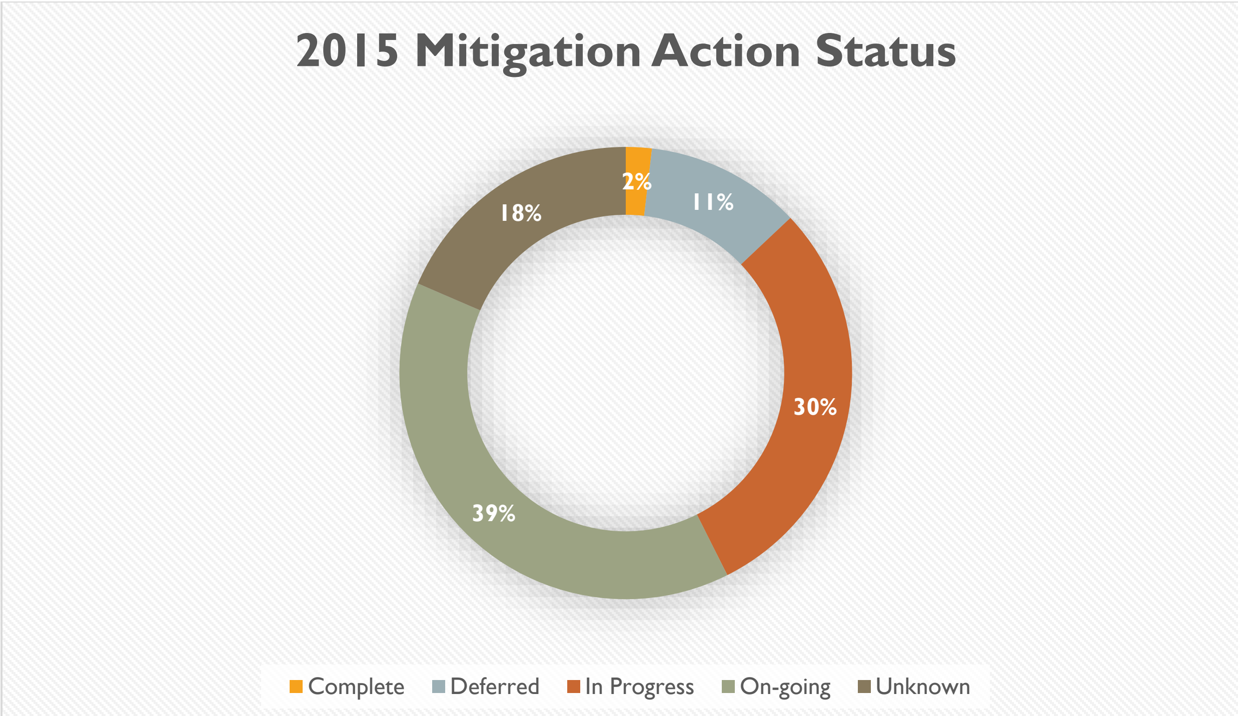
- **Goal 1**: Reduce loss of life, impacts to critical lifelines, and damages to public and private property from disasters.
  - **Objectives**
    - Implement mitigation strategies and actions to reduce the severity of potential impacts from local hazards. (1a)
    - Continually evaluate and develop plans, programs, trainings, and exercises to improve disaster preparedness and mitigation options. (1b)
    - Create education and engagement opportunities for jurisdictions, community leaders, and the public to understand the Lifeline framework and preparedness planning. (1c)
- **Goal 2**: Develop support for mitigation planning and actions through continual evaluation and active participation of local jurisdictions and local officials.
  - **Objectives**
    - Perform assessments of ongoing mitigation programs and activities to evaluate progress and effectiveness. (2a)
    - Adopt codes, standards, rules, and regulations to aid in mitigation implementation. (2b)
- **Goal 3**: Expand countywide awareness of community preparedness, response, and long-term mitigation planning through education and engagement opportunities for the public and community leaders.
  - **Objectives**
    - Educate the public about preparedness activities and mitigation goals for the county. (3a)
    - Encourage engagement of the public and community leaders to include them in community preparedness education and inclusive planning. (3b)
    - Create opportunities for public education on reducing personal risk, including community members with access and functional needs (AFN), and increasing property protection. (3c)
- **Goal 4**: Improve interagency and multi-jurisdictional collaboration in planning and response within the county and with neighboring counties.
  - **Objectives**

        - Cooperate with area partners in long-term planning efforts and mutual aid agreements. (4a)
        - Communicate mitigation and disaster preparedness efforts across the county and with neighboring counties. (4b)
        - Strengthen capabilities across jurisdictional boundaries and interagency operations by developing and sharing operational policies, practices, and procedures. (4c)
        - Conduct training and exercises with all agencies in the county, communities, and adjacent jurisdictions to improve preparedness and response capabilities. (4d)
- **Goal 5**: Promote inclusion of hazard awareness and risk reduction principles in plans, processes, and functions for the county and jurisdictions.
    - **Objectives**
        - Incorporate relevant emergency management plans into institutional county plans, documents, and practices. (5a)
        - Update existing policy documents and initiatives to include risk reduction principles and ensure inclusion in future documents. (5b)

2015 ACTIONS REPORT

Table 2 presents the current status (as of April 2021) of all mitigation actions included in the 2015 plan. Of the 54 collective actions across that plan's participants, a majority are either on-going or in progress. Figure 1 provides a summary of this status report. Those actions labeled as unknown are due to the stakeholder not participating in this planning process.

FIGURE 1: 2015 MITIGATION ACTION STATUS



Those actions labeled as on-going are also included in Table 3, which presents this plan's 2021 mitigation actions. Actions labeled as in progress will continue to be implemented by communities going forward but are not specifically included as 2021 mitigation actions.

TABLE 2. 2015 MITIGATION ACTION STATUS REPORT

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-01	Fremont County	Public Information and Awareness	Bring all-hazard awareness and education to public venues (Using the Firewise Trailer)	Staff time	On-going	The Firewise Trailer is used 12 to 20 times a year in Fremont County - providing materials, talks, and videos to citizens and groups. It goes to schools, fire stations, Safety Jam, Fire Prevention Week activities, Safety Town, HOA meetings, Blossom Festival, National Night Out, and any other community event that I can be involved in. It is also used as a regional asset that goes to slash collections, MAWPP events, and other community events around the South All Hazards Region.
2015-02	Fremont County	Floodplain Mapping - Swissvale Community	Mapping of area within Zone A (approximate) flood zone	N/A	In Progress	FEMA working on County Wide floodplain modeling - this process takes several years before completed maps are distributed
2015-03	Fremont County	Floodplain Mapping - Howard Community	Mapping of area within Zone A (approximate) flood zone	N/A	In Progress	FEMA working on County Wide floodplain modeling - this process takes several years before completed maps are distributed
2015-04	Fremont County	Floodplain Mapping - Cotopaxi Community	Mapping of area within Zone A (approximate) flood zone	N/A	In Progress	FEMA working on County Wide floodplain modeling - this process takes several years before completed maps are distributed
2015-05	Fremont County	Detailed Floodplain Mapping - Texas Creek Community	Mapping of area within Zone A (approximate) flood zone	N/A	In Progress	FEMA working on County Wide floodplain modeling - this process takes several years before completed maps are distributed
2015-06	Fremont County	Detailed Floodplain Mapping - Penrose Area	Mapping of area within Zone A (approximate) flood zone	N/A	In Progress	FEMA working on County Wide floodplain modeling - this process takes several years before completed maps are distributed
2015-07	Fremont County	Detailed Floodplain Mapping - C-3 and C-4 Dam Area	Base Flood Mapping of area within inundation zones of both C-3 and C-4 dams	N/A	In Progress	FEMA working on County Wide floodplain modeling - this process takes several years before completed maps are distributed

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-08	Fremont County	Floodway Determination Mapping of Arkansas River - Eastern Fremont County	Floodway determination mapping of Arkansas River from Ash Street to S.H. 115	N/A	In Progress	FEMA working on County Wide floodplain modeling - this process takes several years before completed maps are distributed
2015-09	Fremont County	Beaver Park and Bear Creek Retention/Detention Ponds	Construct a series of 8 detention ponds on Bear Creek to prevent flooding on private lands and county roads	$36k	In Progress	Detention ponds on KP Creek are constructed. On-going with Bear Creek as funds are allowed.
2015-10	Fremont County	Right-of-Way Debris Management	Clear ROW for EM multiple uses	N/A	In Progress	R-O-W has been cleared and is kept free of debris as needed
2015-11	Fremont County	Wildfire Protection	Develop and implement CWPPs for different areas of the county	$5-20k per plan	On-going	Since the 2015 plan there have been CWPP's created for Indian Springs, Chandler Heights, Garden Park, South West Cañon and Upper Beaver Creek. Middle Arkansas Wildfire Prevention Partnership (MAWPP) is very active in mitigation efforts and mitigation. MAWPP does a lot of mitigation projects, and community education and slash collection events. Continued coordination with landowners in Fremont county to educate them on "Firewise" construction and landscaping. One project completed by Colorado State Forest Service. Southwest Cañon CWPP core team has completed about 10 acres of fuel break on the western edge of Dawson Ranch and the adjacent BLM land. The BLM completed an additional 6 (estimated) acres on their side of the fence.

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-12	Fremont County	Fuel Reduction and increase carrying capacity of drainage channel – Phantom Canyon drainage	Ensure adequate flow of major drainage and removal of fuel loading	N/A	Complete	Phantom Canyon has been repaired from previous flooding
2015-13	Fremont County Sanitation District	Stream Channel Armoring	Armoring stream and dry wash pipeline crossings in channels vulnerable to erosion	N/A	Unknown	Lead organization is not participating in this plan update
2015-14	Fremont County Sanitation District	Fuel Storage	Mobile fuel storage containers and truck	N/A	Unknown	Lead organization is not participating in this plan update
2015-15	Fremont County Sanitation District	Watertight Manhole Lids	Installation of 554 watertight frames and lids located in floodplains	N/A	Unknown	Lead organization is not participating in this plan update
2015-16	Fremont County Sanitation District	Backup Communication System	Two-way radio system for alternate means of communication	N/A	Unknown	Lead organization is not participating in this plan update
2015-17	Fremont County Sanitation District	Backup Power Generator at Service Center	(2) 25 kW Diesel-powered generators	N/A	Unknown	Lead organization is not participating in this plan update
2015-18	Fremont County Sanitation District	Ultraviolet (UV) Disinfection System Upgrade	Upgrade UV disinfection system to increase treatment capacity	N/A	Unknown	Lead organization is not participating in this plan update

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-19	Western Fremont FPD	Floodplain Mapping	Accurate LiDAR mapping of Arkansas River and Hayden Creek. Identify evacuation and road closure areas in the event of flooding. Will also allow targeted and cost-effective mitigation measures.	N/A	Unknown	Lead organization is not participating in this plan update
2015-20	Penrose Water District	Arkansas Penrose Pipeline Project to Diversify Raw Water Source	Arkansas-Penrose Pipeline Project: acquisition of raw water on the Arkansas River; diversion of water from a location near Penrose; construction of a conveyance pipeline to Penrose for beneficial use of the District's constituents; raw water storage.	N/A	Unknown	Lead organization is not participating in this plan update
2015-21	Cañon City	Floodplain and Hazard Mapping	8 drainages and river basin – update detail floodplain/floodway mapping.	$1.567M	On-going	Arkansas River Hydrologic Analysis and Floodplain Coordination Study completed 2016. LOMR for Arkansas River (Sand Creek to 9th Street) and Sand Creek completed 2015. Capacity and Flooding Analysis for the Cañon City Hydraulic and Irrigation Ditch completed 2019.

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-22	Cañon City	Flood Control – Abbey Drainage Basin	Multiple actions including riprapping channels, enlarge/open channels, construction of drop structures, inlet/outlet improvements, reinforced concrete box culverts, and reinforced concrete pipe.	$16.245 M	On-going	Stormwater COP CIP Project - Rhodes Ave Channel Improvements to be constructed spring 2021.
2015-23	Cañon City	Flood Control – Four Mile Creek Drainage Basin	Multiple actions including channel improvements, construction of detention basin, and RCBC.	$2.235 M	On-going	No progress made.
2015-24	Cañon City	Flood Control – Hogback Area Drainage Basin	Construction of 10 detention basins and installation of 3 culverts in the Hogback Basin.	$250 k	On-going	No progress made.
2015-25	Cañon City	Flood Control – N. 9th Street Drainage Basin	Construction of storm sewer and inlets on 9th Street in Cañon City	$5 M	On-going	Stormwater COP CIP Project - new stormsewer on N. 9th Street from US50 to Mystic Ave constructed summer 2020.
2015-26	Cañon City	Flood Control – North Sand Creek Drainage Basin	Erosion repair work and installation of corrugated metal piping and concrete reinforced box culverts in the North Sand Creek Drainage Basin.	$1.879 M	On-going	No progress made.

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-27	Cañon City	Flood Control – Northeast Cañon Drainage Basin	Multiple actions including riprapping channels, channel improvements, installation of one oversized detention basin, reinforced concrete box culverts, and arch pipe.	$9.275 M	On-going	Four future detention pond sites acquired - N. 9th Street X2 and N. 15th Street and South Street.
2015-28	Cañon City	Flood Control – South Sand Creek Drainage Basin	Multiple actions including installation of a pedestrian crossing and ditch crossing, open channels, construction of drop structures, reinforced concrete box culverts, reinforced concrete pipe, and a detention basin.	$9.082 M	On-going	Stormwater COP CIP Project - Dawson Ranch Culvert Improvements constructed spring 2020.

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-29	Cañon City	Drought Mitigation	Implement a plan to provide our water users with information regarding how to use water efficiently inside/outside the home or business. Create an on-line Water Efficiency Plan for Homeowners and Business Owners. Providing information to our water users will give them the tools that they can use to develop efficient water usage habits. This in turn will save them money and help save a finite water resource.	N/A	In Progress	Developing the Online Water Efficiency Plan for Homeowners and Business Owners. Working with PIO on community outreach webpages.
2015-30	Cañon City	Wildfire Education and Awareness Program	Community presentations, printing/purchase of educational materials	N/A	In Progress	Coordinated with CCAFPD to augment the Firewise program into their Ready, Set, Go program and fire prevention week activities. We also work together at community events together with both programs.
2015-31	Cañon City	Local Planning and Regulations	Develop and adopt a WUI Building Code	N/A	In Progress	City is adopting new IBC/IRC building codes in 2021.
2015-32	Cañon City	Structure and Infrastructure Projects	Expand and enhance the availability of water supplies in the WUI areas	>$100k	On-going	No progress made.

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-33	Cañon City	Structure and Infrastructure Projects	Creating defensible space around structures, infrastructure, and critical facilities.	>$100k	On-going	On-going meetings with many home and property owners around Fremont County regarding defensible space, wildfire plans, and evacuation considerations.
2015-34	Cañon City	Natural Systems Protection	Perform regular maintenance activities for fuel management, including cutting and maintaining firebreaks in WUI areas and sponsoring local slash and chipping programs for residents.	>$100k	On-going	Coordinating with Pine Ridge Subdivision for a slash collection event as well with our Middle Arkansas Wildfire Prevention Partnership (MAWPP) Partners in several counties for slash collection events.
2015-35	Cañon City	Install Actuators on Control Gates of the Cañon City Hydraulic Ditch Main Canal.	Actuators are electrically controlled systems allowing for regulation of water levels in the canal. The actuators stop the flow of irrigation water into the canals during heavy rain events. This does not address the additional problems of stormwater runoff into the canals that could cause flooding.	TBD	On-going	Capacity and Flooding Analysis for the Cañon City Hydraulic and Irrigation Ditch completed 2019.

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-36	Brookside	Vegetative Fuel Reduction	• Seek funding and real assistance to reduce vegetative fuels where natural vegetation and weeds interface with structures and infrastructure. • Continue to develop partnerships with other organizations to implement wildfire mitigation plans and other hazard reduction programs. • Create and maintain defensible space around structures and infrastructure.	$75k	On-going	Completed significant fire mitigation in Spring Creek Park with the aid of Youth Corps through GOCO grants in 2016 and 2020
2015-37	Brookside	Disaster-Resistant Community	Provide all residents/businesses with appropriate emergency preparedness information and supplies. Encourage residents to take personal action to protect private property from all potential disaster scenarios.	$5k	On-going	Town Clerk shares information that she receives via email with Town businesses.

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-38	Brookside	Drought-resistant community	Identify alternative water supplies for time of drought. Develop mutual aid agreements with alternative suppliers.	Staff time, TBD	On-going	See Vulnerability Assessment Plan updated annually
2015-39	Brookside	Earthquake Resistant Buildings/Infrastructure	Update building codes and practices related to appropriate levels of seismic safety. Further enhance seismic risk assessment to target high hazard buildings.	$20k	On-going	No progress made.
2015-40	Brookside	Thunderstorm run-off controls	Implement structural and non-structural flood mitigation measures for flood-prone properties. Seek engineering and project assistance to mitigate stormwater runoff. Develop and begin to implement a systematic process to evaluate and upgrade aging infrastructure such as transportation, drainage, utilities, and others that could be affected during a major natural disaster.	$400k	On-going	Town accomplished significant thunderstorm run-off controls in 2015.
2015-41	Florence	Floodplain and Hazard Mapping	Determine regulatory floodway limits within City of Florence	N/A	In Progress	FEMA working on County Wide floodplain modeling - this process takes several years before completed maps are distributed

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-42	Florence	Bridge Reconstruction	Existing bridge decks are obstructions to flood water flow. Raise decks to enable flood flow to remain in designated channels instead of inundating broad floodplains in populated areas.	TBD	Deferred	Not currently a top mitigation priority.
2015-43	Florence	Provide Stormwater Detention Pond	Obtain land sufficient for detention of runoff in two locations to mitigate downstream flooding and to improve discharge water quality from City storm drainage systems	TBD	Deferred	Not currently a top mitigation priority.
2015-44	Florence	Oak Creek Flood Channel Enlargement	Existing channel geometry is an obstruction to flood water flow. Increase channel dimensions to enable flood flow to remain in designated channel instead of inundating broad floodplain in populated areas.	TBD	Deferred	Not currently a top mitigation priority.

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-45	USDI - BLM	Fuel Load Thinning at Multiple Locations Throughout the BLM Managed Forest (Royal Gorge Field Office)	Mechanical thinning to reduce hazardous fuel; reduce hazardous fuel; protect Wildland Urban Interface (WUI); improve response to wildland fire; improve firefighter safety; improve forest and rangeland health; protect threatened and endangered species; control epidemic insects and disease; restore ecosystems.	N/A	Unknown	Lead organization is not participating in this plan update
2015-46	USDI - BLM	Arkansas Mountain Stewardship - Prescribed Fire	Prescribed fire to reduce hazardous fuel; protect Wildland Urban Interface (WUI); improve response to wildland fire; improve firefighter safety; improve forest and rangeland health; protect threatened and endangered species; control epidemic insects and disease; restore ecosystems.	N/A	Unknown	Lead organization is not participating in this plan update

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-47	Fremont County	Review and Update Plans and Procedures to Improve Disaster Response Efforts	Countywide response agencies and other personnel will meet periodically as part of a Planning Committee or Emergency Services Committee to review, update and develop operating plans and procedures to improve disaster response efforts among residents and geographical areas of Fremont County.	N/A	In Progress	We continue to have at least two countywide stakeholder meetings a year. The stakeholder meetings will be a combination Stakeholder/LEPC meeting moving forward. County Fire Chiefs, LEO, and EMS, meetings are held regularly. We have formed an EOC Team that is active in training, exercises, and EOC activation support. ARES has become very involved with comms and support in our region and county.
2015-48	Fremont County	Review and Update of Emergency Operations Center Procedures	Countywide response agencies and other personnel involved in EOC operations will meet regularly to improve, develop and enhance EOC operational procedures for future incidents.	N/A	In Progress	In our stakeholder/LEPC meetings, EOC Team, Fire Chiefs, LEO, EMS meetings we continue to plan for events and emergencies. ARES has stepped up to plan and support COMMS. The South Region COMMS committee is planning for and holding regional COMMS tabletop exercises where all stakeholders and agencies are involved. The COMMS TTX was very successful. We continue to update and acquire radios, batteries, computers, equipment, and EOC supplies as grant funding allows.

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-49	Fremont County	Continue to Improve Communication of Hazards to Residents	Continue development and participation in the regional Public Information Group, which works with members of local state and federal agencies in and around Fremont County to improve communications with residents before, during, and after a disaster or incident. The group offers multiple methods of dispersing information to residents of the county and the region. Development and participation involve regular meetings and training, as necessary.	N/A	In Progress	Fremont County is rolling out a new Alert and Warning system. EVERBRIDGE will be replacing TFCC. This is a strong and robust system with many routes to notify residents. FC OEM has written a new Alert and Warning Plan. FC OEM uses our new Fremont County Emergency Management Facebook Page to pass along all types of communications to citizens and agencies as well. With 2020 HSG Grants we hope to get a towable VMS Board for more messaging capabilities to citizens and the AFN community.

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-50	Fremont County	Coordination of Testing of Emergency Communication Systems	Tests of emergency notification systems will be scheduled and coordinated with local, county, and regional agencies. These tests may be scheduled and tracked during meetings of personnel involved in the EOC operations, the regional Public Information Group, or the Planning Committee and Emergency Services Committee.	N/A	In Progress	FRECOM is developing a new Emergency Alert testing plan that will work with the new Alert and Warning Plan. When this plan is complete there will be coordinated monthly tests of the new EVERBRIDGE Alert and Warning system. Already conducted testing of the EVERBRIGE system with my EOC Team.
2015-51	Cañon City	Flood Control – Orchard Avenue Drainage Basin	Multiple actions including stabilizing channels, enlarge/open channels, construction of drop structures, inlet/outlet improvements, reinforced box culverts, detention basin work, and reinforced concrete pipe.	TBD	On-going	No progress made.
2015-52	Florence	Backup Emergency Mobile Communications System	Mobile communication vehicle and two-way radio system for alternative communication for use in case of failure of County system.	TBD	Deferred	Not currently a top mitigation priority.

ID	Org.	Title	Description	Cost Est.	2021 Status	2021 Notes
2015-53	Florence	Identify and Remove Dangerous Trees and Branches from City Streetscape	Identify and remove decayed trees and limbs to prevent or minimize property damage and loss of life in high wind storms	TBD	On-going	
2015-54	Florence	Identify earthquake-prone unreinforced structures	Assess and identify non-reinforced structures prone to earthquake damage.	TBD	Deferred	Not currently a top mitigation priority.

2021 ACTIONS

Table 3 includes all new and deferred mitigation actions included in this updated 2021 HMP. In order to prioritize the mitigation actions in this plan, the county and each participating jurisdiction reviewed FEMA's STAPLEE methodology, in addition to a number of additional criteria. This allowed for a careful review of the feasibility of mitigation actions.

Following is a list of those prioritization criteria that each jurisdiction considered. FEMA mitigation planning requirements indicate that any prioritization system used shall include a special emphasis on the extent to which benefits are maximized according to a cost-benefit review of the proposed projects.

- Positive Cost-Benefit
- Social considerations – life/safety impact
- Social equity
- Administrative considerations – administrative / technical assistance
- Economic considerations – project cost / reductions in future disaster costs
- Alignment with other local objectives
- Environmental considerations
- Lifeline protection
- Legal considerations
- Availability of local funding

Ultimately, it was decided by the Steering Committee that mitigation actions would be prioritized by each community using a three-tiered High, Medium, or Low methodology.

As part of the planning process, a *Mitigation Strategy Action Idea* document was developed. This guide identified a number of additional mitigation actions that were considered during development of this mitigation strategy. Appendix B: includes this guide for future reference.

TABLE 3. 2021 MITIGATION ACTIONS

ID	Juris-diction	Title	Description	Priority	Goals / Obj. Met	Lead and Support Org.	Hazard(s) Mitigated	Potential Funding Source	Expected Complete Year
2021-01	Fremont County	Assist with implementation of community wildfire protection plans (CWPPs)	There are currently 6 communities across Fremont County with local CWPPs. These plans have identified numerous mitigation actions to take, but access to funding and resources for implementation are oftentimes a challenge for communities. Fremont County will support these communities in identifying and pursuing available grant funding opportunities. Additionally, the county will coordinate with these communities to develop a master CWPP action tracker to assist with wildfire mitigation prioritization and progress reporting.	High	1a, 4b	Fremont County EM	Wildfire, Flood, Debris Flow, Landslide, Subsidence / Erosion	FEMA HMA, County budget	On-Going, 2026
2021-02	Fremont County	Firewise Program	Continue to travel around Fremont County to community events and promote the Firewise Program and do home assessments with home and property owners.	High	1c, 3abc	Fremont County EM	Wildfire	County Budget, HSGP	On-Going, 2026
2021-03	Fremont County	Assist with Firewise Communities	Assist local communities, subdivisions, and homeowner associations with becoming a recognized Firewise Community	High	1c, 3abc	Fremont County EM	Wildfire	FEMA HMA, HMGP Post Fire	2026
2021-04	Fremont County	Support municipalities in becoming StormReady Communities	Assist the National Weather Service with data collection, plans, and procedures to make Cañon City and other Fremont County municipalities recognized StormReady Communities.	High	1c, 3abc	Fremont County EM	Severe Winter Weather, Thunderstorm, Tornado	County budget	2026

ID	Juris-diction	Title	Description	Priority	Goals / Obj. Met	Lead and Support Org.	Hazard(s) Mitigated	Potential Funding Source	Expected Complete Year
2021-05	Fremont County	Continue to assist with projects in Bear Creek / CR49	Continue to assist with mitigation, planning, monitoring, and recovery projects in Bear Creek / CR49 due to the Decker Fire.	High	1a, 2a, 4a	Fremont County EM	Wildfire, Flood, Debris Flow, Landslide, Subsidence / Erosion	DOLA, HMGP Post Fire, FEMA HMA	2026
2021-37	Fremont County	Broadband Internet Feasibility Study	Conduct a feasibility study to identify options for expanding broadband internet service for all areas of the county. The current lack of reliable internet access is an impediment to communication across the county and can negatively impact vital community lifelines.	Medium	1a, 1b	Fremont County	All	USDA, FCC, NTIA	2023
2021-40	Fremont County	Intersection Drainage Improvement (Kelso/CR 47)	Upgrade culvert to 42" squash tube or comparable. Located at the intersection of Kelso Rd. & CR 47.	Medium	1a	Fremont County	Flood	County budget	2022
2021-41	Fremont County	Intersection Drainage Improvement (Ash/Grandview)	Upgrade culvert to 42" squash tube or comparable. Located at the intersection of Ash St. and Granview Ave.	Medium	1a	Fremont County	Flood	County budget	2023
2021-08	Brookside	Vegetative Fuel Reduction	Seek funding and real assistance to reduce vegetative fuels where natural vegetation and weeds interface with structures and infrastructure. Continue to develop partnerships with other organizations to implement wildfire mitigation plans and other hazard reduction programs. Create and maintain defensible space around structures and infrastructure.	High	1a, 4a	Town, County EM	Wildfire	Continued research of grant sources, Town Budget, FEMA HMA, HMGP Post Fire	On-Going, 2026

ID	Juris-diction	Title	Description	Priority	Goals / Obj. Met	Lead and Support Org.	Hazard(s) Mitigated	Potential Funding Source	Expected Complete Year
2021-09	Brookside	Disaster-Resistant Community	Provide all residents/businesses with appropriate emergency preparedness information and supplies. Encourage residents to take personal action to protect private property from all potential disaster scenarios.	High	1a, 3abc, 4a	Town, County EM	Multiple	Continued research of grant sources, Town Budget, FEMA HMA	On-Going, 2026
2021-10	Brookside	Drought-resistant community	Identify alternative water supplies for time of drought. Develop mutual aid agreements with alternative suppliers.	High	1ab, 4a	Town	Drought	Continued research of grant sources, Town Budget, FEMA HMA	On-Going, 2026
2021-11	Brookside	Earthquake Resistant Buildings / Infrastructure	Update building codes and practices related to appropriate levels of seismic safety. Perform further enhanced seismic risk assessment to target high hazard buildings.	Low	1ab, 2b, 5ab	Town	Earthquake	Continued research of grant sources, Town Budget, FEMA HMA	On-going, 2026
2021-12	Brookside	Thunderstorm run-off controls	Implement structural and non-structural flood mitigation measures for flood-prone properties. Seek engineering and project assistance to mitigate stormwater runoff. Develop and begin to implement a systematic process to evaluate and upgrade aging infrastructure such as transportation, drainage, utilities, and others that could be affected during a major flood event.	Medium	1ab, 5b	Town	Flood, Debris Flow, Landslide	Continued research of grant sources, Town Budget, FEMA HMA	On-Going, 2026

ID	Juris-diction	Title	Description	Priority	Goals / Obj. Met	Lead and Support Org.	Hazard(s) Mitigated	Potential Funding Source	Expected Complete Year
2021-13	Brookside	Pandemic Support	Provide education and outreach to the community to improve compliance with public health orders.	High	1a, 3c	Town, County EM	Pandemic	Continued research of grant sources, Town Budget, DOLA	2021
2021-15	Cañon City	Floodplain and Hazard Mapping	8 drainages and river basin – update floodplain/floodway mapping as well as continue to update/revise Master Drainage Plans providing information for risk assessment, identifying infrastructure needs, and funding priorities.	High	1b, 2a, 5b	City, County	Flood	FEMA, FEMA HMA, City	On-Going, 2026
2021-16	Cañon City	Flood Resiliency / Natural Systems Protection	Acquire and remove Repetitive Loss Structures as well as flooded properties. Acquire and preserve floodplains. Maintain NFIP/CRS participation and compliance.	High	1a, 2b, 4a	City, County	Flood	FEMA HMA, City	2026
2021-17	Cañon City	Flood Control – Abbey Drainage Basin	Multiple actions including riprapping channels, enlarge/open channels, construction of drop structures, inlet/outlet improvements, reinforced concrete box culverts, and reinforced concrete pipe. Double size of Abbey Detention Basin to accommodate Hydraulic Ditch overflow.	High	1a	City	Flood	FEMA HMA, City	On-going, 2022/2023
2021-18	Cañon City	Flood Control – Four Mile Creek Drainage Basin	Multiple actions including channel improvements, construction of detention basin, and RCBC.	High	1a	City	Flood	FEMA HMA, City	On-going, 2026

ID	Juris-diction	Title	Description	Priority	Goals / Obj. Met	Lead and Support Org.	Hazard(s) Mitigated	Potential Funding Source	Expected Complete Year
2021-19	Cañon City	Flood Control – Hogback Area Drainage Basin	Modification of 10 existing detention basins/culverts in the Hogback Basin.	High	1a	City	Flood	FEMA HMA, City	On-going, 2026
2021-20	Cañon City	Flood Control – N. 9th Street Drainage Basin	Construction of addition storm sewer and inlets on 9th Street north of Mystic Ave. Enlargement of storm sewer on 9th Street from US 50 to river.	High	1a	City	Flood	FEMA HMA, City	On-going, 2026
2021-21	Cañon City	Flood Control – North Sand Creek Drainage Basin	Erosion repair work and installation of corrugated metal piping and concrete reinforced box culverts in the North Sand Creek Drainage Basin.	High	1a	City	Flood	FEMA HMA, City	On-going, 2026
2021-22	Cañon City	Flood Control – Northeast Cañon Drainage Basin	Multiple actions including riprapping channels, channel improvements, installation of one oversized detention basin, reinforced concrete box culverts, and arch pipe.	High	1a	City	Flood	FEMA HMA, City	On-going, 2026
2021-23	Cañon City	Flood Control – South Sand Creek Drainage Basin	Multiple actions including open channels, construction of drop structures, reinforced concrete box culverts, reinforced concrete pipe, and a detention basin.	High	1a	City	Flood	FEMA HMA, City	On-going, 2026
2021-24	Cañon City	Flood Control – Orchard Avenue Drainage Basin	Multiple actions including stabilizing channels, enlarge/open channels, construction of drop structures, inlet/outlet improvements, reinforced box culverts, detention basin work, and reinforced concrete pipe. Acquisition of property south of US50 for outfall to river.	High	1a	City	Flood	FEMA HMA, City	On-going, 2026

ID	Juris-diction	Title	Description	Priority	Goals / Obj. Met	Lead and Support Org.	Hazard(s) Mitigated	Potential Funding Source	Expected Complete Year
2021-25	Cañon City	Stormwater Infrastructure Funding	Formation of a Stormwater Utility District to more equitably and substantially fund stormwater infrastructure in the greater Cañon City area.	High	1ab, 2b, 4c, 5b	City, County	Flood	FEMA HMA, City	2022/2023
2021-26	Cañon City	Drought Mitigation	Identify alternative water supplies and water storage rights.	High	1b	City	Drought, Water Source Protection	Continued research of grant sources, City Budget, FEMA HMA	2026
2021-27	Cañon City	Water Treatment Redundancy	Build secondary raw water settling pond to be used when primary pond is offline.	High	1a	City	Drought, Water Source Protection	Continued research of grant sources, City Budget, FEMA HMA	2026
2021-28	Cañon City	Local Planning and Regulations	Update Building and Land Use Codes to mitigate hazards to life and property.	High	1a, 2b, 5b	City	Multiple	City budget, FEMA HMA	2021/2022
2021-33	Cañon City	Expand Water Supplies in WUI	Expand and enhance the availability of water supplies in the WUI areas	High	6a, 7a	City	Wildfire	City Budget, FEMA HMA	On-going, 2026
2021-34	Cañon City	Defensible Space	Creating defensible space around structures, infrastructure, and critical facilities.	High	6a, 7a	City	Wildfire	City Budget, FEMA HMA	On-going, 2026

ID	Juris-diction	Title	Description	Priority	Goals / Obj. Met	Lead and Support Org.	Hazard(s) Mitigated	Potential Funding Source	Expected Complete Year
2021-35	Cañon City	Wildland Fuel Management	Perform regular maintenance activities for fuel management, including cutting and maintaining firebreaks in WUI areas and sponsoring local slash and chipping programs for residents.	High	2a, 6a, 7a	City	Wildfire	City Budget, FEMA HMA	On-going, 2026
2021-36	Cañon City	Install Actuators on Control Gates of the Cañon City Hydraulic Ditch Main Canal.	Actuators are electrically controlled systems allowing for regulation of water levels in the canal. The actuators stop the flow of irrigation water into the canals during heavy rain events. This does not address the additional problems of stormwater runoff into the canals that could cause flooding.	High	6a, 7b	City	Flood	City Budget, FEMA HMA	On-going, 2026
2021-06	Coal Creek	Flood Control	Coal Creek is a small community with gravel roads for the most part. The town is basically built on a slope, with two large gullies that dissect the town. These gullies are a product of years of heavy runoff, which was likely exaggerated by the early years of coal mining. Mitigation for flood control would be top of the list for Coal Creek. Proposed project is a two phased approach including: a) engineering study to identify potential mitigation solutions, and b) project implementation.	High	1a	Town	Flood, Debris Flow	FEMA HMA	2026

ID	Juris-diction	Title	Description	Priority	Goals / Obj. Met	Lead and Support Org.	Hazard(s) Mitigated	Potential Funding Source	Expected Complete Year
2021-07	Coal Creek	Fire Hazard Fuel Reduction	Situated on the southern slope of Eastern Fremont County, precipitation typically is less than other areas of Fremont County, but it is not uncommon to have very heavy rainfall at times along with some heavy hail storms. Most of the year is typically very dry, but the moisture we do receive creates a lot of weeds and undergrowth which we fight every summer as best we can. Project would fund community-wide fuel reduction efforts.	High	1a	Town	Wildfire	FEMA HMA, HMGP Post Fire	2026
2021-29	Florence	Coal Creek Channel Improvement	Assess and create a project to increase capacity in the Coal Creek Channel and work on trying to mitigate the bottleneck that creates a large swath of downtown floodplain	High	6a, 7B	City	Flood	City Budget, FEMA HMA	2026
2021-30	Florence	Cultural Resource Hazard Mitigation & Planning Study	Historic property assessment of those structures at risk to natural hazards and how best to mitigate.	High	1c, 7a-d, 8ab	City	Multiple	City Budget, DOLA, FEMA HMA	2026
2021-38	Florence	Identify and Remove Dangerous Trees and Branches from City Streetscape	Identify and remove decayed trees and limbs to prevent or minimize property damage and loss of life in high wind storms	Moderate	1a	City	Thunderstorm	City Budget	2026

ID	Juris-diction	Title	Description	Priority	Goals / Obj. Met	Lead and Support Org.	Hazard(s) Mitigated	Potential Funding Source	Expected Complete Year
2021-39	Florence	Review and Update Stormwater Regulations	Update the City's existing stormwater and drainage regulations.	Moderate	1a, 5b	City	Flood	City Budget	2026
2021-31	Rockvale	Develop a CWPP	Development of a Community Wildfire Protection Plan (CWPP) to help develop partnerships and identify projects and implementation plans to mitigate the risk of wildfire to our Town.	High	3b, 7a	Town	Wildfire	Town Budget, FEMA HMA	2026
2021-32	Rockvale	Oak Creek Debris Reduction Project	Project goals would be to remove excess vegetation and tree debris from Oak Creek, to help reduce future damages these materials could cause during a dam, flood, or wildfire event. Coordination with private landowners will ensure that the entire stream reach can be mitigated.	High	6a, 7ab	Town	Dam Failure, Debris Flow, Flood, Wildfire	Town Budget, FEMA HMA	2026
2021-14	Williams-burg	Stormwater management - paved road upgrade	Bring paved roads across Town up to State standards to allow for proper stormwater management. Junction of Churchhill Ave. and Quincy Ave.	High	1a	Town Board of Trustees	Flood	Continued research of grant sources, Town Budget, FEMA HMA	2026
2021-36	Williams-burg	Stormwater management - paved road upgrade	Bring paved roads across Town up to State standards to allow for proper stormwater management. Central Ave.	Medium	1a	Town Board of Trustees	Flood	Continued research of grant sources, Town Budget, FEMA HMA	2026

ID	Juris-diction	Title	Description	Priority	Goals / Obj. Met	Lead and Support Org.	Hazard(s) Mitigated	Potential Funding Source	Expected Complete Year
2021-37	Williams-burg	Stormwater management - paved road upgrade	Bring paved roads across Town up to State standards to allow for proper stormwater management. Remaining portions of Quincy Ave	Low	1a	Town Board of Trustees	Flood	Continued research of grant sources, Town Budget, FEMA HMA	2026

PLAN MONITORING AND MAINTENANCE

Fremont County will actively maintain this HMP by coordinating a review of all mitigation actions annually. This process is currently followed and allows jurisdictions to report on progress made towards implementing the mitigation actions identified in this plan. Fremont County's Emergency Manager will present this summary status report to the Fremont County Commissioners annually. This report will be made available to the general public.

Additional stakeholder meetings will be coordinated as needed, as mitigation opportunities are identified. Fremont County's Emergency Manager will also disseminate information relating to potential mitigation funding resources to communities and the Steering Committee as application periods are identified.

The 2021 Plan will be updated by the FEMA approved five-year anniversary date, as required by the Disaster Mitigation Act of 2000, or following a disaster event. Future HMP updates will account for any new hazard vulnerabilities, special circumstances, or new information and data that becomes available. During the five-year review process, the following questions will be considered as criteria for assessing the effectiveness of the Fremont County HMP.

- Has the nature or magnitude of hazards affecting the county changed?
- Are there new hazards that have the potential to impact the county?
- Do the identified goals and actions address current and expected conditions?
- Have mitigation actions been implemented or completed?
- Has the implementation of identified mitigation actions resulted in expected outcomes?
- Are current resources adequate to implement the plan?
- Should additional local resources be committed to address identified hazards?

Issues that arise during monitoring and evaluation which require changes to the local hazard, risk and vulnerability summary, mitigation strategy, and other components of the plan will be incorporated during future updates.

PLANNING INTEGRATION

Fremont County maintains a comprehensive set of emergency management plans, developed in a multi-disciplinary environment where county departments, jurisdictional agencies and representatives, non-profit and community organizations, and the private sector are included in the planning process. This set of plans encompass all phases of emergency management and the work done on the 2021 Fremont County HMP will be integrated into these efforts moving forward.

By integrating the HMP with the county's comprehensive set of emergency management plans, a strong foundation for resilience can be set through smart emergency preparedness, mitigation, response, and recovery; before, during, and after an emergency or disaster event.

Additionally, there are a number of other community plans that will benefit from strategies and content within this HMP. Integrating components of this plan across other community planning efforts will be an ongoing effort and will help to ensure no strategic conflicts are created through other planning processes. This will also help to ensure that hazard mitigation is considered during all applicable future county, municipal, and regional planning efforts. Some of the larger opportunities for impactful integration involve comprehensive plans, transportation plans, building codes, community wildfire protection (and implementation) plans, and annual capital expenditure planning.

Community Wildfire Protection Plans

The Fremont County Community Wildfire Protection Plan (CWPP) is a direct extension of the National Fire Plan authorized by Congress, as a response to the tragic summer wildfires of 2000. As a component of the National Fire Plan, the CWPP is meant to help coordinate fire readiness efforts between local communities and federal agencies through four major goals.

- Ensure firefighting resources are available.
- Rebuild communities and ecosystems damaged by wildfire.
- Thin vegetation in areas where public lands and developing areas meet.
- Help local residents to reduce fire risk and improve fire protection.

This countywide CWPP has been developed to assist the Sheriff, Fire Officials, and residents of Fremont County in the identification of private and public lands at risk of severe wildfire and explore strategies for the prevention and suppression of such fires. The intent of the CWPP was to take a closer look at the scientific factors that influence fire behavior in a particular area or region.

Fremont County has four County Fire Protection Districts: Cañon City, Florence, South Arkansas, and Deer Mountain. Some remaining unincorporated land is covered by multiple volunteer fire departments, including Howard, and the Tallahassee Volunteer Fire Protection. Since the countywide CWPP was created in 2008, a number of localized CWPPs have been developed for specific communities across the county. Current local CWPPs are shown in Figure 8 and include:

- Dakota Hideout (2015)
- Four Mile - Current Creek (2013)
- Garden Park (2013)
- Indian Springs (2016)
- Southwest Cañon (2014)
- Upper Beaver Creek (2015)

These plans assist each community in the identification of subdivision and surrounding private and public lands at risk from wildfire. They identify mitigation strategies for reducing wildfire fuels while improving forest health, structure protection, increasing community preparedness, supporting the local economy, and improving firefighting response capabilities.

CONTINUED PUBLIC ENGAGEMENT

To sustain public support of mitigation, it is important to continually engage the community. As mentioned previously, there will be a number of opportunities for public touchpoints during both plan monitoring and integration efforts. These will provide updates on plan implementation activities and will also show how this HMP aligns with other community planning processes.

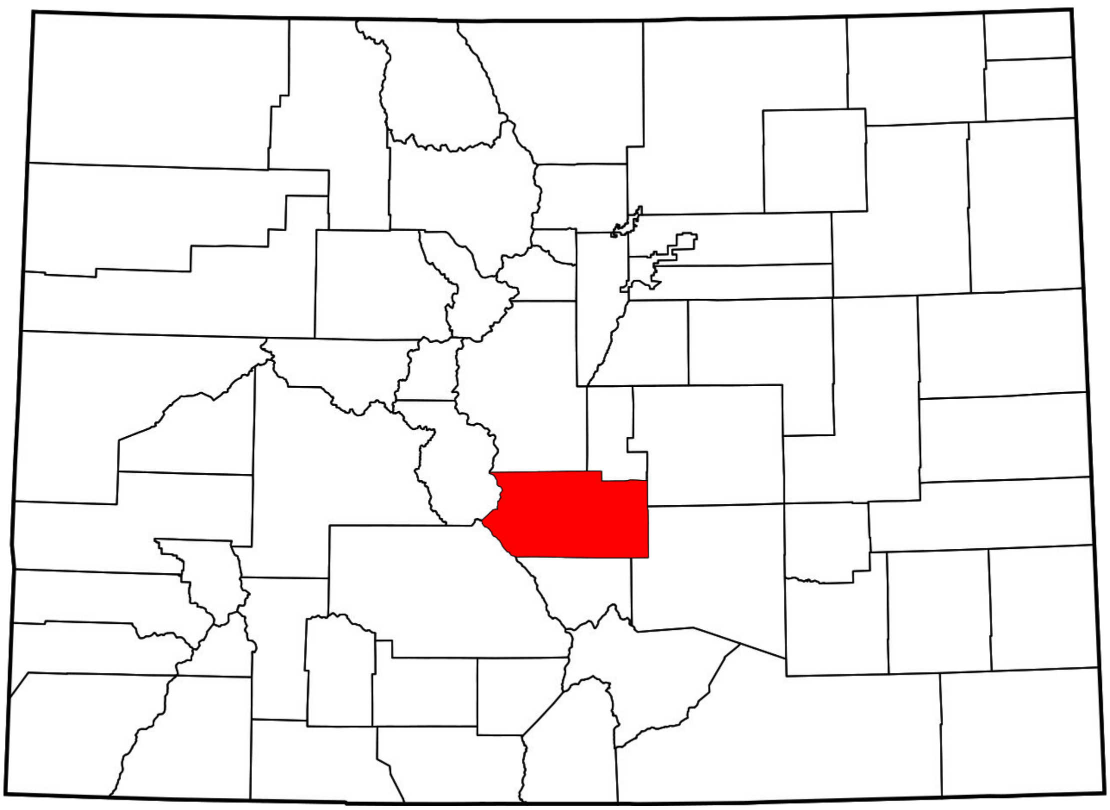
Additional public education activities will occur through the continued use of county social media and website postings. This content will focus on educating the public about hazards which impact the county and progress made towards mitigating them. The county has been successfully utilizing these tools for these same purposes previously and this messaging has been well received by the public.

Other efforts aimed at continued public participation will include mitigation-specific public outreach and engagement activities (e.g. information booths / spots at community events, etc.). During these engagements, it is important to not only educate the public but to solicit feedback regarding community thoughts on hazard mitigation.

Chapter 2: FREMONT COUNTY PROFILE

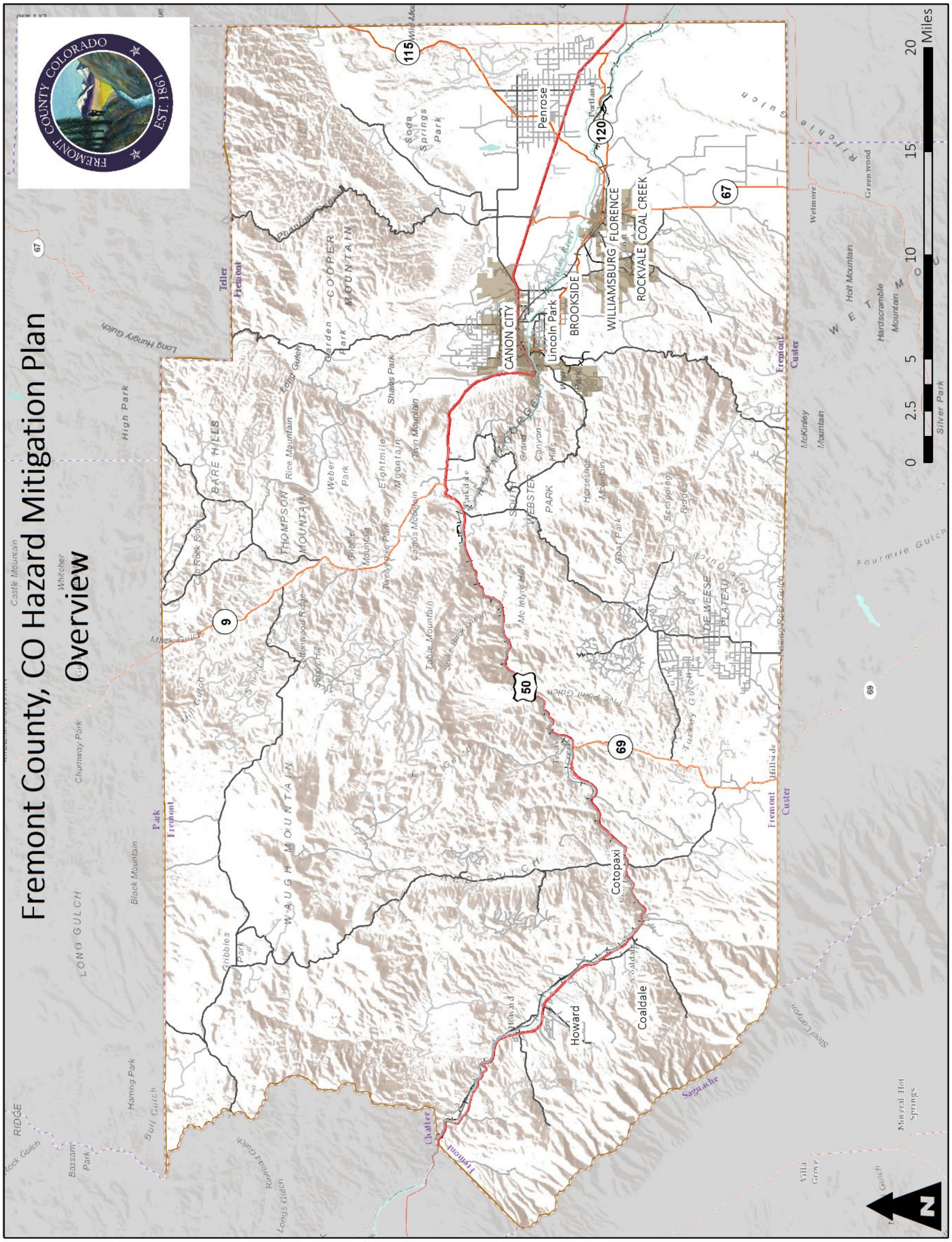
Fremont County covers approximately 1,500 square miles in south-central Colorado (Figure 6-1). The county lies along the Arkansas River valley at the foot of the Rocky Mountains. Fremont County communities include the cities of Cañon City and Florence, as well as the incorporated towns of Brookside, Coal Creek, Rockvale and Williamsburg. Cañon City is the largest city in the county and is the county seat. The county is the 16th most populous of Colorado's 64 counties, with a population of 47,839, based on 2019 US Census data.

FIGURE 2: LOCATION OF THE FREMONT COUNTY WITHIN THE STATE OF COLORADO



The geography of Fremont County varies from the plains in the east to the Sangre De Cristo Mountain range that forms the western boundary of the county. Fremont County is within the Arkansas River Basin and is bisected from west to east by the upper Arkansas River. At the Royal Gorge, located outside of Cañon City, the Arkansas River has carved a canyon approximately 1,000 feet deep.

FIGURE 3: FREMONT COUNTY OVERVIEW



Adjacent counties include:

- Teller County - north
- El Paso County - northeast
- Pueblo County - southeast
- Custer County - south
- Saguache County - southwest
- Chaffee County - northwest
- Park County - northwest

Fremont County consists primarily of rural, undeveloped land dedicated to the production of livestock. Increasingly, private lands are being developed (especially when adjacent to public lands) as residential areas.

The cities and incorporated towns of Fremont County have four fire protection districts, volunteer fire agencies, and a search and rescue organization. City and county law enforcement oversee public safety and there are two medical districts that provide medical services to the majority of the county. Fremont County is home to a total of 13 correctional facilities. Nine are state run and there are four different facilities on the Federal Correctional Complex (FCC). These facilities are the primary employers in the region.

The main highway transportation route in the county is U.S. Highway 50, which bisects the county east to west, passing through Cañon City and connecting to both Pueblo County and Chaffee County. Other main routes, running north to south, include State Highway 9 which connects to Park County and State Highway 67, which connects to Custer County to the south and Teller County to the north, through Florence. State Highway 115 and State Highway 120 are main routes from Pueblo County through Florence and up to Cañon City.

HISTORY AND RESOURCE OVERVIEW

The majestic Royal Gorge Canyon is a focal point of Fremont County history and the Royal Gorge Bridge, owned by the City of Cañon City, is one of the major tourist attractions. Beautiful natural attractions, including the Arkansas River, the Pike and San Isabel National Forests, and the Sangre de Cristo wilderness, draw numerous visitors to the area year-round.

Fremont County took its name from western explorer Captain John C. Fremont, who, along with his scout Kit Carson, mapped the territory in 1843. The Pikes Peak Gold Rush in 1859 brought more residents, resulting in the settlement of Cañon City, Florence, and the Hardscrabble area.

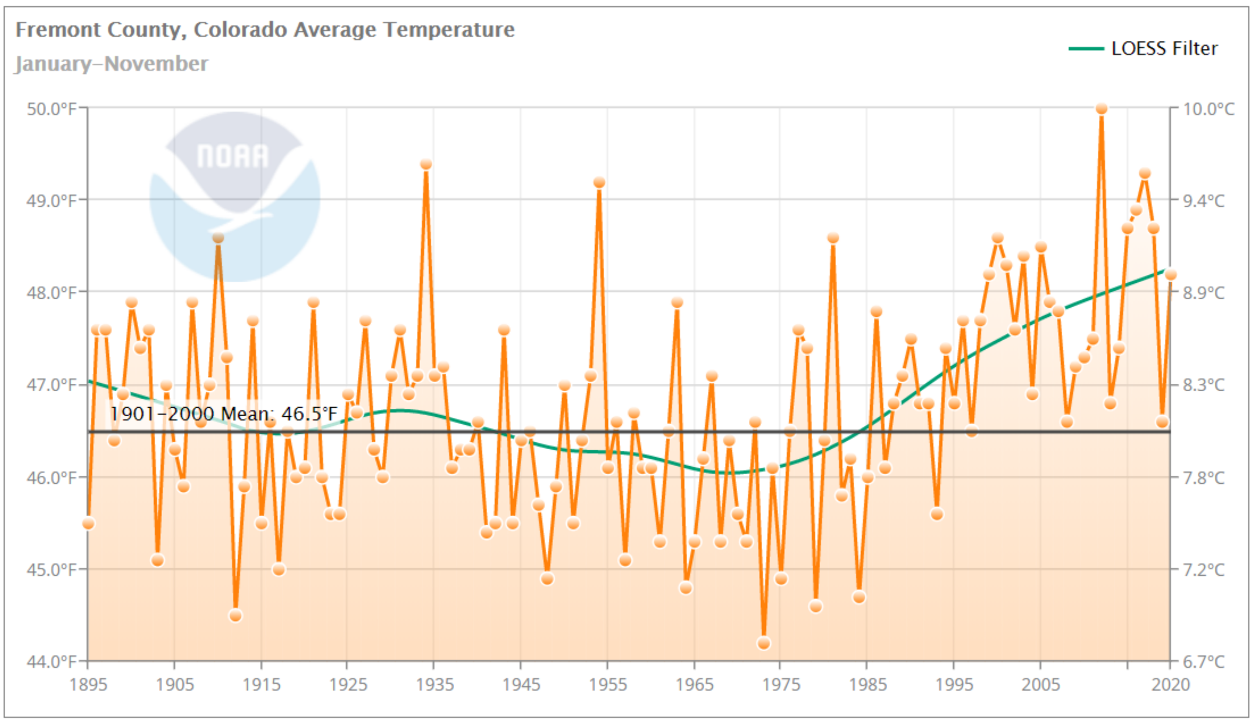
Early in 1860, the first mining claim for coal was filed in Fremont County near what is now known as Coal Creek. Oil discovery and production began shortly thereafter. Over time there has been mining for iron, gypsum, marble, limestone, and granite. Mining continues in the county today.

In 1871, the first Colorado Territory prison was built in Fremont Count. Since then, Fremont County has expanded to include several state and federal correctional facilities.

CLIMATE

The climate of Fremont County is wide-ranging across its diverse topography and conditions can change quickly. Due to the changes in elevation across the county, temperatures, precipitation, and snow accumulation can vary significantly. The information in this section is based on NOAA long-term average annual data from the weather station in Cañon City.

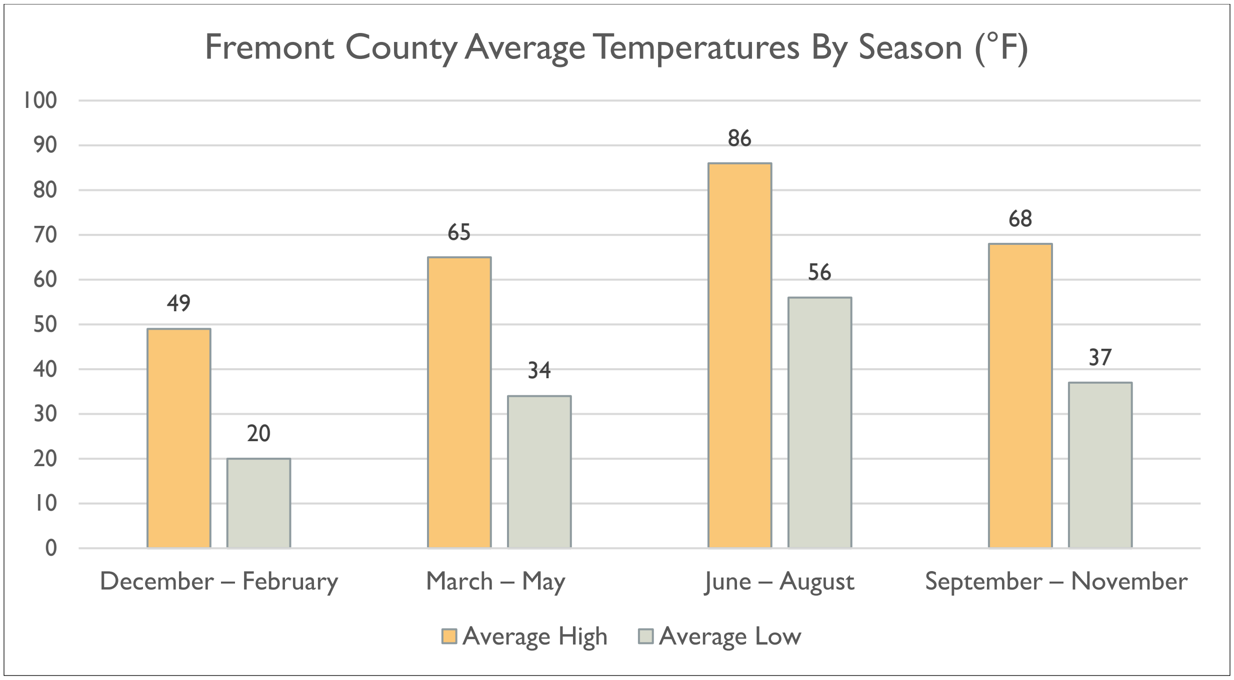
FIGURE 4. MEAN ANNUAL COLORADO TEMPERATURE TRENDS (1895 – 2019)



SOURCE: NOAA CLIMATE DATA ONLINE

Figure 4 shows the overall average of each year's temperatures based on NOAA data beginning in 1895. The annual average seasonal temperatures range between a high of 86°F and low of 20°F. Highest temperatures are seen June through August, with spring and fall having milder high temperatures in the 60°F to 70°F range. Low temperatures across the seasons range between 20°F in the winter and over 50°F in the summer.

FIGURE 5. FREMONT COUNTY AVERAGE TEMPERATURES BY SEASON (°F)



Source: NOAA Climate Data Online

Based on NOAA long-term average data from the weather station in Cañon City, the total average annual precipitation is roughly 14 inches falling primarily in spring and summer, with an average of 9 inches falling between March and August. Long-term annual average of snowfall is around 40 inches, with the majority of snowfall occurring between December and February, averaging around 20 inches.

TABLE 4. SNOWFALL AND PRECIPITATION

Season	Average Precipitation (Inches)	Average Snowfall (Inches)
December – February	1.5	20
March – May	4	13
June – August	5	0
September – November	8	3
Annual	14	41

Source: NOAA Climate Data Online

COMMUNITY LIFELINES

The community Lifelines framework was developed by FEMA to increase effectiveness in disaster operations and enable the continuous functioning of critical government, infrastructure, and business activities. In day-to-day community functions, Lifelines support the recurring needs of the community. When these Lifelines are stabilized, they safeguard the health, safety, and well-being of the public during a natural disaster occurrence.

Lifelines were created to provide an outcome-based, survivor-centric framework to assist responders with determining the scale, complexity, and severity of a disaster. This information is used to establish operational priorities for the response and involves identifying the root causes and interdependencies of impacts to critical services, especially those that are life-sustaining or lifesaving.

An important component to the Lifeline framework is the ability to communicate disaster-related information across all levels of public, private, and non-profit sectors using commonly understood, plain language. This is vital to preparedness education, community engagement, and public outreach.

Each Lifeline category has subcomponents which impact the functionality of the lifeline. The lifeline categories and subcomponents are:

- Safety and Security
    - Law Enforcement/Security
    - Fire Service
    - Search and Rescue
    - Government Service
    - Community Safety
- Food, Water and Shelter
    - Food
    - Water
    - Shelter
    - Agriculture
- Health and Medical
    - Medical Care
    - Public Health
    - Patient Movement
    - Medical Supply Chain
    - Fatality Management
- Energy
    - Power
    - Fuel
- Communications
    - Infrastructure
    - Responder Communications
    - Alerts, Warnings, and Messages
    - Finance
    - 911 and Dispatch
- Transportation
    - Highway/Roadway/Motor Vehicle
    - Mass Transit
    - Railway
    - Aviation
    - Maritime
- Hazardous Materials
    - Facilities
    - HAZMAT
        - Pollutants
        - Contaminants

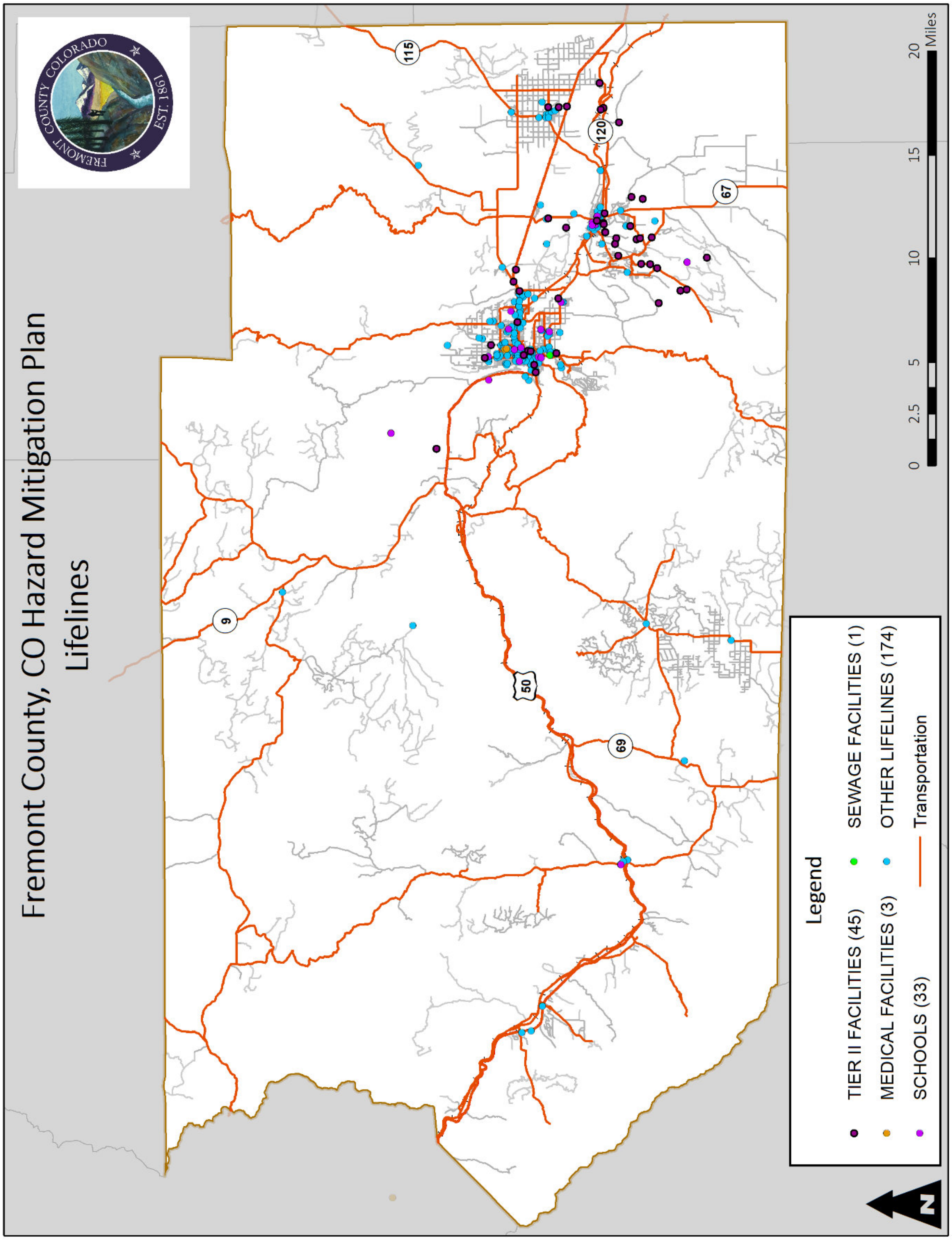
The inclusion of the community Lifelines in planning and mitigation strategy is important to address critical processes and infrastructure specific to Fremont County. Identifying the Lifelines across the county creates a better understanding of effects from hazards and risks to assets. Figure 6 shows the Lifelines and their components specific to Fremont County. Within those components, Fremont County identified specific assets.

Figure 6. Fremont County Lifeline Components

LIFELINES	Communications	Energy	Food, Water, Shelter	Hazardous Material	Health and Medical	Safety and Security	Transportation
COMPONENTS	Infrastructure	Power	Food	Facilities	Medical Care	Law Enforcement	Highway / Roadway
	Emergency Messaging	Fuel	Water	HAZMAT / Etc.	Patient Movement	Search and Rescue	Mass Transit
	911 / Dispatch		Shelter		Public Health	Fire Services	Railway
	Responder Comms		Agriculture		Facility Management	Government Services	Aviation
	Financial Services				Medical Supply Chain	Community Safety	
FREMONT COUNTY INPUTS	Post Office	Power Plant	-Schools -Arena -Assisted Living -Church -Daycare -County Fairground -Non-profit School -Senior Center -Senior Living -Water Treatment	-Sewage Facility -Hazmat Routes -TIER II Facilities	-Medical Facility -Clinic -Hospital -Mortuary -Rehabilitation -Veterinary	-County Shop -Fire Station -Government City / County / State / Federal -Police Station -Juvenile Prison -Sherriff	-Airport -Railroad -Road Freeway / Principal / Minor Arterial / Collector

After collecting lifeline and asset data across the county, GIS mapping and analysis was conducted as part of the risk and vulnerability assessment. Figure 7 illustrates the product of these mapping efforts.

FIGURE 7. FREMONT COUNTY LIFELINES ASSESSED



MITIGATION CAPABILITIES

The mitigation capability assessment examines the ability of Fremont County to implement and manage the comprehensive mitigation strategy laid out in this plan. The strengths, weaknesses, and resources of the county are identified here as a means for evaluating and maintaining effective and appropriate management of the county's hazard mitigation program.

Mitigation capabilities are classified into the following types and are detailed in the following Tables.

- Planning & Regulatory
  - Plans
  - Building Code, Permitting, & Inspection
  - Land Use Planning & Ordinances
- Administrative & Technical
  - Administration
  - Staff
  - Technical
- Financial
  - Funding Resources
- Education & Outreach
  - Programs & Organizations

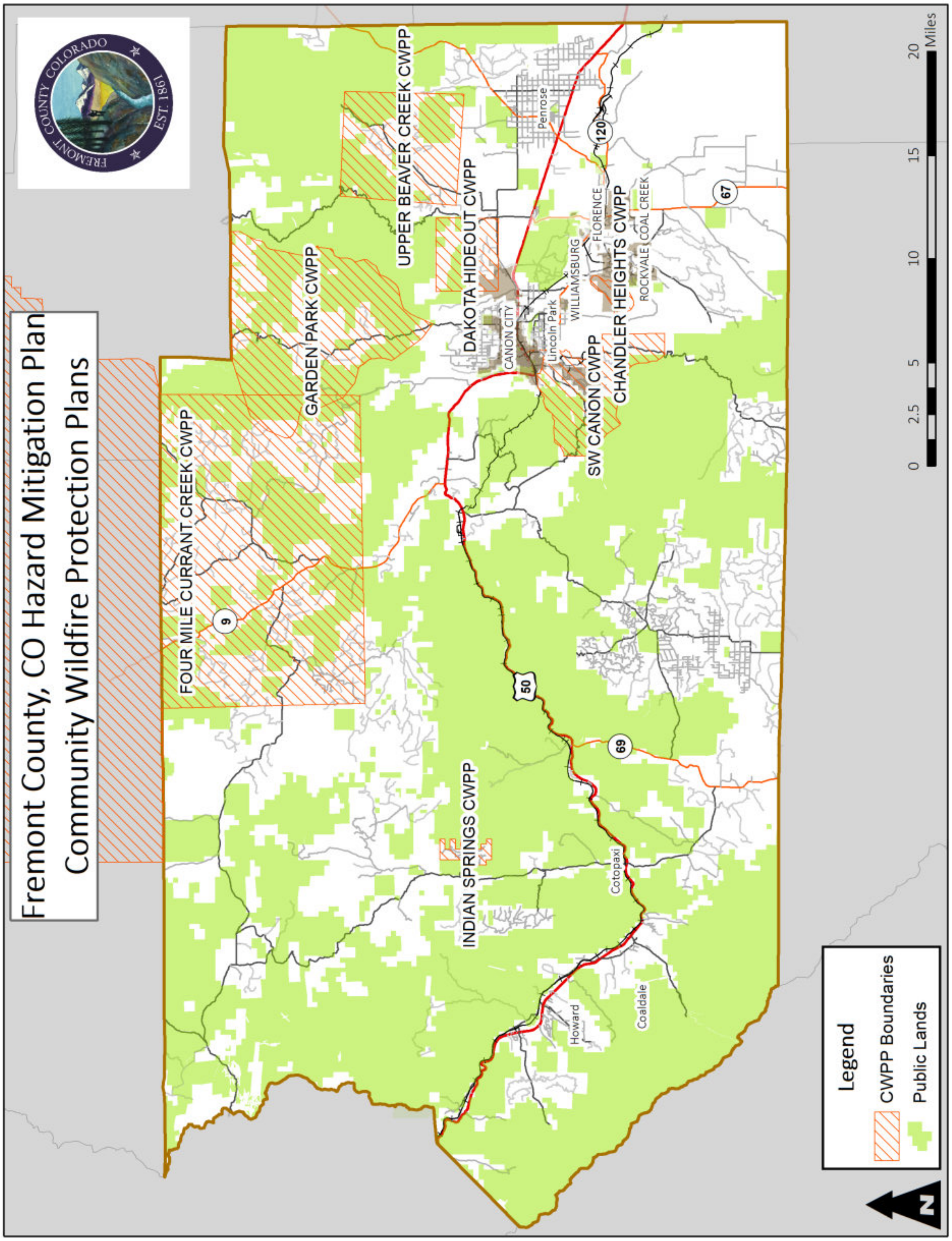
Planning and regulatory capabilities are powerful tools for implementing hazard mitigation. The county currently utilizes or has implemented most of these capabilities shown in Table 5. It is important for the county to regularly review each of these tools, to identify opportunities for further risk reduction efforts.

Table 5. Planning & Regulatory Capabilities

Mitigation Capability	Utilized?	Comments
Comprehensive, Master, or General Plan	Yes	Master Plan
Capital Improvement Program or Plan (CIP)	In Development	
Floodplain Management Plan	Yes	
Stormwater Program / Plan	Yes	Part of the Master Plan

Mitigation Capability	Utilized?	Comments
Community Wildfire Protection Plan (CWPP)	Yes	See Figure 8 for an overview of areas covered by CWPPs.
Erosion / Sediment Control Program	Yes	Part of the Master Plan
Economic Development Plan	Yes	Part of the Master Plan
Other: Required Permits	Yes	Explosives or Fire Hazards special review
Building Codes (Year)	Yes (2018)	
BCEGS Rating	6	For 1&2 family residential, 5 commercial/industrial
Site Plan Review Requirements	Yes	
Other:	No	
Zoning Ordinance (Land Use)	Yes	Fremont County Zoning Resolution
Subdivision Ordinance	Yes	Regulations
National Flood Insurance Program (NFIP) Participant	Yes	
Flood Insurance Study / Flood Insurance Rate Map / DFIRM	Yes	
Floodplain Ordinance	Yes	
Elevation Certificates for Floodplain Development	Yes	
Community Rating System (CRS) Participant	Yes	
Open Space / Conservation Program	No	
Growth Management Ordinance	Yes	Part of Master Plan
Stormwater Ordinance	No	
Other Hazard Ordinance (steep slope, wildfire, snow loads, etc.)	Yes	Snow loads site specific, steep slope setbacks
Other:	No	

FIGURE 8. COMMUNITY WILDFIRE PROTECTION PLANS



Available resources including staff, municipal groups, and technology are all vital for a community to be able to implement hazard mitigation. Fremont County is fortunate to have most of these capabilities identified in Table 6.

Table 6. Administrative & Technical Capabilities

Mitigation Capability	Utilized?	Comments
Planning Commission	Yes	
Mitigation Planning Committee	No	
Maintenance Programs (tree trimming, clearing drainage, etc.)	Yes	Fremont County Road and Bridge Yearly Maintenance
Emergency Manager	Yes	Full Time
Building Official	Yes	Full Time
Floodplain Administrator	Yes	Full Time
Community Planner	Yes	Planning and Zoning Director
Transportation Planner	Yes	DOT Director
Civil Engineer	Yes	Consultant. Continuing to build internal capabilities as well.
GIS Capability	Yes	Fremont County GIS Authority Full Time
Resiliency Planner	No	
Other:	No	
Warning Systems / Services (flood)	Yes	TFCC and Everbridge
Warning Systems / Services (other / multi hazard)	Yes	TFCC and Everbridge
Grant Writing / Management	Yes	Departmental
Other:	No	

The ability of a community to implement a comprehensive mitigation strategy is largely dependent on available funding. These related municipal capabilities are outlined in Table 7 and show that the county utilizes a number of these financial tools that can support mitigation activities.

Table 7. Financial Capabilities

Mitigation Capability	Utilized?	Comments
Levy for Specific Purposes with Voter Approval	No	
Utilities Fees	No	
System Development / Impact Development Fee	Yes	Impact fees for roads and mining operations
General Obligation Bonds to Incur Debt	No	
Special Tax Bonds to Incur Debt	No	
Open Space / Conservation Fund	Yes	
Stormwater Utility Fees	No	
Capital Improvement Project Funding	Yes	
Community Development Block Grants (CDBG)	Yes	Serve as a Pass thru
Withhold Spending in Hazard-Prone Areas	No	
Other:	No	

Education and outreach are important capabilities that allow a community to continue the conversation with their public regarding hazard risk and opportunities to mitigate. Table 8 shows that the county does leverage most of these capabilities.

Table 8. Education & Outreach Capabilities

Mitigation Capability	Utilized?	Comments
Public Hazard Education / Outreach Program	Yes	Fire Districts, Fremont SAR, LE, EMS
Local Citizen Groups That Communicate Hazard Risks	Yes	HOA's
Firewise	Yes	
StormReady	Yes	
Other:	No	

Municipal capabilities have also been evaluated as part of this planning process. They are presented in Appendix A: Municipal Annexes.

ECONOMY

The Gross Domestic Product for all industries in Fremont County, was $1,646,304, according to the U.S. Bureau of Economic Analysis 2019 data. The correctional facilities in the county are the primary employers, employing almost half of residents.

TABLE 9. ECONOMIC SNAPSHOT OF FREMONT COUNTY, CAÑON CITY, AND THE STATE OF COLORADO

	Fremont County	Cañon City	Colorado
Median Household Income	$49,409	$46,494	$72,331
Percent of Population over 16 in labor force	37.2%	48.1%	67.6%
Percent of Population between 65-74 in labor force	17.8%	14.6%	28.9%
Unemployment Rate as of October 2020	7%	*	6.4%

Sources: U.S. Census Bureau, 2012-2018 American Community Survey, Federal Reserve Bank of St Louis / Note: * - data unavailable

Jobs

According to the Colorado Department of Local Affairs, as of 2019 there were an estimated 35,000 jobs in Fremont County. The five sectors employing the most people are listed in Table 10.

TABLE 10. FREMONT COUNTY JOBS BY SECTOR (TOP 5 SECTORS)

Sector	Number of Jobs
Government (Federal, State and Local)	10,496
Health Services	2,418
Accommodation, Food Services and Drinking Places	2,318
Retail Trade	1,964
Construction	1,128

Source: Colorado Department of Local Affairs (DOLA), 2020

Unemployment

Prior to the impact of Novel Coronavirus 2019 (COVID-19), the February 2020 unemployment rate in Fremont County was 5.1%, just over double the State unemployment rate of 2.5%. Per the most recent data, the October 2020 unemployment rate for the county was 7% and was slightly higher than the State unemployment rate at 6.4% (U.S. Bureau of Labor Statistics). The impacts of COVID-19 have been far reaching in the local, state and national economies, at the time of publishing the unemployment rate continued to fluctuate unpredictably.

DEMOGRAPHICS

The current population of Fremont County is 47,839 people, based on 2019 US Census data. Over the next three decades, Fremont County will have an estimated annual average change of 0.5% in population. By comparison, Colorado percent growth change will range from 0.7% to 1.4% over the same period. The projected populations based on these change rates are in Table 11.

TABLE 11. POPULATION PROJECTIONS FOR FREMONT COUNTY AND COLORADO (5-YEAR INCREMENTS)

Area	2020	2025	2030	2035	2040	2045	2050
Fremont County	47,463	47,496	48,445	49,726	50,933	52,163	53,469

Area	2020	2025	2030	2035	2040	2045	2050
Colorado	5,819,337	6,132,563	6,562,402	6,970,549	7,342,121	7,658,761	7,929,215

Sources: Colorado Department of Local Affairs, 2020

A snapshot of the demographics of the county (Table 12) shows some key characteristics including proportions of the ages of the population, disability, poverty, and education attainment. With the exception of high school diploma status, the population of the county looks quite different than that of the state's demographics.

Most notable are the higher proportions of people living in poverty, a difference of 7.5% over the state, and those over the age of 65, higher in Fremont County by 6.8%. The difference in proportion of those with a disability under the age of 65, higher in the county by 5.9%, is important to recognize, as well in the context of hazard mitigation.

TABLE 12. DEMOGRAPHIC SNAPSHOT OF FREMONT COUNTY, CAÑON CITY AND COLORADO

Demographic	Fremont County	Cañon City	Colorado
Population (2019 ACS)	47,839	16,725	5,758,736
Median Age	45 years	43 years	37 years
Percent of Population Under 18	16.1%	22.6%	21.9%
Percent of Population 65 and over	22.1%	24.6%	14.6%
Percent of Population in Poverty	16.1%	17.1%	9.3%
Percent of Population with Disability, under 65	13.1%	11.1%	7.2%
Percent of Population with High School Diploma, over 25	90.1%	91.2%	91.7%
Percent of Population over 25 with Bachelor's Degree or Higher	18.5%	23.6%	40.9%

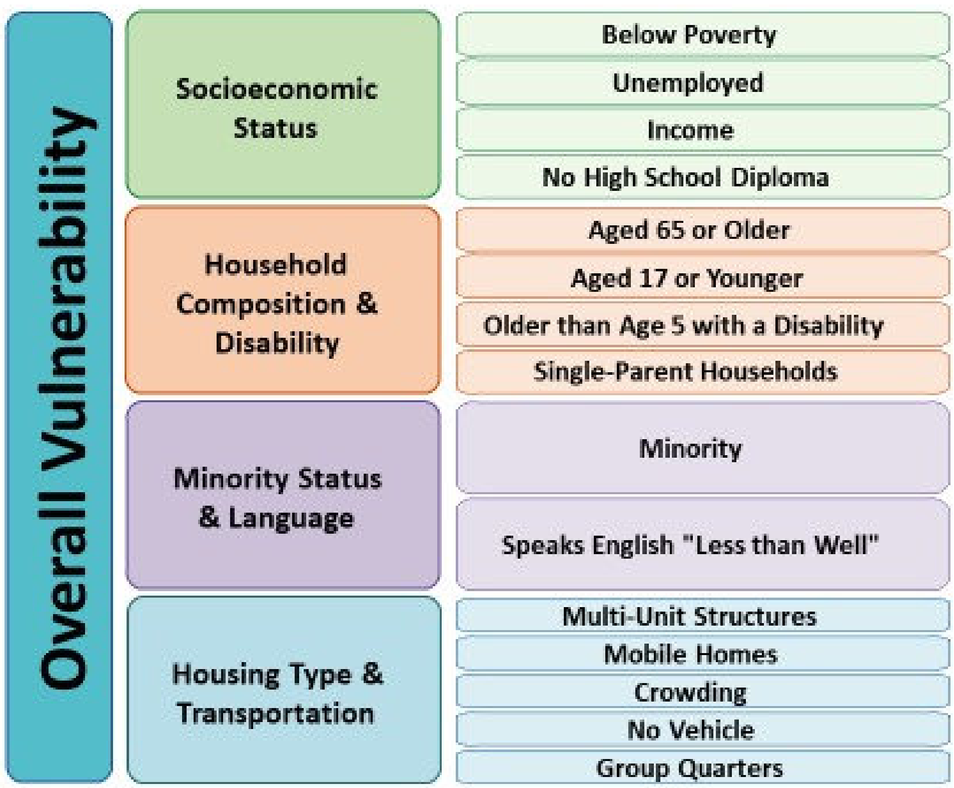
Sources: U.S. Census Bureau, 2018 American Community Survey, Federal Reserve Bank of St Louis

COMMUNITY INCLUSION

Community inclusion in preparedness and response to hazards is a crucial component to the resilience of a community. This is especially important for those in the community who experience access and functional needs (AFN) during disasters. Access and functional needs are the factors which may limit a person, in an emergency situation, in their ability to communicate, maintain their health, act independently, access adequate transportation, and acquire necessary services and support. These needs encompass a variety of social and economic factors, which are critical to consider when developing inclusive emergency systems and planning with those with AFN. Those factors are divided into four main categories: socioeconomic status, household composition & disability, language & minority status, and housing type & access to transportation. The components in these categories directly affect a community's ability to prepare for, respond to, and recover from hazards and disasters.

Figure 9 from the Centers for Disease Control, illustrates the components in the categories for access and functional needs.

FIGURE 9. COMMUNITY INCLUSION CATEGORIES AND COMPONENTS



SOURCE: CDC

Impacts of hazards fall disproportionately on those with access and functional needs in a community, for example: low income or unemployed individuals, children, the elderly, those with disabilities, and underrepresented racial/ethnic groups. This can be seen in situations needing self-evacuation which can be unmanageable for elderly people, people with disabilities and mobility issues, those with independent living difficulty, institutionalized individuals, and those without necessary finances and means of transportation. In considering preparedness actions, individuals and families may have limited resources to invest into residential mitigation actions, their home may be a rental property, or they may not be physically capable of completing the needed actions. Social and economic factors like these have an effect on the safety of community members, decrease the ability of communities to recover from a disaster, and inhibit the building of resilience against future disaster events. Because these factors create unequal conditions outside of disasters too, it is clear that planning with non-traditional community partners who understand everyday community experiences will be critical for planning inclusive emergency responses.

Notable for Fremont County is the large population of people who are institutionalized in the correctional facilities across the county. This presents a unique challenge for preparedness, response, and mitigation planning. This population falls under the category of people living in group quarters, which presents unique challenges. According to 2020 data from the Federal Bureau of Prisons and the Colorado Department of Corrections, Fremont County facilities have the capacity to house over 8,600 inmates.

This plan integrates community inclusion by assessing needs of the community using the Community Inclusion in Colorado (CICO) maps created by the Colorado Department of Public Health and Environment. These maps are designed to illustrate the various aspects of demographics and AFN within the population of Colorado and Fremont County. These maps are designed to aid in the improvement of local relationship building with organizations supporting access & functional needs, decision making, hazard prioritization, and emergency management activities. By incorporating community inclusion into the risk assessments of individual hazards, local communities are able to identify more vulnerable areas and tailor their mitigation actions to accommodate all members of their community, including groups who may have difficulty accessing information and resources.

Figure 10 through Figure 13 illustrate some of the various demographic representation across Fremont County. Specific to the county, these maps use census tract data to show the percentage of populations experiencing different access and functional needs. The interactive CICO maps for all categories of community inclusion can be found here.

FIGURE 10. FREMONT COUNTY PERCENT OF POPULATION OVER AGE 65

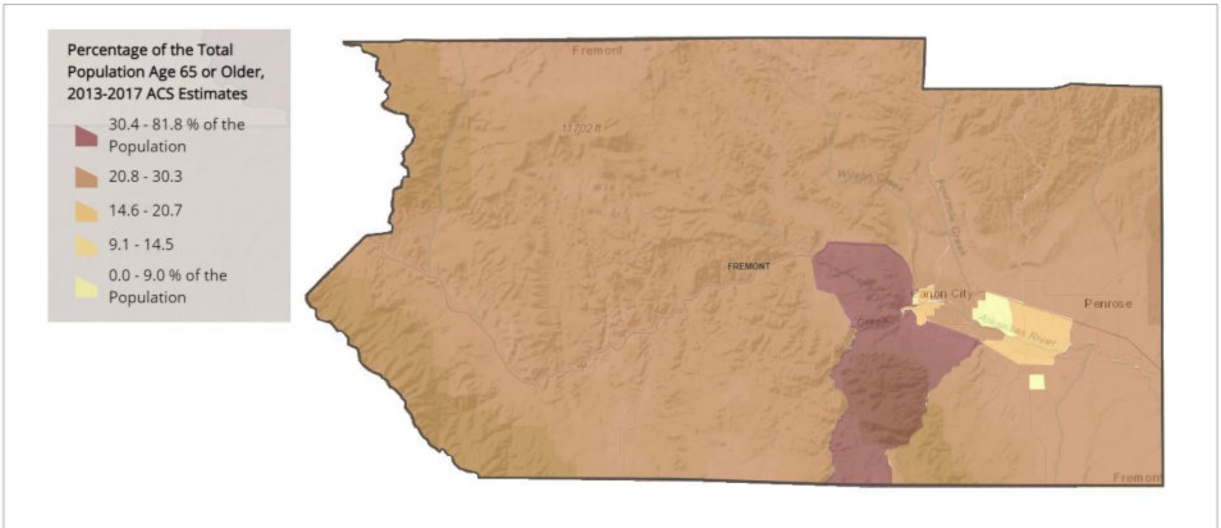


FIGURE 11. FREMONT COUNTY PERCENT OF POPULATION WITH A DISABILITY

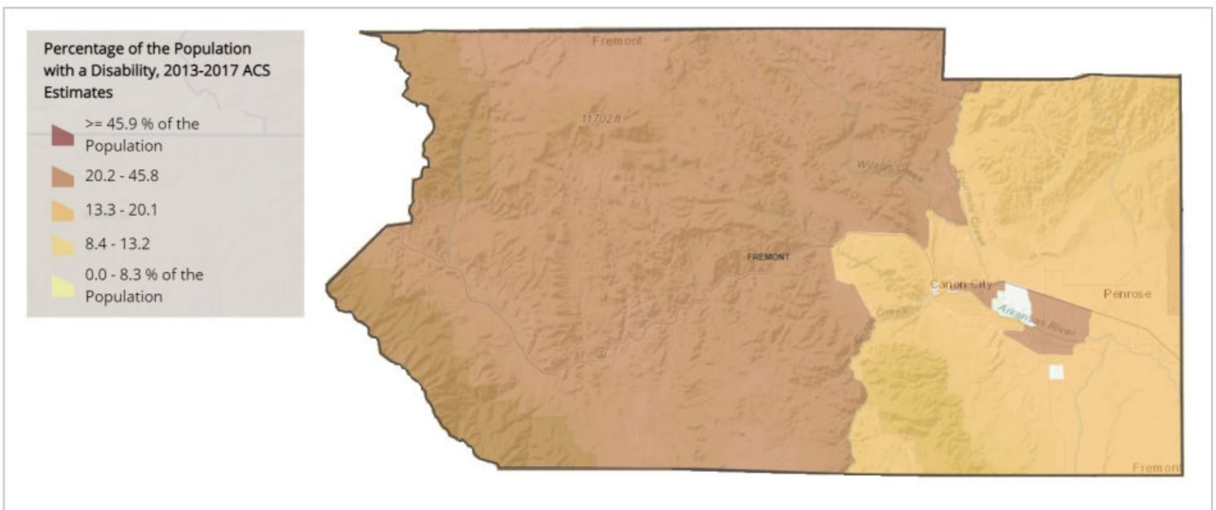


FIGURE 12. FREMONT COUNTY PER CAPITA INCOME

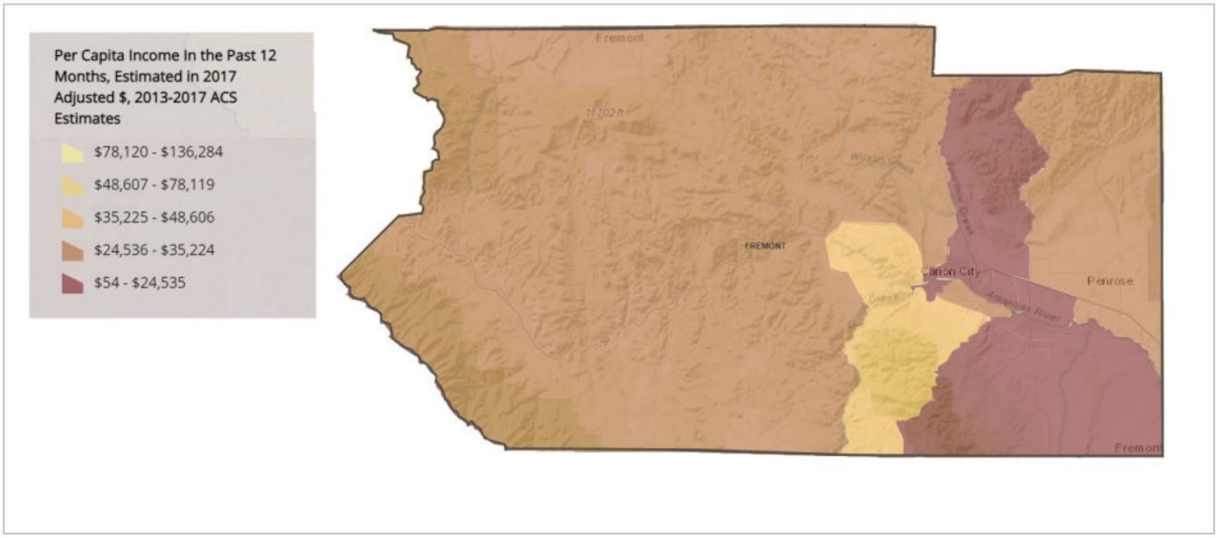
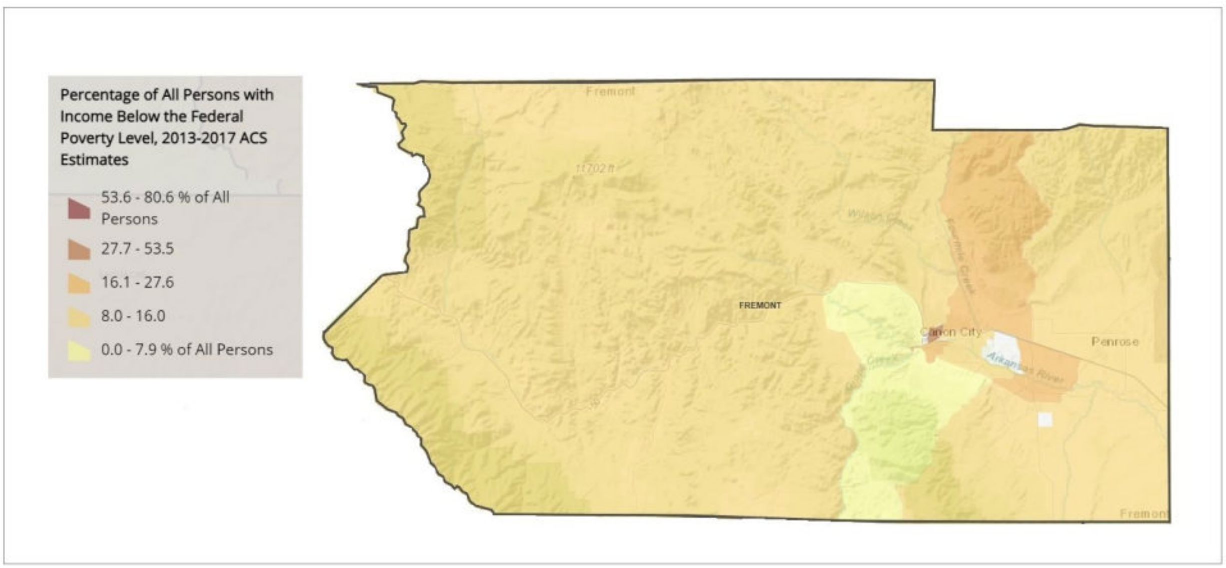


FIGURE 13. FREMONT COUNTY PERCENT OF POPULATION IN POVERTY



HOUSING

Roughly three quarters of housing in Fremont County consists primarily of single unit homes and 75% of these are owner occupied. The low rental vacancy rate suggests that as the county continues to grow, rents may increase and there may be pressure for construction of more rental units.

As Fremont County is home to nine correctional facilities on multiple campuses, it is critical to identify this population to create inclusive and effective plans for preparedness, response, and mitigation actions. In US Census Bureau data, the term used for data of those in correctional facilities is institutionalized, which falls under the category of Group Quarters. As discussed in Community Inclusion, Group Quarter populations experience disproportionate effects from hazards and require specific planning to address the unique challenges resulting from the living situation. In Table 13, the category for Total Correctional Facility Capacity was included to adjust for the fluctuation of numbers of inmates at any given time. Whereas the US Census Bureau number represents a moment in time data collection of inmates in facilities, the total capacity allows for planning regardless of inmate census.

TABLE 13. HOUSING CHARACTERISTICS OF FREMONT COUNTY, CAÑON CITY AND COLORADO

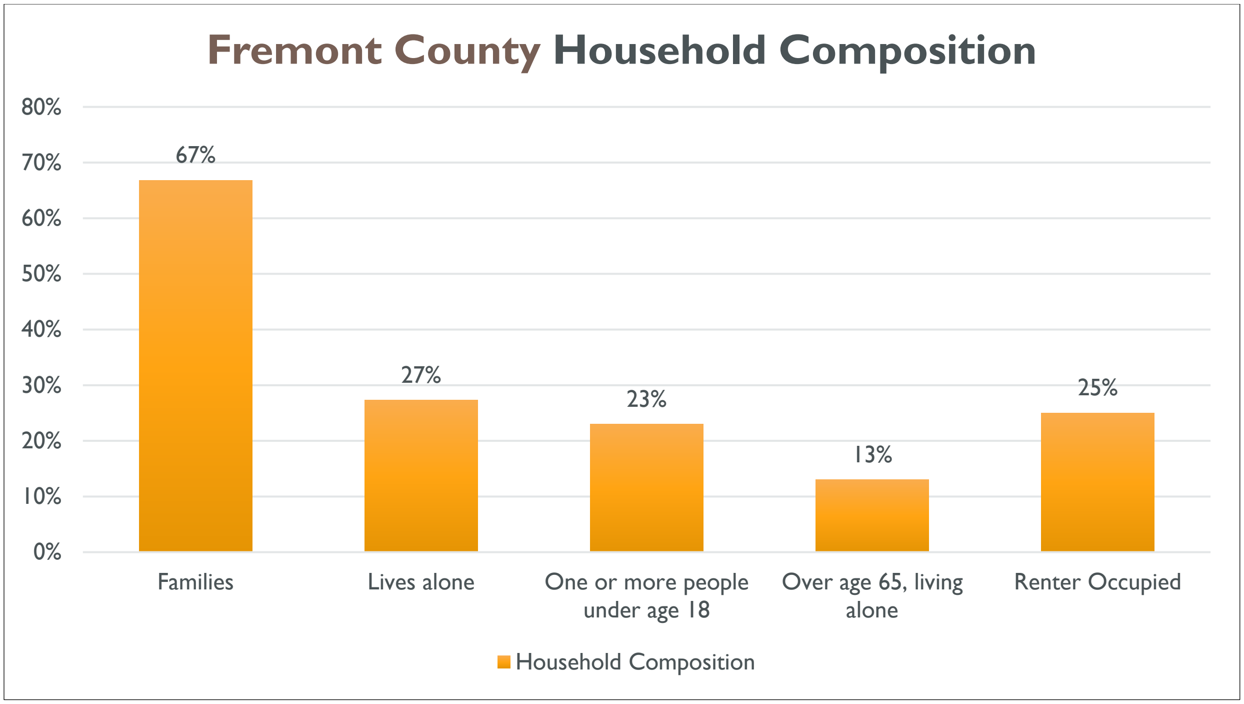
	Fremont County	Cañon City	Colorado
Total Housing Units	19,805	8,148	2,386,475
Occupied Housing Units %	86.5%	91.4%	90%
Renter Occupied Units %	25%	32.4%	34.8%
Rental Vacancy Rate	5.6%	5.7%	4.8%
Average Household Size	2.11	2.05	2.56
Mobile Homes	14.1%	11.2%	4%
Total Correctional Facility Capacity*	8,600	N/A	21,270

Source: US Census Bureau American Community Survey 2019, Federal Bureau of Prisons, Colorado Department of Corrections Note: * - includes all state and federal correctional facilities

Household composition information in Fremont County is valuable to preparedness, response, and mitigation planning efforts. Understanding the characteristics of your community can offer insight into the needs for specific groups, which can be beneficial for preparedness education and outreach efforts.

For example, Figure 14 shows that in Fremont County roughly 13% of the population, or over 2,200 people, are over the age of 65 and living alone. The ability of the county to reach those specific community members to ensure their understanding of emergency preparedness could be lifesaving should a disaster happen.

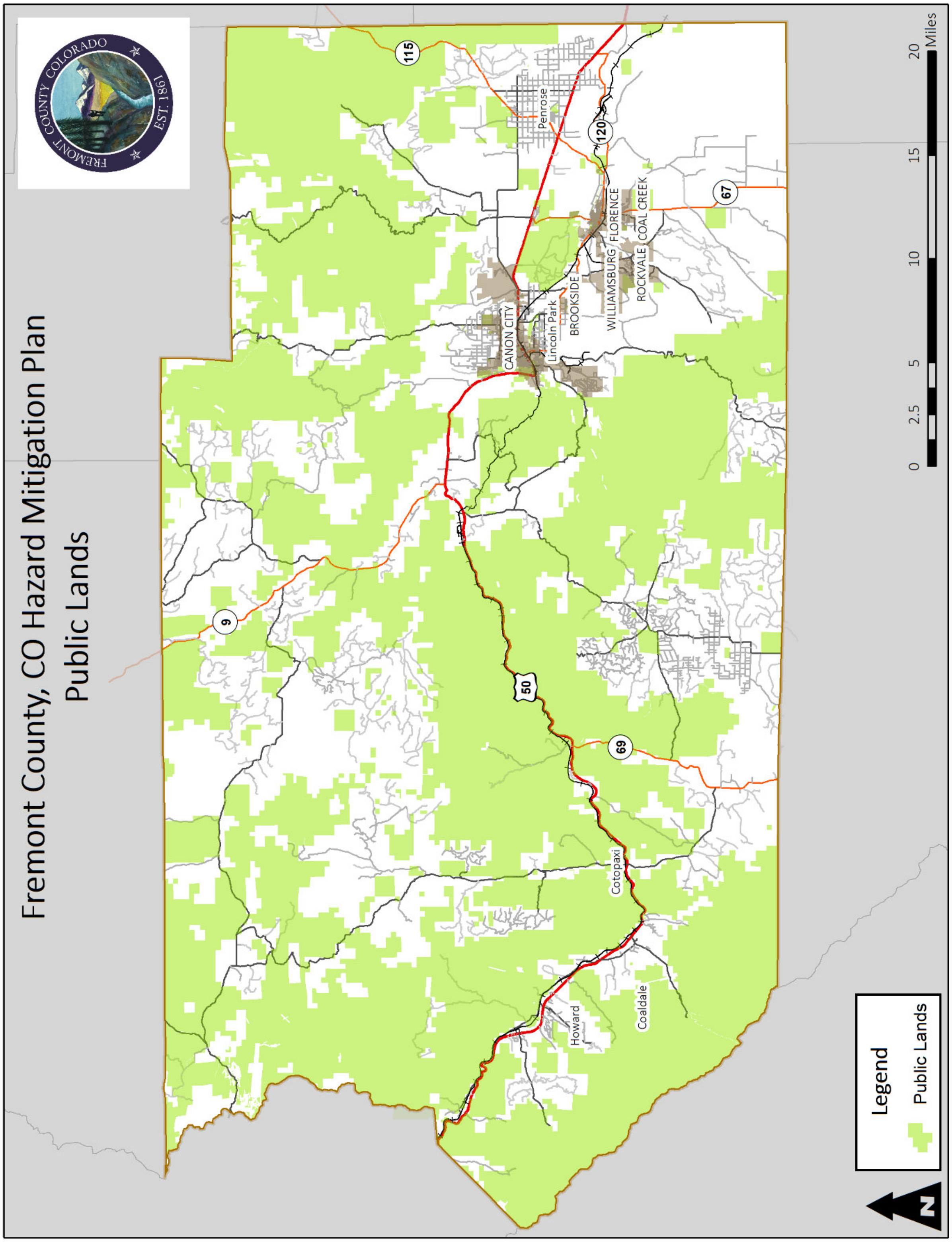
FIGURE 14. FREMONT COUNTY HOUSING COMPOSITION



PUBLIC LANDS

A majority of Fremont County is covered by public lands. This is important to note in the context of a hazard mitigation plan, as implementing mitigation actions will require coordination with the multitude of landowners. Additionally, these public lands do safeguard future development from these areas, many of which are hazard prone.

FIGURE 15. FREMONT COUNTY PUBLIC LANDS



FUTURE DEVELOPMENT

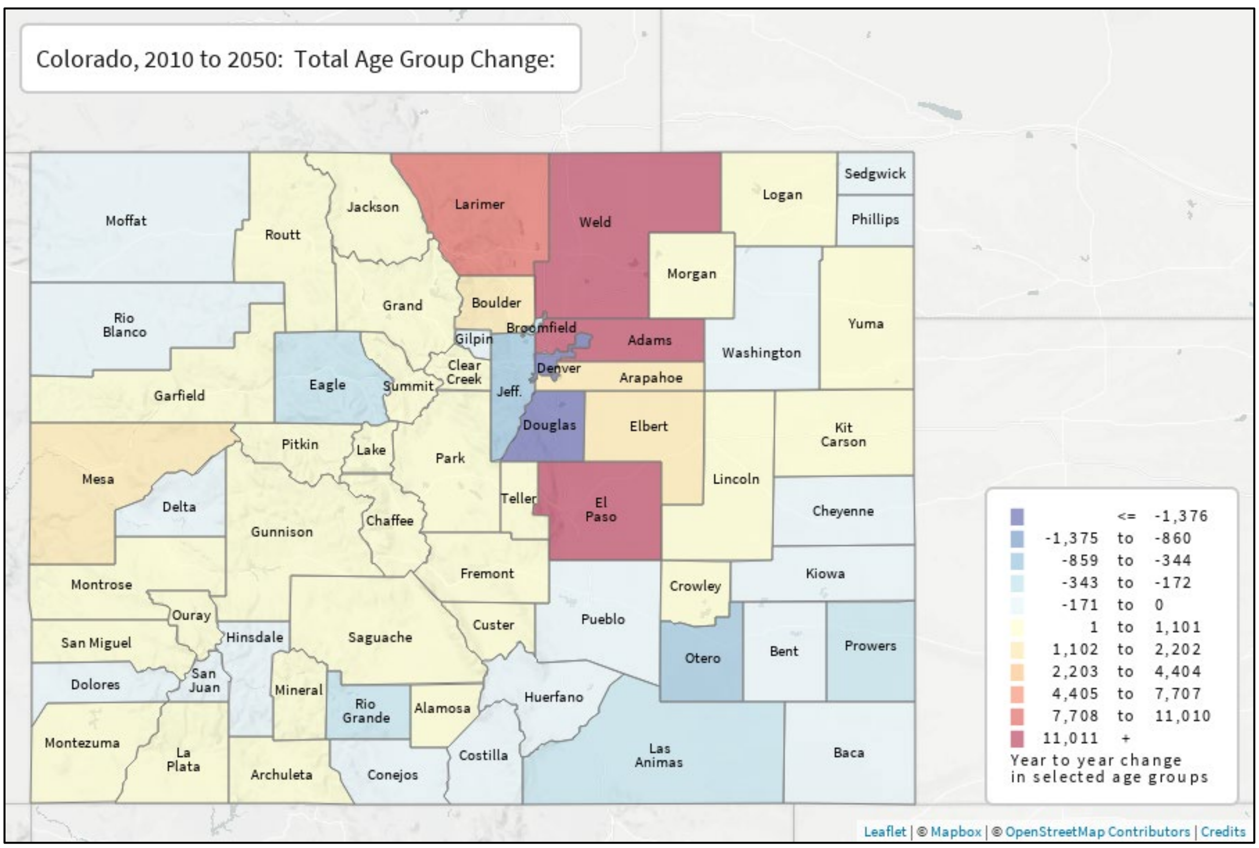
Fremont County is expected to continue to grow at a steady rate of population change over the next three decades.

TABLE 14. POPULATION CHANGE FORECASTS FOR FREMONT COUNTY AND COLORADO 2010 - 2050

	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050
Colorado	1.9%	1.7%	1.4%	1.3%	1.1%	1.0%	0.8%
Fremont County	0.5%	0.0%	0.4%	0.5%	0.5%	0.5%	0.5%

Source: Colorado Department of Local Affairs (DOLA), 2020

FIGURE 16.COLORADO PROJECTED POPULATION GROWTH MAP



Source: Colorado Department of Local Affairs (DOLA), 2020

Fremont County has seen a nominal increase in the recent number of permits for housing structures issued, with 139 permits issued in 2019 compared to 137 in 2018, or an increase of roughly 1%. Notable growth was seen between 2015 and 2016, with a 36% increase in permits issued. However, this trend declined each year, seeing 29% growth between 2016 and 2017 and 13% for 2018 over the year before.

The late 1990's and early 2000's saw the highest numbers of permits issued. The years after the 2008 economic downturn saw a considerable drop. The highest number of permits issued, 416, was in 1999 and the lowest issued, 46, in the years 2009 and 2011.

TABLE 15. ANNUAL NEW, PRIVATE HOUSING STRUCTURE BUILDING PERMITS ISSUED IN FREMONT COUNTY

Year	Permits/Buildings (total for all jurisdictions)
2019	139
2018	137
2017	119
2016	85
2015	54
2014	55
2013	53
2012	52
2011	46
2010	53
2009	46
2008	96
2007	163
2006	250

Year	Permits/Buildings (total for all jurisdictions)
2005	273
2004	221
2003	304
2002	246
2001	370
2000	385
1999	416
1998	356
1997	327
1996	241
1995	336
1994	284
1993	210
1992	172
1991	83
1990	132

SOURCE: U.S. CENSUS BUREAU, BUILDING PERMITS SURVEY

Chapter 3: PLANNING PROCESS

The following section reviews the planning process and public outreach with participating jurisdictions and Fremont County to inform the HMP update.

BACKGROUND

The 2021 Fremont County HMP is an update to the 2015 Plan. Hazard mitigation plans are community-led efforts designed to identify, manage, and avoid risks through pre-planning. This plan is designed to reduce the risks posed by hazards that affect Fremont County communities and must be updated and approved by the Federal Emergency Management Agency (FEMA) every five years to keep it current and to maintain eligibility for certain federal Hazard Mitigation Assistance (HMA) Grants.

What is Hazard Mitigation?

The term "hazard mitigation" describes actions that can help reduce or eliminate long-term risks caused by hazards, such as floods, wildfires, and severe weather. Hazard mitigation is best accomplished when based on a comprehensive, long-term plan developed before a disaster strikes. As the costs of disaster recovery continue to rise, governments and citizens must find ways to reduce community hazard risks. Oftentimes after disasters, repairs and reconstruction are completed in such a way as to simply restore damaged property to pre-disaster conditions. These efforts may "get things back to normal," but the replication of pre-disaster conditions often results in a repetitive cycle of damage, reconstruction, and repeated damage. Hazard mitigation breaks this repetitive cycle by producing less vulnerable conditions through pre- and post-disaster repairs and reconstruction. The implementation of such hazard mitigation actions by state and local governments means building stronger, safer, and smarter communities that will be able to reduce future disaster losses.

Purpose

Mitigation is an investment in a community's future safety and resiliency. Recent cost-benefit studies have proven mitigation to be cost effective for communities, with mitigation projects returning six dollars for every one dollar spent. Hazard mitigation planning helps residents, business owners, elected officials, and municipal departments think through how to plan, design, build, and establish partnerships for risk reduction. Consider the critical importance of mitigation to:

- Protect public safety and prevent loss of life and injury.
- Reduce property damage to existing and future development.
- Maintain community continuity and strengthen the social connections that are essential for recovery.
- Prevent harm to a community's unique economic, cultural, and environmental assets.
- Minimize operational downtime and accelerate recovery of government and business after disasters.
- Reduce the costs of disaster response and recovery and the exposure to risk for first responders.
- Help accomplish other community objectives, such as capital improvements, infrastructure protection, open space preservation, and economic resiliency.

Additionally, Fremont County and its municipalities will benefit from this HMP by:

- Ensuring eligibility for all sources of hazard mitigation funds made available through FEMA.
- Increasing public awareness and understanding of vulnerabilities, as well as support for specific actions to reduce losses from future disasters.
- Ensuring community policies, programs, and goals are compatible with reducing vulnerability to all hazards and identifying those that are incompatible.
- Building partnerships with diverse stakeholders, increasing opportunities to leverage data and resources in reducing workloads, as well as achieving shared community objectives.
- Expanding the understanding of potential risk reduction measures to include: local plans and regulations; structure and infrastructure projects; natural systems protection; education and awareness programs; and other tools.

- Informing the development, prioritization, and implementation of mitigation projects. Benefits accrue over the life of these projects as losses are avoided from each subsequent hazard event.

Scope

This 2021 HMP has been prepared to meet requirements set forth by FEMA and the Colorado Division of Homeland Security and Emergency Management (DHSEM) in order for Fremont County and its municipalities to be eligible for funding and technical assistance from state and federal hazard mitigation programs. This Plan will be updated and FEMA-approved within its five-year expiration date.

Authority

This HMP has been adopted by Fremont County and its participating jurisdictions in accordance with the authority granted to counties and municipalities by the State of Colorado. This Plan was developed in accordance with current state and federal rules and regulations governing local HMPs. The plan shall be monitored and updated on a routine basis to maintain compliance with the following legislation and guidance:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C., Section 322, Mitigation Planning, as enacted by Section 104 of the Disaster Mitigation Act of 2000 (P.L. 106-390) and by FEMA's Interim Final Rule published in the Federal Register on February 26, 2002, at 44 CFR Part 201

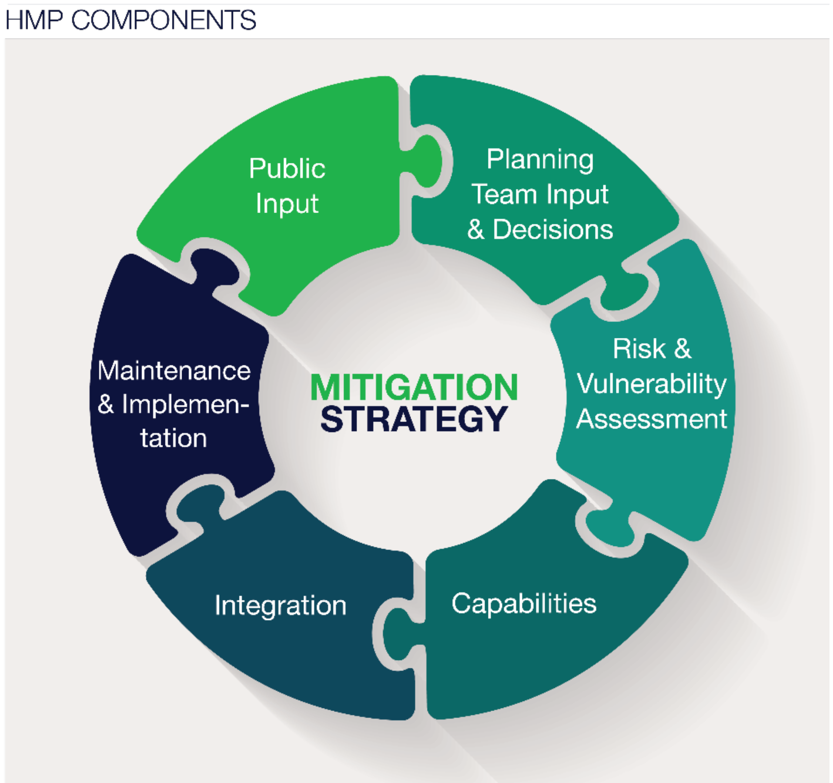
The following Federal Emergency Management Agency (FEMA) guides and reference documents were used to prepare this document:

- FEMA. Local Mitigation Plan Review Guide. October 1, 2011.
- FEMA. Local Multi-Hazard Mitigation Planning Handbook. March 2013.

Update Process and Methodology

The planning process included data gathering and analysis while simultaneously meeting with a Hazard Mitigation Steering Committee and gathering public input to support the plan. The following section details the timeline and methods of public outreach, steering committee meetings, and plan development. A high-level summary of the components that assembled into the updated HMP is presented in Figure 17.

FIGURE 17: HMP COMPONENTS



From a 'big picture' standpoint, Fremont County identified the following overreaching project goals:

- Obtaining FEMA Approval
- Remaining on schedule (especially important given the challenges presented by COVID)
- Broadening jurisdictional collaboration and participation
- Improving public engagement
- Incorporating FEMA's Lifeline construct
- Increasing mitigation grant funding pursuits

Input into the planning process came from a number of entities, shown in Figure 18.

FIGURE 18: PLANNING PROCESS INPUTS

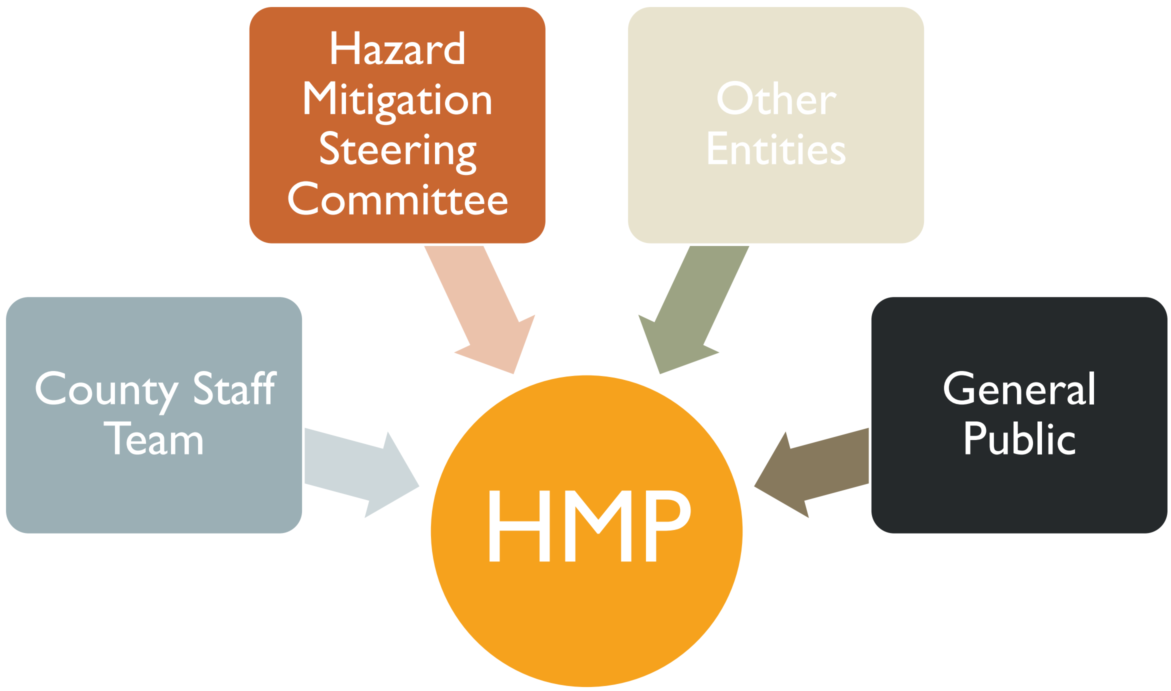
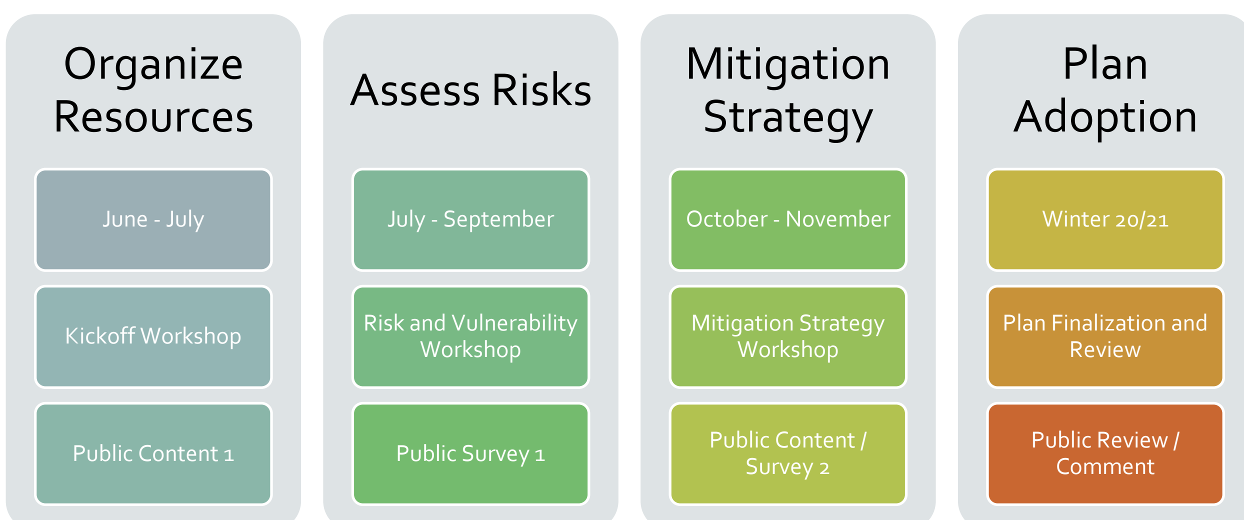


Figure 19 summarizes the project schedule, including Steering Committee and public touchpoints over the course of the planning process.

FIGURE 19: PROJECT TIMELINE



Participating Communities

All municipalities in Fremont County were invited to participate in the planning process. They were informed of the participation requirements related to the adoption of the plan and the formation of the Steering Committee. The following jurisdictions were formal participants in the planning process and signed a letter of participation:

- Fremont County
- City of Cañon City
- City of Florence
- Town of Brookside
- Town of Coal Creek
- Town of Rockvale
- Town of Williamsburg

Jurisdictional participation in the planning process was closely tracked to ensure all communities remained engaged across the planning process. Table 16 shows community participation at HMP meetings and webinars. It is important to also point out meeting participation from four of Fremont County's neighboring counties.

TABLE 16. PLANNING MEETING PARTICIPATION

	6/18/20 Kick-Off Webinar	9/30/20 Risk Assessment Meeting	12/08/20 Mitigation Strategy Webinar	1/26/2021 Webinar	Individual Community Meetings & Webinars
Fremont County	x	x	x	x	
Brookside		x	x		x
Cañon City	x		x	x	x
Coal Creek					x
Florence				x	x
Rockvale	x	x			x
Williamsburg					x
Custer County			x		
Pueblo County			x		
Chaffee County			x		
Teller County			x		

HAZARD MITIGATION STEERING COMMITTEE

The Steering Committee consisted of members of participating local governments and districts, as well as public stakeholders, special interest groups, and county staff. The role of the committee was to review and comment on the content of the plan as it was developed and to weigh in on the big decisions to enhance the plan with local expertise. The Steering Committee was tasked with participating in meetings, helping to disseminate public outreach materials, and to inform and review plan content. Members of the Steering Committee participated in development of the risk assessment, mitigation strategy development, plan review, public outreach, and plan maintenance strategies. Table 8 presents a list of the Steering Committee members with each jurisdiction's primary point of contact shown in **BOLD**.

TABLE 17. HAZARD MITIGATION PLAN STEERING COMMITTEE

Name	Title	Organization
Adam Lancaster	City Engineer	Cañon City
Adrian Washington	Emergency Manager	Custer County
Ashley Smith	Mayor	Cañon City
Becky Frank	Emergency Manager	Teller County
Bob Hartzman	Water Superintendent	Cañon City
Bobby Woelz	Emergency Manager	Saguache County
Brenda Jackson	County Attorney	Fremont County
Christe Coleman	South Region Field Manager	DHSEM
Chuck Bradley	Emergency Manager	Pueblo County
Connie Gjelfness	**Town Clerk**	**Rockvale**
Dan Witt	Manager Electric Operations	Black Hills Corp.
Danni Taylor	Town Clerk	Coal Creek
Dave DelVecchio	Fire Chief	Cañon City Area Fire Protection District
Debbie Bell	County Commissioner	Fremont County

Name	Title	Organization
Dwayne McFall	County Commissioner (Chairman)	Fremont County
Gene Stanley	Emergency Manager	Park County
James Wade	District Manager	Park Center Water District
Jeff Blue	District Manager	Fremont Sanitation District
Jerry Farringer	**Project Support**	**Williamsburg**
Judy McCormick		**Coal Creek**
Katie Rosenquist		Brookside
Keith Berry	County GIS	Fremont County
Lonnie Inzer	Emergency Manager	El Paso County
Mark Thompson	Mitigation Planning Specialist	DHSEM
Matthew Sheldon	County Engineer	Fremont County
Mike Patterson	**City Manager**	**Florence**
Mykel Kroll	**Director of Emergency Management**	**Fremont County**
Patricia Gavelda	Mitigation Section Planning Team Supervisor	DHSEM
Katie Rosenquist	**Town Clerk**	**Brookside**
Richard Atkins	Emergency Manager	Chaffee County
Rusty Huddle	Operations Supervisor	ATMOS Energy
Ryan Stevens	**City Administrator**	**Cañon City**
Sean Garrett	County Planning and Zoning	Fremont County
Sunny Bryant	County Manager	Fremont County
Tamara Wagner	Interim Police Chief	Cañon City

Name	Title	Organization
Tim Payne	County Commissioner (retired)	Fremont County
Tony Adamic	DOT Director	Fremont County
Tony Falgien	Streets Superintendent	Cañon City
Wade Broadhead	City Planner	Florence
Wyatt Sanders	County Building Department / Flood Plain Administrator	Fremont County

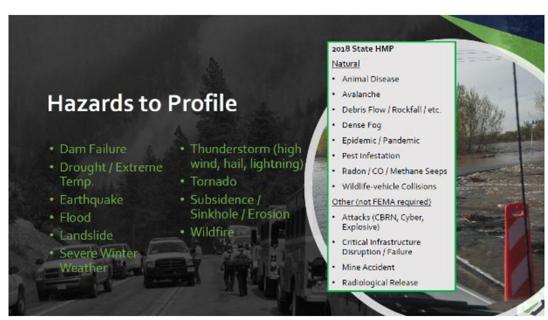
Steering Committee Meetings

The planning process involved three planned Steering Committee meetings, an additional follow-up meeting, and a number of individual one-on-one discussions with local municipalities. Meeting dates were identified through an online Doodle Poll to identify the dates available for most participants. A list of meeting participants can be found in Appendix G: MEETING ATTENDANCE.

Due to the COVID-19 pandemic, modifications were made to the intended engagement formats. Many of the Steering Committee meetings were held virtually through interactive webinars, with instant polling and group discussions, to avoid the spread of the virus. Separate stakeholder meetings were conducted over the phone or in small groups.

Kickoff Webinar (June 18th, 2020)

The kickoff meeting was held virtually via webinar in June. The meeting started with an introduction to the planning process, schedule, and responsibilities of the Steering Committee, as well as an overview of hazard mitigation. Discussion then focused on the list of hazards to profile, including debris flow, pandemic, rockfall, and wildlife-vehicle collisions which were not profiled in the 2015 plan. Participants were invited to discuss how the 2015 plan was used and what elements worked well, in addition to other on-going or recently completed community planning projects. Another main topic included an introduction to the



public outreach portion of the planning process and the group was encouraged to comment on the public outreach tools and processes that work best. Initial discussions relating to available mitigation grant funding, including FEMA's new Building Resilient Infrastructure & Communities (BRIC) Program, also helped to educate the committee.

Additional topics included an introduction to the Lifeline construct used by FEMA and plan requirements to achieve FEMA approval. Previous hazard events over the last five years were also discussed by the committee. Group discussion focused on the definition and application of the hazards being added to the 2021 plan, and a review of the participating jurisdictions. To encourage dialogue in a virtual presentation, live polling was used through an online tool called Mentimeter. The program presents the results of polls, in real-time, to gather input from the Steering Committee. The results of the polls are included below and throughout this plan to support what was heard.

FIGURE 20: STEERING COMMITTEE POLLING RESPONSES

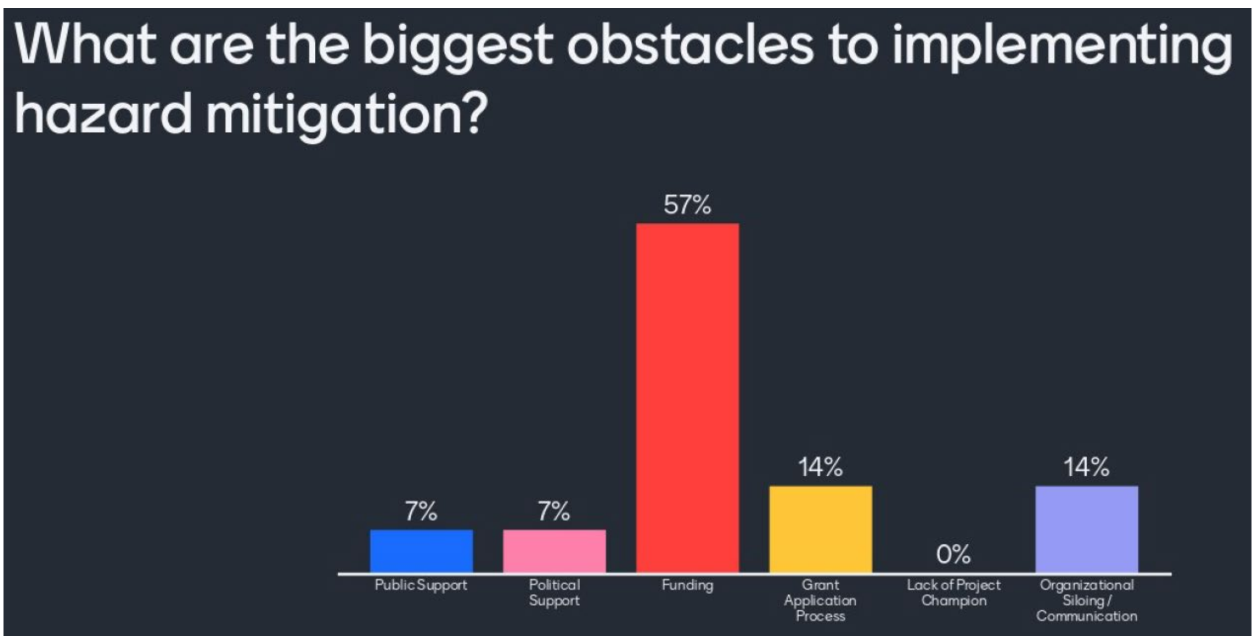


FIGURE 21: STEERING COMMITTEE POLLING RESPONSES

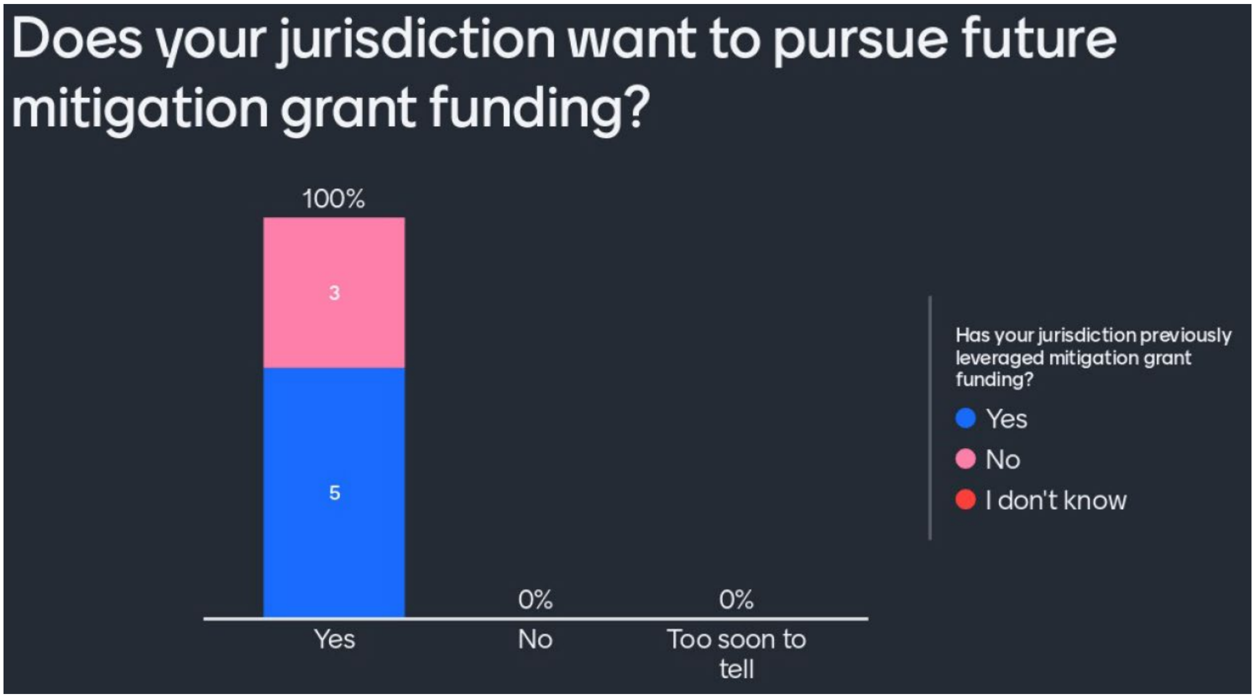


FIGURE 22: STEERING COMMITTEE POLLING RESPONSES

At the end of the meeting, participants were given four action items:

- Provide the best available hazard data and recent / ongoing community plans
- Help expand the Steering Committee roster
- Provide input on the public involvement plan
- Assist with dissemination of the public involvement plan's messaging

Hazard Identification and Risk Assessment (HIRA) Meeting (September 30th, 2020)

The HIRA meeting was held in person in September of 2020 and a webinar connection was provided for those committee members unable to attend in person. Discussion in this meeting focused on the

preliminary results of the risk assessment. Each hazard was reviewed, and best available data was presented pertaining to the risk and vulnerability assessment. The results of the Lifeline assessments were also presented. Additional historical events and data gaps were discussed with the committee.

The kickoff meeting identified funding as the primary obstacle to implementing mitigation which prompted continued discussion of FEMA mitigation funding programs. Following this, a lengthy discussion focused on the current plan's mitigation strategy and both the goals and objectives were refined based on committee input. The last main content of the meeting involved reviewing the results of the first public survey.

To encourage dialogue as part of this hybrid in-person / remote presentation, live polling was again utilized through an online tool called Mentimeter. The program presents the results of polls asked in real-time to gather input from the Steering Committee. The results of the polls are included below and throughout this plan to support what was heard. Details of the Steering Committee risk ranking can be found in Table 21.

FIGURE 23: STEERING COMMITTEE POLLING RESPONSES

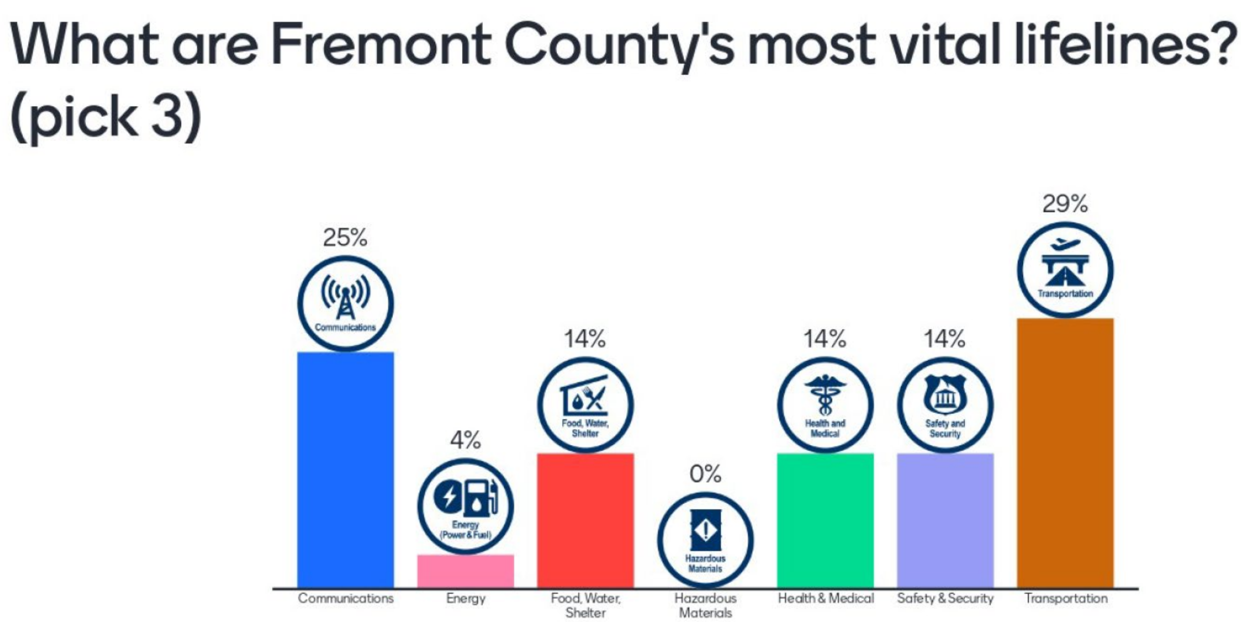
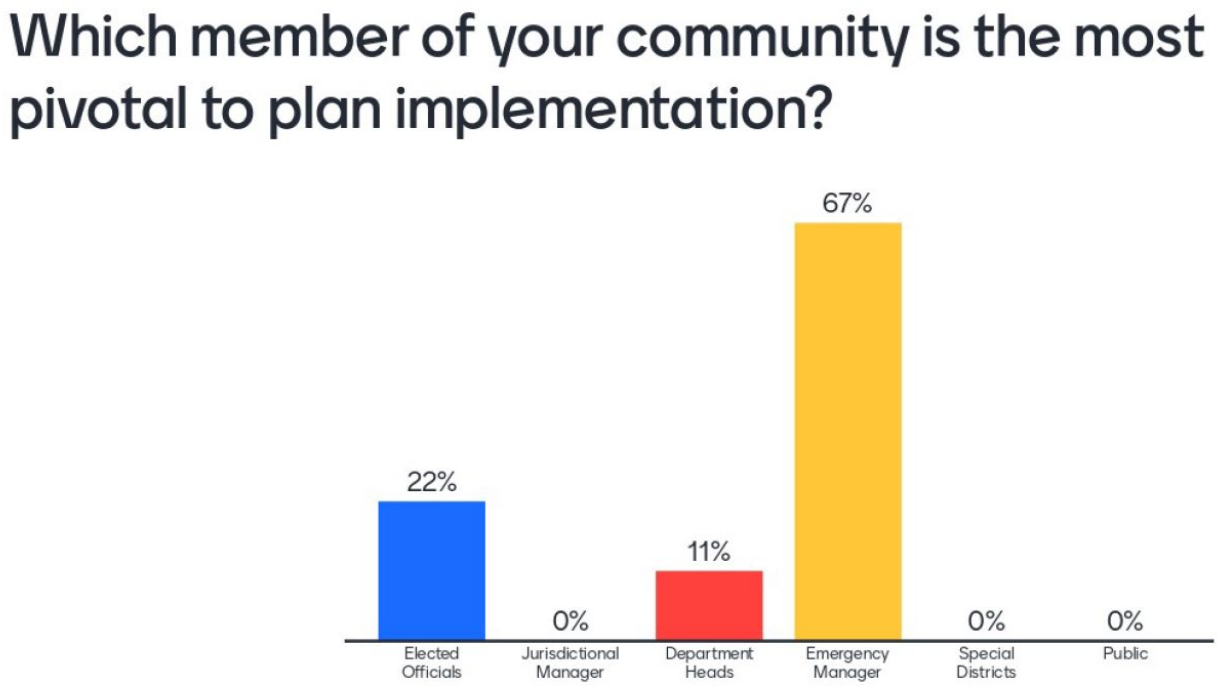


FIGURE 24: STEERING COMMITTEE POLLING RESPONSES



At the end of the meeting, participants were given the following action items:

- Assist with continued dissemination of the public involvement plan's messaging
- Begin drafting new 2021 mitigation actions
- Complete a mitigation capability assessment
- Begin reporting on 2015 mitigation actions
- Provide additional comments on the mitigation strategy's goals and objectives

Mitigation Strategy Webinar (December 8th, 2020)

The final Steering Committee meeting was held virtually in December 2020. The agenda focused on remaining plan requirements, including a discussion about plan maintenance and implementation over the next five years. Additionally, opportunities for plan integration were talked through.

The results of the second public survey were reviewed. Conversations from the HIRA meeting pertaining to the mitigation goals and objectives were also revisited to ensure the committee was in agreement on those updates. The conversation then turned to new mitigation actions. A number of resources and ideas were presented to the committee for their consideration, as jurisdictions continued developing new actions. Prioritization of those new actions was then discussed, as the group felt a number of criteria should be evaluated when ranking these actions. Equity was discussed as needing heightened focus, as was the consideration of those members of the community with access and functional needs.

The final risk assessment results were reviewed and the Lifeline assessment was again presented. The webinar concluded with time spend further discussing mitigation funding opportunities and how communities can prepare now for future grant applications.

To encourage dialogue in a virtual presentation, live polling was conducted again through Mentimeter. The results of the polls are included below and throughout this plan to support what was heard.

FIGURE 25: STEERING COMMITTEE POLLING RESPONSES

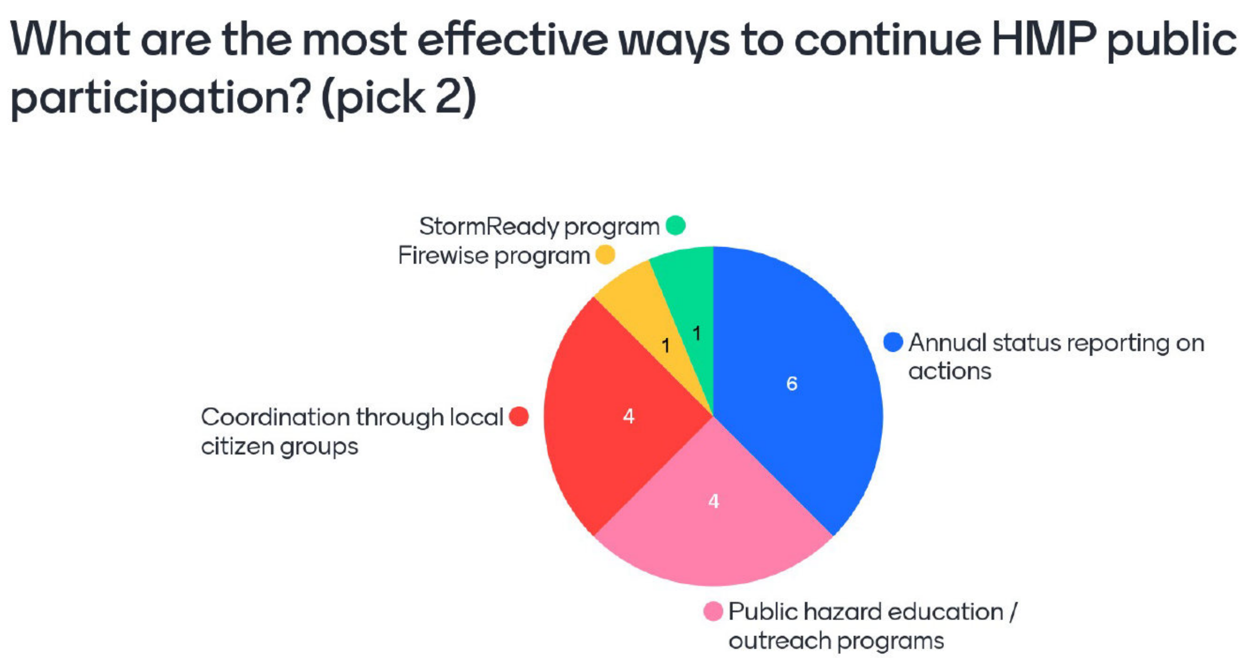


FIGURE 26: STEERING COMMITTEE POLLING RESPONSES

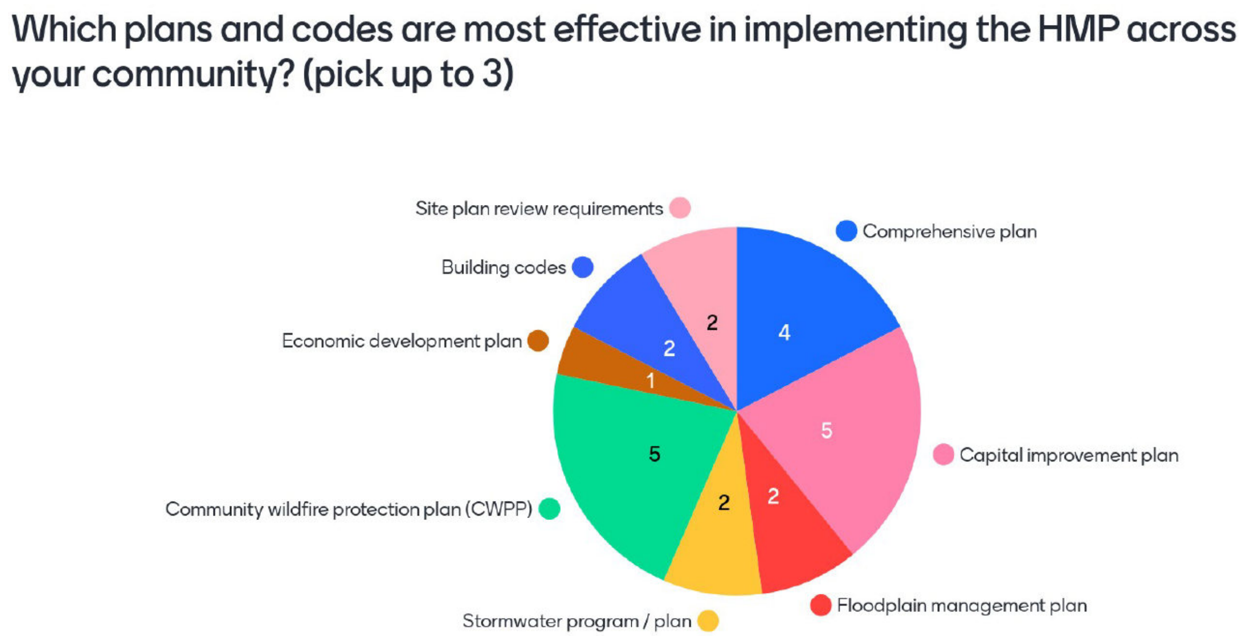


FIGURE 27: STEERING COMMITTEE POLLING RESPONSES

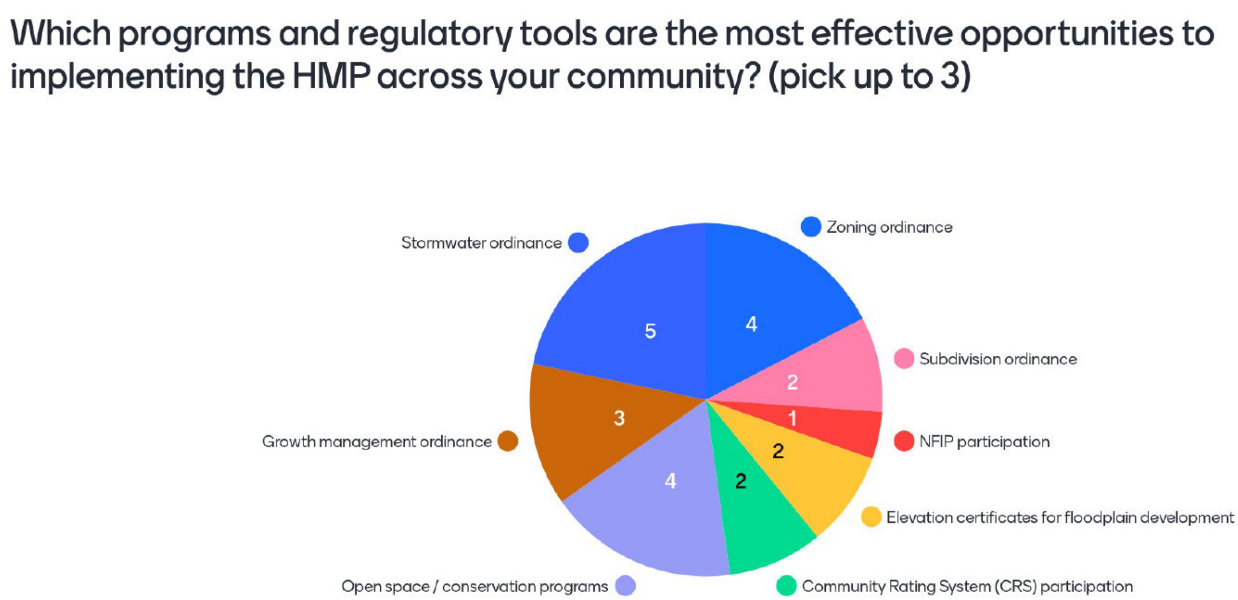


FIGURE 28: STEERING COMMITTEE POLLING RESPONSES

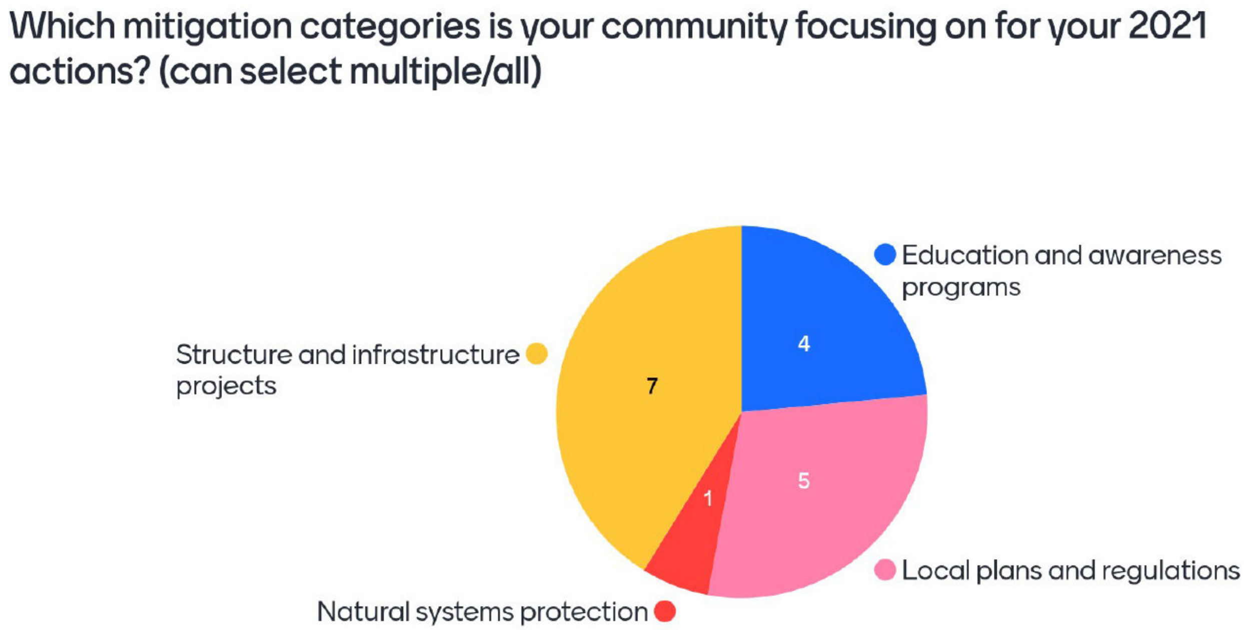
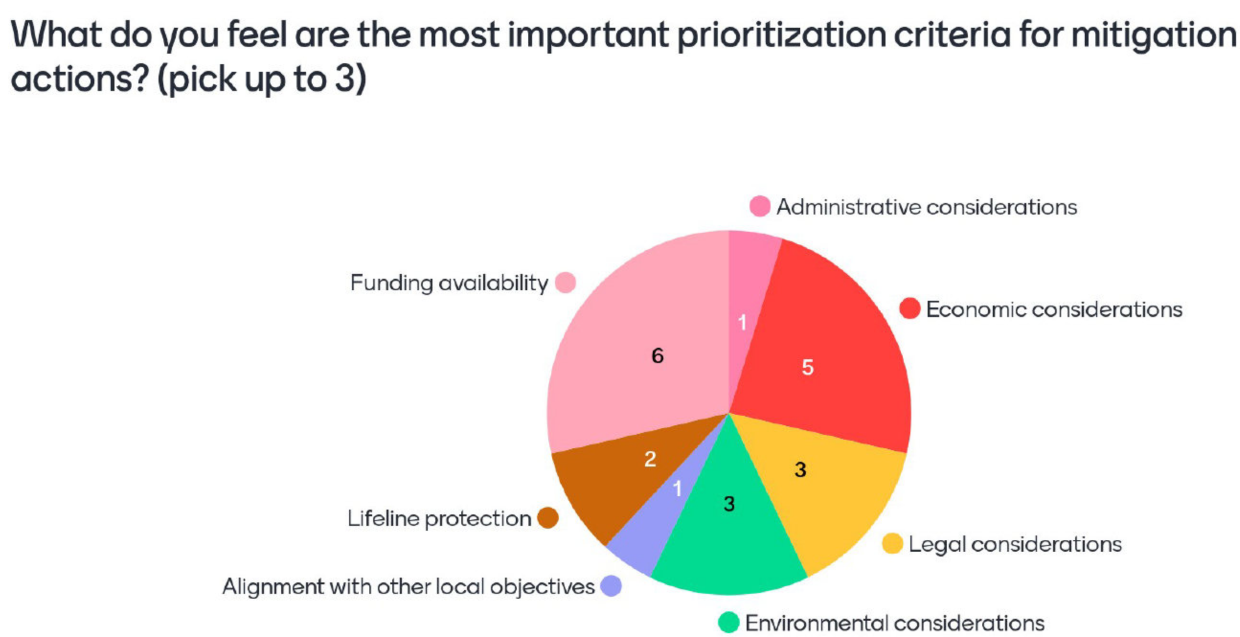


FIGURE 29: STEERING COMMITTEE POLLING RESPONSES



At the end of the meeting, participants were given the following action items:

- Assist with continued dissemination of the public involvement plan's messaging
- Continue drafting new 2021 mitigation actions
- Continue reporting on 2016 mitigation actions

Follow-up Webinar (January 26th, 2021)

A fourth webinar was offered up to the Steering Committee in January 2021, to provide an additional and final opportunity for jurisdictions to participate in the planning process. The planned agenda was flexible and discussions focused on those remaining questions committee members had. The ultimate goal of this webinar was to ensure municipalities were able to meet all requirements to be able to adopt the updated HMP.

HMP Individual Municipality One-on-Ones (on-going throughout planning process)

Fremont County Emergency Management and county leadership also facilitated a number of individual meetings and conversations with local municipalities over the course of the planning process. These meetings helped to inform and involve those municipalities that were unable to participate in Steering Committee meetings held during the planning process. It was important to the county that all municipalities were able to meet planning process requirements so they could adopt the plan and remain eligible to pursue mitigation grant funding opportunities.

Steering Committee Draft Plan Review

Upon completion of the final draft plan, the Steering Committee was provided an opportunity to review and comment on the document. Comments were received from all adopting communities and were incorporated.

PUBLIC AND STAKEHOLDER PARTICIPATION

Public involvement was a key component to informing the HMP update. Due to COVID-19, in-person events did not occur. However, several techniques listed below were employed to educate the public about the plan and process, as well as to gather public input on issues and opportunities to make mitigation improvements. The Steering Committee was asked how best to engage the public in their jurisdiction and the responses highlighted: surveys, social media, and newsletters. The following materials were distributed to communities by the committee.

Website

Fremont County utilized its Emergency Management webpage to provide background information, contacts, and links to the surveys and supporting documents. Additionally, information was included on the websites of Brookside, Cañon City, Coal Creek, Rockvale, and Williamsburg.

Fremont County Hazard Mitigation Plan

Newsletter July 2020

Fremont County is updating the 2015 Multi-Jurisdictional Hazard Mitigation Plan in collaboration with local municipalities, districts, and other community organizations. This plan is designed to reduce the risks posed by hazards that affect our county and must be updated and approved by FEMA every five years to keep it current and to maintain eligibility for certain types of disaster assistance.

What is hazard mitigation?

The term "Hazard Mitigation" describes actions that can help reduce or eliminate long-term risks caused by hazards, such as floods, wildfires, tornados, and earthquakes. Hazard mitigation is best accomplished when based on a comprehensive, long-term plan developed before a disaster strikes.

As the costs of disaster impacts continue to rise, governments and citizens must find ways to reduce hazard risks to our communities. Oftentimes after disasters, repairs and reconstruction are often completed in such a way as to simply restore damaged property to pre-disaster conditions. These efforts may "get things back to normal," but the replication of pre-disaster conditions often results in a repetitive cycle of damage, reconstruction, and repeated damage.

Hazard mitigation breaks this repetitive cycle by producing less vulnerable conditions through pre- and post-disaster repairs and reconstruction. The implementation of such hazard mitigation actions now by state and local governments means building stronger, safer, and smarter communities that will be able to reduce future injuries and damages.

Project Benefits

Mitigation is an investment in a community's future safety and sustainability. Recent cost-benefit studies have proven mitigation to be cost effective for communities, with mitigation projects returning $6 for every $1 spent. Mitigation planning helps communities take action now, before a disaster, to reduce impacts when a disaster occurs.

Hazard mitigation planning helps residents, business owners, elected officials, and municipal departments think through how to plan, design, build, and establish partnerships for risk reduction. Consider the critical importance of mitigation to:

- Protect public safety and prevent loss of life and injury.
- Reduce harm to existing and future development.
- Maintain community continuity and strengthen the social connections that are essential for recovery.
- Prevent damage to your community's unique economic, cultural, and environmental assets.
- Minimize operational downtime and accelerate recovery of government and business after disasters.
- Reduce the costs of disaster response and recovery and the exposure to risk for first responders.
- Help accomplish other community objectives, such as capital improvements, infrastructure protection, open space preservation, and economic resiliency.

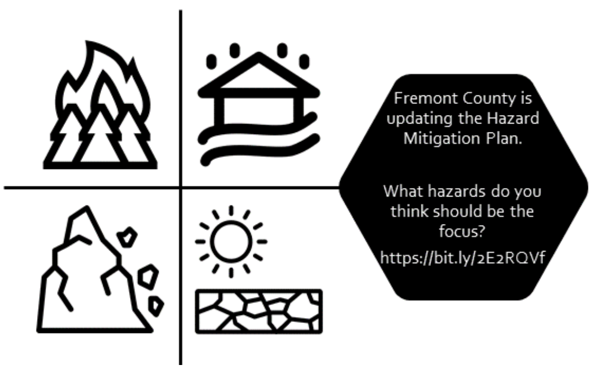
Newsletter

In order to provide hardcopy materials for small group gatherings or to insert educational material into existing newsletters, project information was sent out to participating municipalities for distribution. The newsletter described the purpose of the project, timeline, contact, links to the survey, and ways to stay involved in the process.

Social Media & Other Tools

Text describing the HMP and update process was sent to communities in multiple formats to accommodate: e-mail list serves, Facebook, Next Door, and Twitter. Graphic elements were also distributed to allow communities to incorporate educational materials and links to surveys in different media materials.

Fremont County and its municipalities leveraged the following social media accounts and other tools to broadcast information and updates pertaining to the HMP: County Emergency Management Facebook, County Department of Public Health Facebook, Cañon City Fire District Facebook, Cañon City Volunteer Fire Department Facebook, KRLN and Star County Radio and their Facebooks, City of Cañon City Facebook, St. Thomas More Hospital Solvista Facebook, Cañon City Daily Record and Facebook, and City of Florence Facebook.



Community Surveys

As part of the outreach process, two surveys were launched to gather community feedback. Summaries of the survey results are detailed here.

Survey #1 Fremont Public Risk Perception Survey (129 responses)

The first survey focused on understanding the community's perception of hazard risk. Details of the public risk ranking can be found in Table 21. Additionally, ideas for potential mitigation actions were also solicited. Those community suggestions are summarized in Appendix E: MITIGATION IDEAS. The following Figures present some of the other survey responses.

FIGURE 30: PUBLIC SURVEY #1 RESPONSES

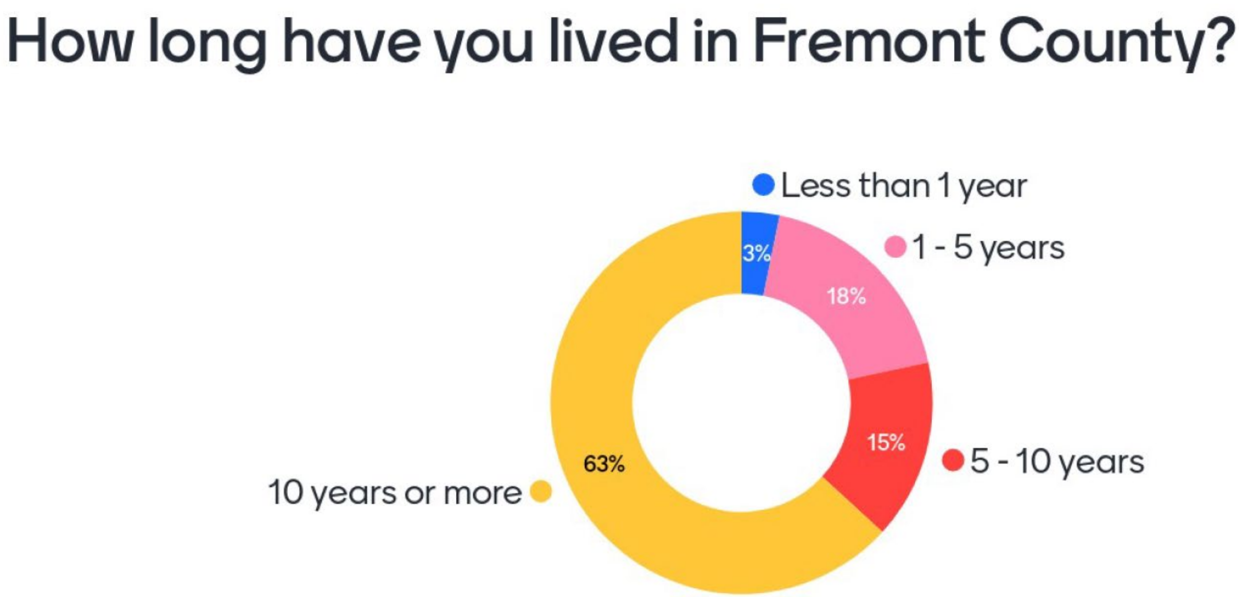


FIGURE 31: PUBLIC SURVEY #1 RESPONSES

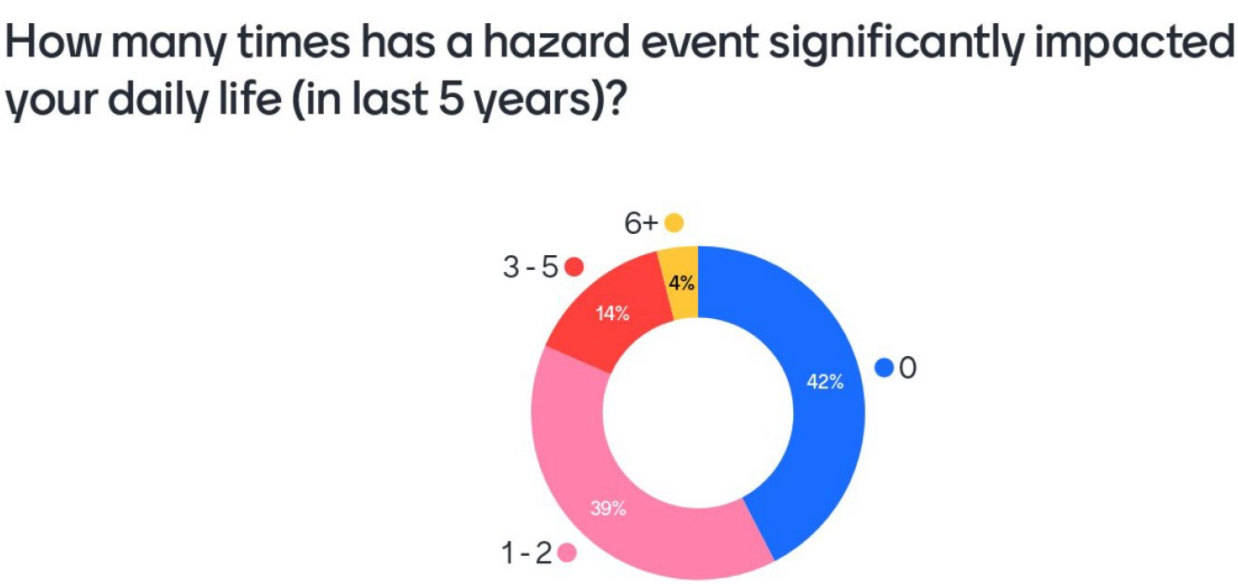


FIGURE 32: PUBLIC SURVEY #1 RESPONSES

FIGURE 33: PUBLIC SURVEY #1 RESPONSES

FIGURE 34: PUBLIC SURVEY #1 RESPONSES

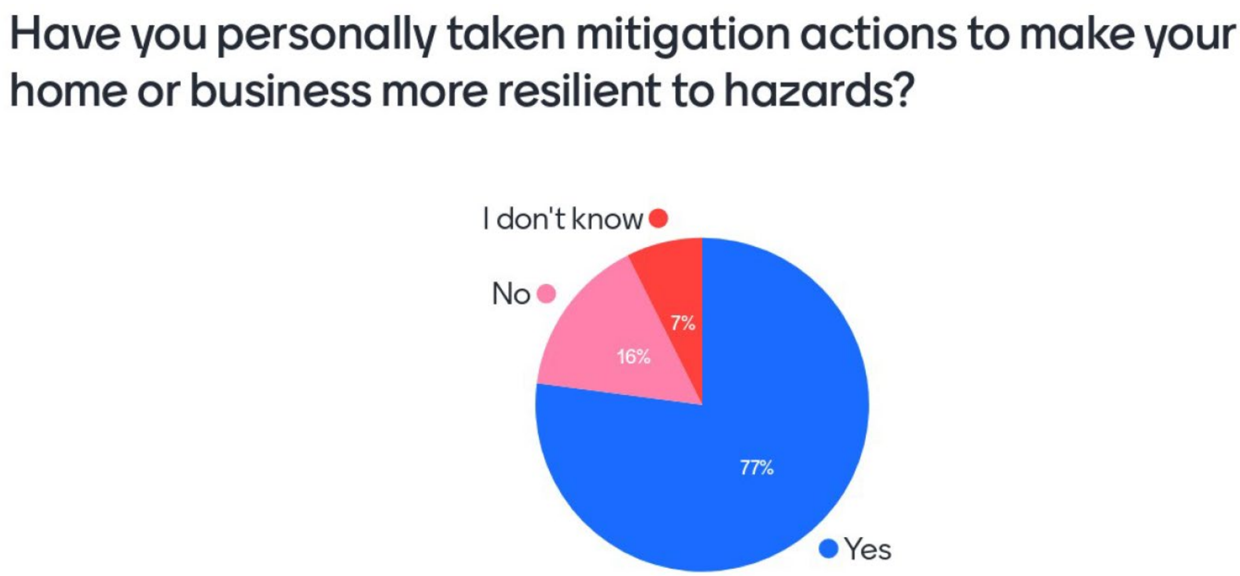
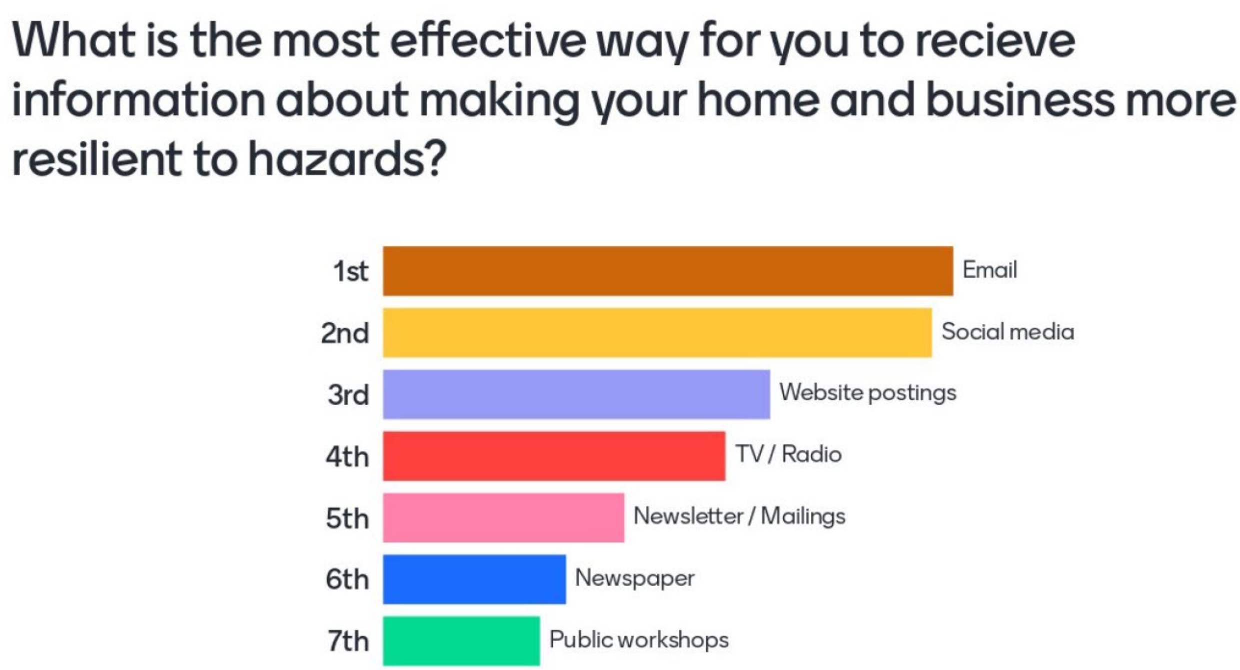


FIGURE 35: PUBLIC SURVEY #1 RESPONSES



Survey #2 Fremont Public Mitigation Strategy Survey (96 responses)

The second survey focused on understanding the community's thoughts on their preferred mitigation strategy. As was solicited during the first survey, additional ideas for potential mitigation actions were requested. Those community suggestions are summarized in Appendix E: MITIGATION IDEAS. The following Figures present some of the other survey responses.

FIGURE 36: PUBLIC SURVEY #2 RESPONSES

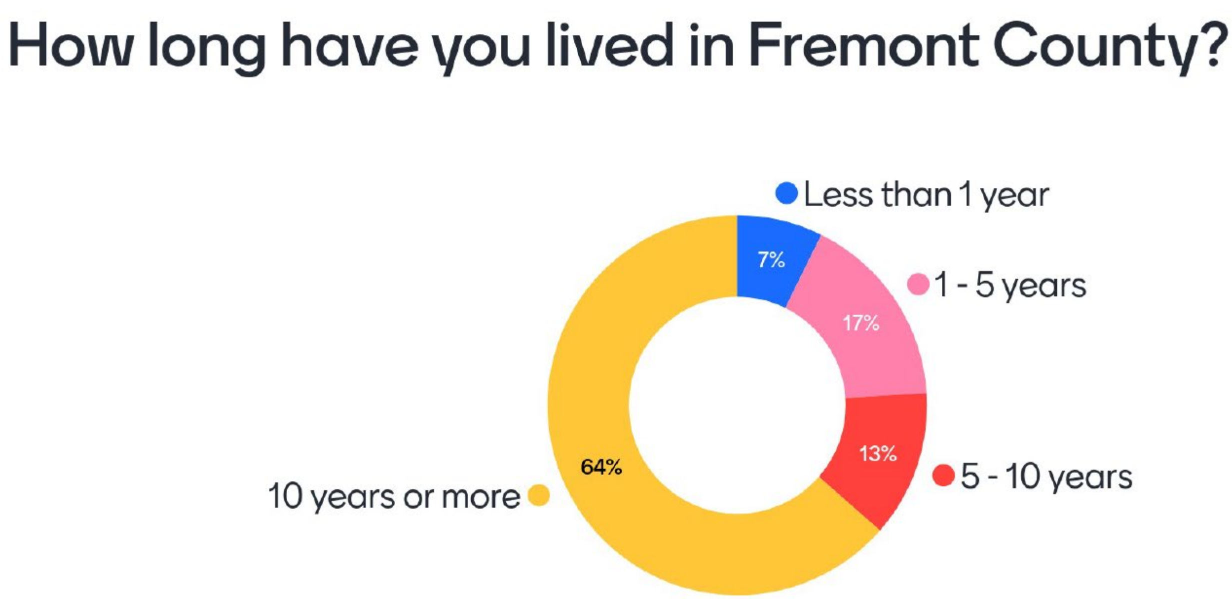


FIGURE 37: PUBLIC SURVEY #2 RESPONSES

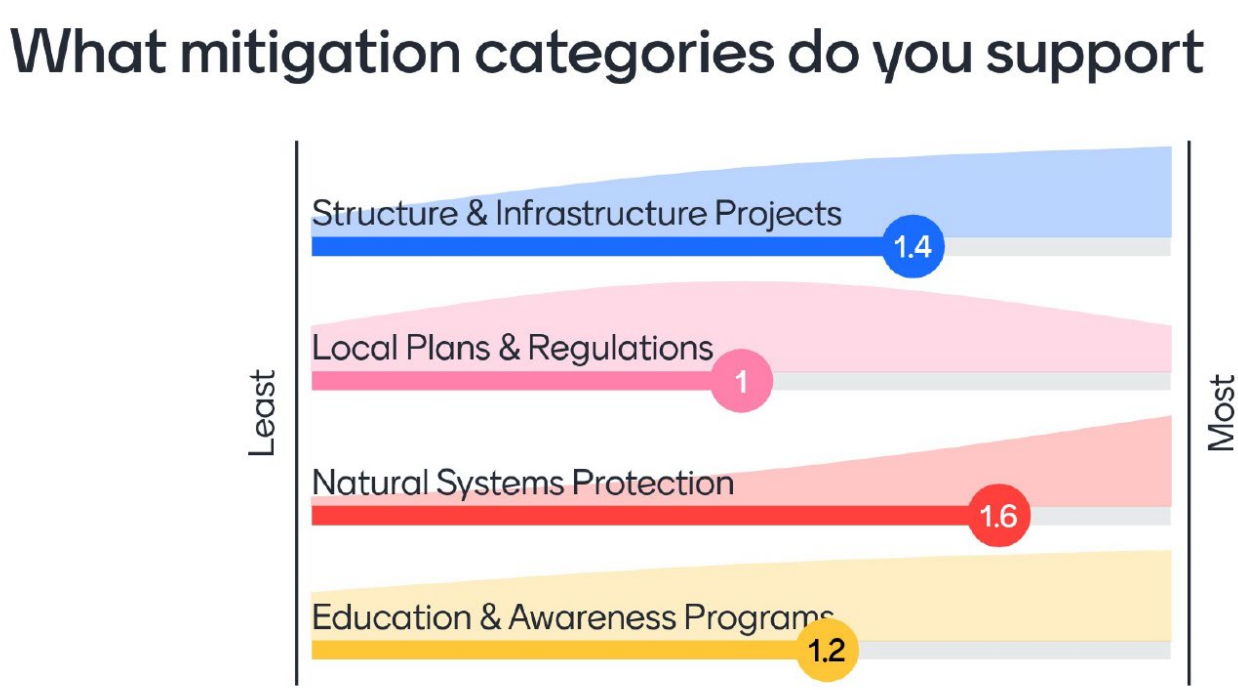


FIGURE 38: PUBLIC SURVEY #2 RESPONSES

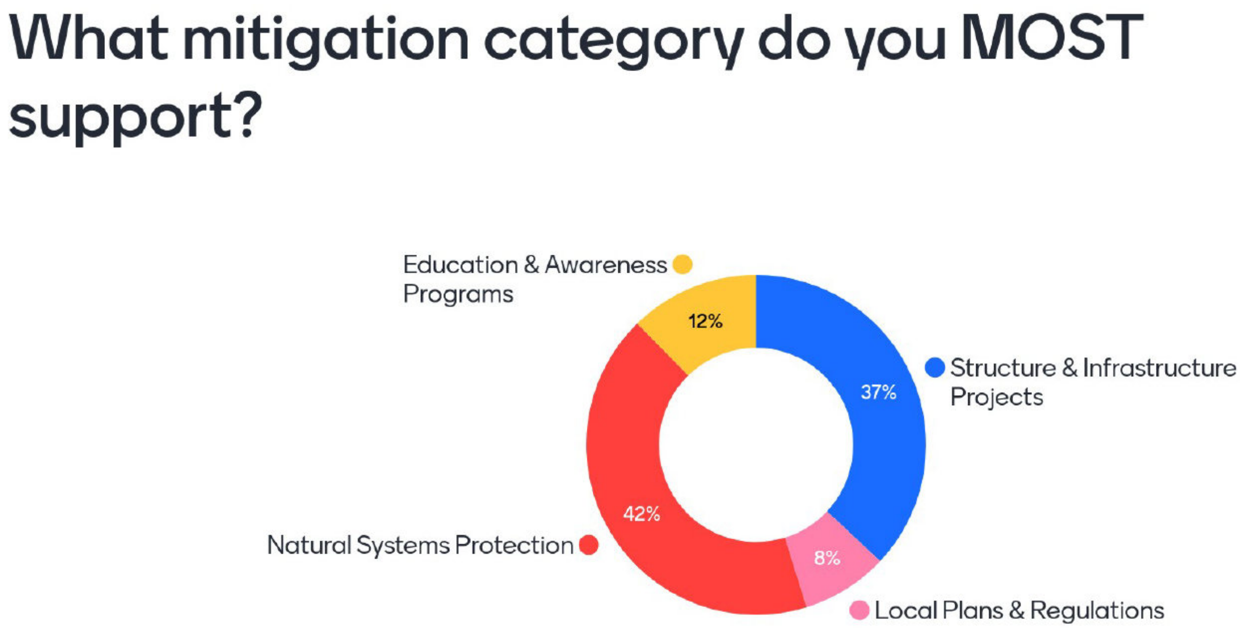


FIGURE 39: PUBLIC SURVEY #2 RESPONSES

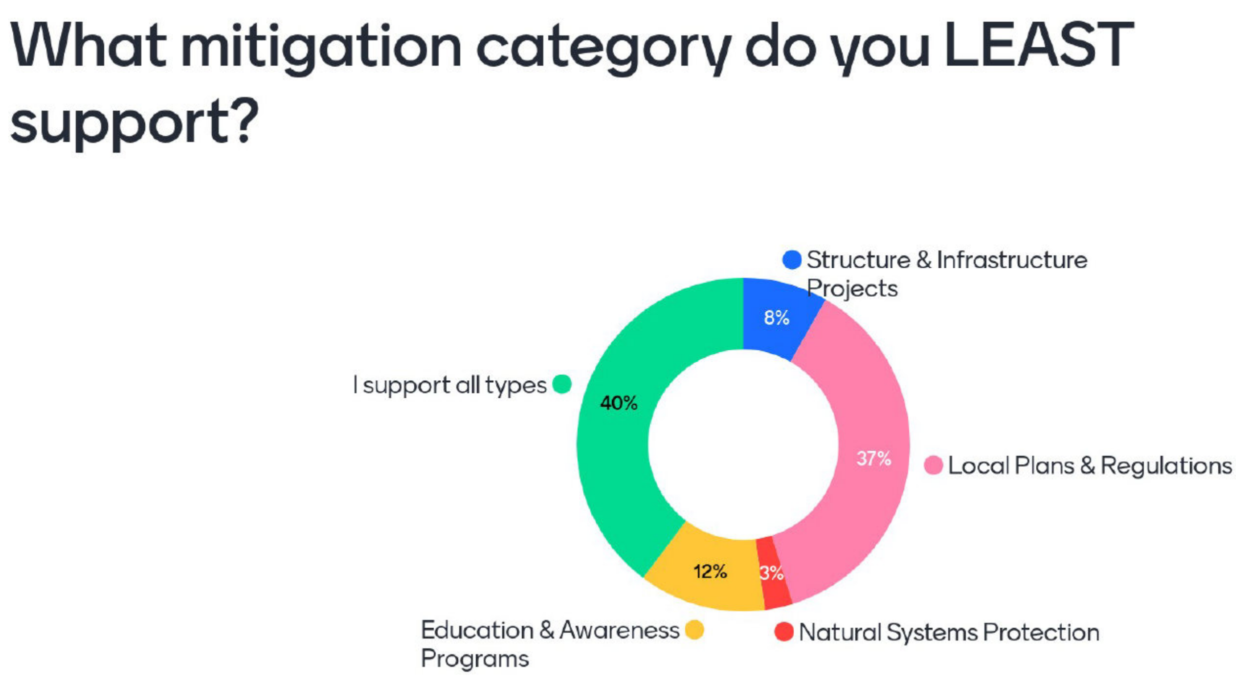


FIGURE 40: PUBLIC SURVEY #2 RESPONSES

Public Plan Review & Comment

A public review of the final draft plan was held from June 1, 2021 through June 18th, 2021. A total of 14 comments were received and addressed, as deemed appropriate by the Steering Committee. News of the public review period were broadly posted throughout the community. Tools utilized included: the Fremont County website's Home Page, Cañon City's website and, the County Emergency Management and Cañon City Facebook pages, Organizations that helped to disseminate the public review included: Canon City Fire District, Canon City Volunteer Fire Department, Fremont County Sheriff, Fremont County Department of Public Health and Environment, City of Canon City FB and home page, Solvista, Canon City Schools, and FRECOM. Media outlets leveraged included: Canon City Daily Record, Florence Citizen, KRLN and Star Country Radio, and the Fremont County Crusader for radio/media and Facebook postings.

Chapter 4: HAZARD IDENTIFICATION & RISK ASSESSMENT

RISK ASSESSMENT OVERVIEW

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage that can result from natural and human-caused hazards. It allows a community to identify potential hazards and vulnerable assets. The process focuses on the following elements:

- Hazard identification - Use all available information to determine what types of disasters may affect a jurisdiction, how often they can occur, and their potential severity.
- Vulnerability identification – Use best available data to determine the impact of natural hazard events on the people, property, environment, economy, and lands of the region.
- Loss evaluation – Use best available data to estimate potential damages and losses, or costs that can be avoided through mitigation.

The risk assessment for this hazard mitigation plan update evaluates the risk of natural hazards prevalent in the planning area and meets requirements of the DMA (44 CFR, Section 201.6(c)(2)).

IDENTIFIED HAZARDS OF CONCERN

For this plan update, the Steering Committee considered the full range of natural and human-caused hazards that could impact the planning area and then identified those hazards that present the greatest concern. The process incorporated review of state and local hazard planning documents, as well as information on the frequency, magnitude, and costs associated with hazards that have impacted or could impact the planning area. Anecdotal information regarding natural hazards and the perceived vulnerability of the planning area's assets to them was also factored in. Based on this review, this plan addresses the following hazards of concern:

- Dam / Levee Failure
- Debris Flow
- Drought / Extreme Heat
- Earthquake
- Flood
- Landslide / Rockfall
- Pandemic
- Severe Winter Weather
- Subsidence / Erosion
- Thunderstorm (hail, high winds, and lightning)
- Tornado
- Wildfire
- Wildlife-Vehicle Collisions

New hazards profiled in this 2021 plan update include: debris flow, pandemic, rockfall (combined with landslide), and wildlife-vehicle collisions.

MAJOR PAST HAZARD EVENTS

Federal disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government. However, no specific dollar loss thresholds are established for these declarations. A federal disaster declaration puts federal recovery programs into motion to help disaster victims, businesses, and public entities. Some of the programs are matched by state programs.

Fremont County has experienced 17 events since 1955 for which federal disaster declarations were issued by FEMA. These events are listed in Table 18.

TABLE 18: FEDERAL FEMA DISASTER DECLARATIONS[1]

Disaster	Description	Incident Date(s)	Declaration Type
DR-33*	Flooding	5/25/1955	Major Disaster Declaration
DR-59*	Flooding	6/12/1956	Major Disaster Declaration
DR-200	Tornadoes, severe storms, and flooding	6/191965	Major Disaster Declaration
EM-3025	Drought	1/29/1977	Emergency Declaration
DR-1276	Flooding	4/29 – 5/19/1999	Major Disaster Declaration
DR-1421	Wildfires	4/23 – 8/6/2002	Major Disaster Declaration
FS-2410	Iron Mountain Fire	6/2 – 6/10/2002	
FS-2421*	Hayman Fire	6/8 – 7/20/2002	Fire Suppression Authorization
EM-3185	Winter storm	3/17 – 3/20/2003	Emergency Declaration
EM-3224*	Hurricane Katrina Evacuees	8/29 – 10/1/2005	Emergency Declaration
FM-2923	Duckett Fire	6/15 – 6/24/2011	Fire Management Assistance
DR-4133	Royal Gorge Fire	6/11 – 6/16/2013	Major Disaster Declaration
EM-3365	Severe storms, flooding, landslides, and mudslides	9/11 – 9/30/2013	Emergency Declaration
DR-4145	Severe storms, flooding, landslides, and mudslides	9/11 – 9/30/2013	Major Disaster Declaration

[1] https://www.fema.gov/disasters/disaster-declarations

Disaster	Description	Incident Date(s)	Declaration Type
DR-4229-CO	Severe storms, tornadoes, flooding, landslides, and mudslides	5/4 – 6/16/2015	Major Disaster Declaration
EM-3436-CO*	COVID-19 pandemic	1/20/2020 - present	Emergency Declaration
DR-4498-CO*	COVID-19 pandemic	1/20/2020 - present	Major Disaster Declaration
* - Declaration was statewide, not specific to Fremont County			

Additionally, the county has experienced U.S. Department of Agriculture (USDA) Secretarial Disaster Designations over 60% of the time since 2003 (with some years receiving multiple declarations). Only ‘primary’ (not ‘contiguous’) designations are presented for Fremont County, listed in Table 19.

Table 19: Federal USDA Disaster Declarations[2]

Crop Year	Declaration
2003	X
2004	X
2005	
2006	X
2007	
2008	X
2009	
2010	
2011	X 2
2012	X
2013	X 2
2014	X
2015	
2016	
2017	
2018	X 5
2019	X
2020	X

The 2018 Colorado State Hazard Mitigation Plan lists state disasters declared by the Colorado Governor, and are included in Table 20. Additional declarations were identified through the Governor’s website.

[2] https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/disaster-designation-information/index , 2018 Colorado Drought Mitigation and Response Plan

TABLE 20: STATE DISASTER DECLARATIONS[3]

Year	Hazard	Statewide?
1994	Wildfires	X
1999	Flooding, landslides, and mudslides	
2002	Wildfires	X
2002	Drought	X
2003	Snow emergency	X
2006	Flooding	
2009	Severe blizzard	X
2009	Severe spring snowstorm	X
2011	Wildfire	
2012	Bridge damage	
2013	Winter storm	X
2013	Flooding	
2013	Wildfire	
2014	Extreme weather	X
2016	Wildfire	
2017	Wildfire	X
2017	Extreme weather and flooding	
2020	Pandemic – COVID-19	X

Review of these events helps identify targets for risk reduction and ways to increase a community's capability to avoid large-scale events in the future. Still, many natural hazard events do not trigger federal or state disaster declaration protocol but have significant impacts on their communities. These events are also important to consider in establishing recurrence intervals for hazards of concern. More detailed event tables can be found in the individual hazard profile chapters.

CLIMATE CHANGE

Climate includes patterns of temperature, precipitation, humidity, wind, and seasons. Climate plays a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them. "Climate change" refers to changes over a long period of time. It is anticipated that climate change will have a measurable impact on the occurrence and severity of natural hazards around the world. Evidence of these changes are being observed first-hand by communities across the globe. Impacts include the following:

- Snow cover losses will continue, and declining snowpack will affect snow-dependent water supplies and stream flow levels around the world.
- The risk of drought and the frequency, intensity, and duration of heat waves are expected to increase, also leading to an increased number and intensity of wildfires.

[3] 2018 Colorado Hazard Mitigation Plan

- More extreme precipitation is likely, increasing the risk of flooding and other secondary hazards.
- The world's average temperature is expected to increase.

Climate change will affect communities in a variety of ways. Impacts could include an increased risk for extreme events such as drought, storms, flooding, and wildfires; more heat-related stress; and the spread of existing or new vector-born disease into a community. In many cases, communities are already facing these problems to some degree. Climate change can influence the frequency, intensity, extent, and magnitude of hazards.

This hazard mitigation plan update addresses climate change as a secondary impact for each identified hazard of concern. Each hazard chapter includes a section with a qualitative discussion on the probable impacts of climate change for that hazard.

HAZARD RISK SUMMARY

A qualitative risk ranking was performed by the Steering Committee and each jurisdiction for the hazards profiled in this plan. Rankings were done by the Steering Committee as a whole and then specific to each jurisdiction. This risk ranking assesses the probability of each hazard's occurrence, as well as its likely impact on the people, property, and economy of the planning area. Through an online survey, the public was also asked to help rank each hazard based on their perceived level of risk. Table 21 presents these results.

TABLE 21: HAZARD RISK RANKINGS

	Public Survey	Steering Committee	Fremont County	Brookside	Cañon City	Coal Creek	Florence	Rockvale	Williamsburg
Dam Failure	1.3	3.8	Moderate	Low	High	Low	Low	High	Low
Debris Flow	3.6	5.7	Moderate	Low	Moderate	Low	Moderate	High	Moderate
Drought / Extreme Heat	8	7.9	Moderate	High	High	High	Moderate	Moderate	High
Earthquake	1	1.6	Low	Moderate	Low	Low	Low	Low	Low
Flood	5.1	6.9	High	Low	High	High	High	High	Moderate
Landslide / Rockfall	2.2	6.4	Low	Low	Low	Moderate	Moderate	Low	Low
Pandemic	6.4	5.1	High	Low	Moderate	Low	Moderate	Moderate	Low
Severe Winter Weather	5	6.6	Moderate	High	Moderate	High	High	Moderate	Moderate
Subsidence / Erosion	2.6	2.6	Low	Low	Low	Low	Low	Low	Moderate
Thunderstorm (hail, high wind, lighting)	7	5.6	High	High	High	High	Moderate	Moderate	Low
Tornado	1.8	2.4	Low	Moderate	Low	Low	Low	Low	Low
Wildfire	7.8	8	High	Moderate	High	High	High	High	Low
Wildlife-Vehicle Collisions	5.9	5.8	Moderate	Low	Low	Low	Low	Low	Low

Colorado Emergency Preparedness Assessment

Fremont County also recently completed its Colorado Emergency Preparedness Assessment (CEPA) in December 2020. Part of this assessment, which is conducted with the state, includes a risk assessment of all hazards identified in the State of Colorado's Hazard Mitigation Plan. The planning team for the CEPA was not the same as for this plan, but there was a lot of membership overlap between the groups.

Figure 41 presents the CEPA risk assessment results. Overall, these align well with the rankings in this HMP.

FIGURE 41: CEPA RISK ASSESSMENT

Risk Assessment

Hazard	Likelihood	Consequence	Relative Risk
Wildfire	Very High	Very High	25
Flood	Very High	High	20
Post Wildfire Flooding	High	High	16
Drought	Very High	Medium	15
Cyber Attack	Medium	High	12
Erosion and Deposition	Medium	High	12
Hail	High	Medium	12
Pandemic/Epidemic	Medium	High	12
Pest Infestation	High	Medium	12
Power Failure	High	Medium	12
Thunderstorms and Lightning	High	Medium	12
Dam and Levee Failure	Low	Very High	10
Radiological Release	Low	Very High	10
Wildlife-Vehicle Collisions	Very High	Low	10
Hazardous Materials Release	Medium	Medium	9
Landslides, Mud/Debris Flows and Rock Falls	Medium	Medium	9
Subsidence & Abandoned Mine Lands	Medium	Medium	9
Water Contamination	Medium	Medium	9
Active Shooter/Threat	Low	High	8
Civil Disorder/Disturbance	Low	High	8
Dense Fog	High	Low	8
Explosive Attack/Bomb Threat	Low	High	8
Severe Wind	High	Low	8
Terrorist Attack	Low	High	8
Animal Disease	Low	Medium	6
Expansive Soils and Heaving Bedrock	Medium	Low	6
Extreme Temperature Heat/Cold	Medium	Low	6
Mine Accidents	Low	Medium	6
Chemical, Biological, and Nuclear Attack	Very Low	Very High	5
Earthquake	Low	Low	4
Infrastructure Failure	Low	Low	4
Radon (Rn), Carbon Monoxide (CO), Methane (CH4) Seeps	Low	Low	4
Severe Winter Weather	Low	Low	4
Tornadoes	Low	Low	4
Avalanche	Low	Very Low	2

HAZARD PROFILES

The following pages provide detailed hazard profile chapters for each of the 13 hazards assessed in this plan. Each profile follows the same outline and addresses the following topics:

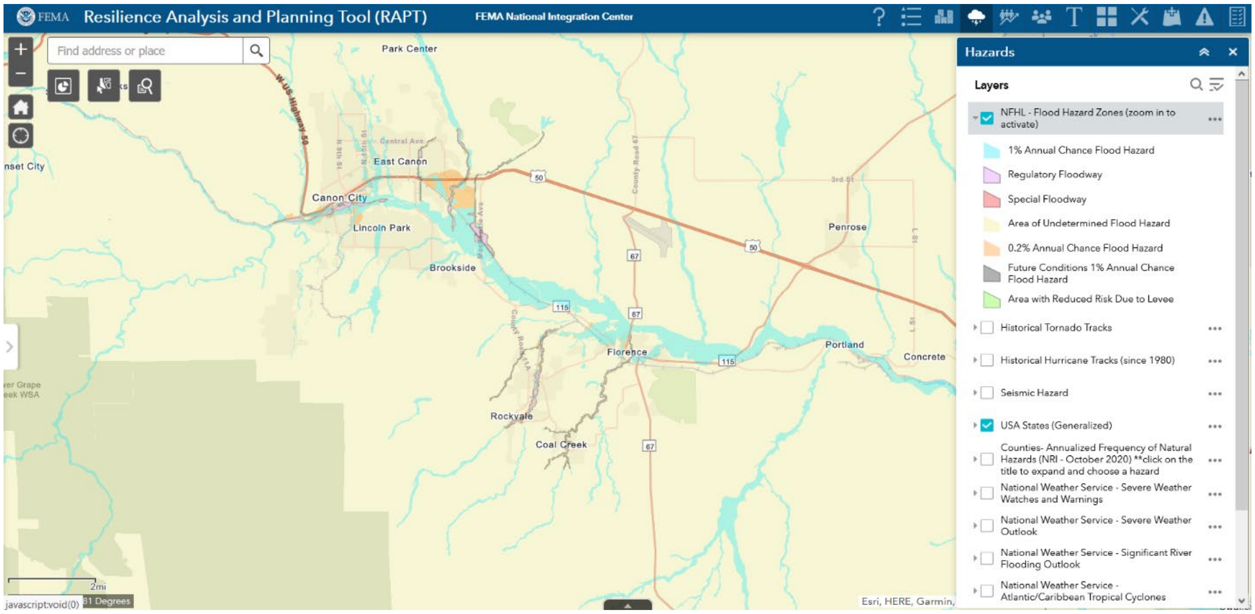
- General background
- Past events
- Location
- Frequency
- Severity
- Warning time
- Secondary hazards
- Climate change impacts
- Exposure and vulnerability
- Future trends in development

HAZARD DATA VIEWERS

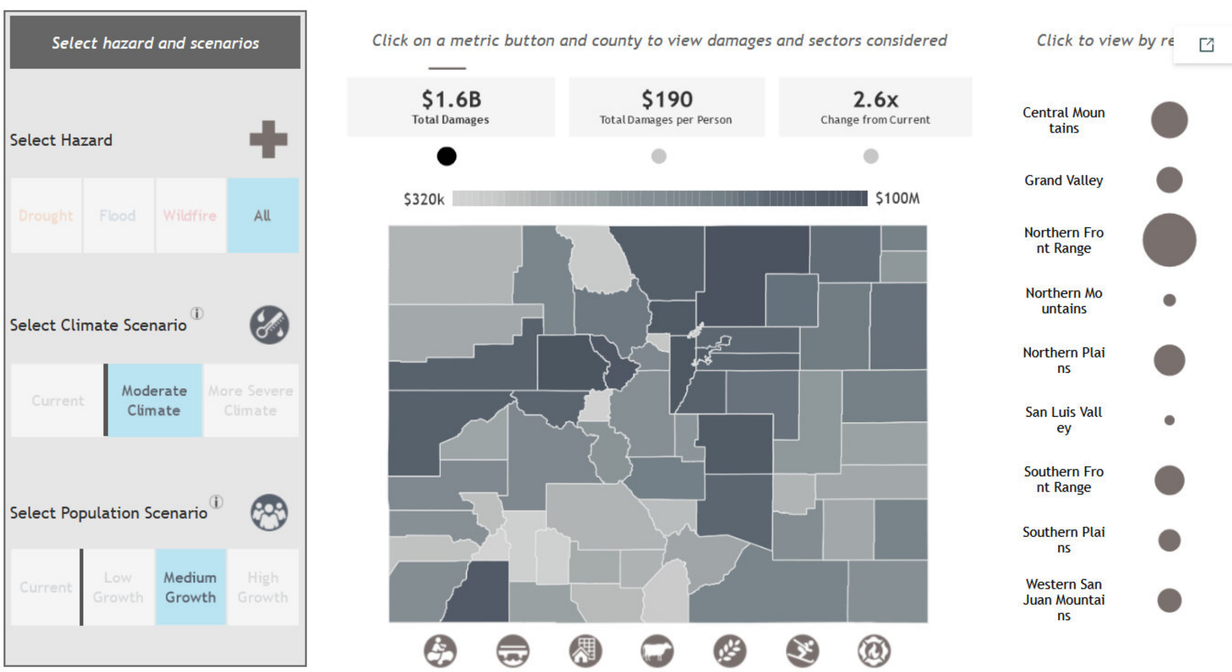
All of the information contained in the following risk and vulnerability assessments is considered a snap-shot in time, based upon the best available data during the time of this Plan's development. It is expected that over the 5-year life of this updated Plan many of these data sets will continue to be updated and enhanced, while new data sources will become available. In order for communities to ensure they are referencing the latest and greatest hazard data, it is important that they are aware of how to access this information.

Fortunately, communities are now able to leverage state and federal web map viewers to assess the most current hazard mapping available for many of the hazards profiled in this Plan. The following bullets provide details on these currently available tools.

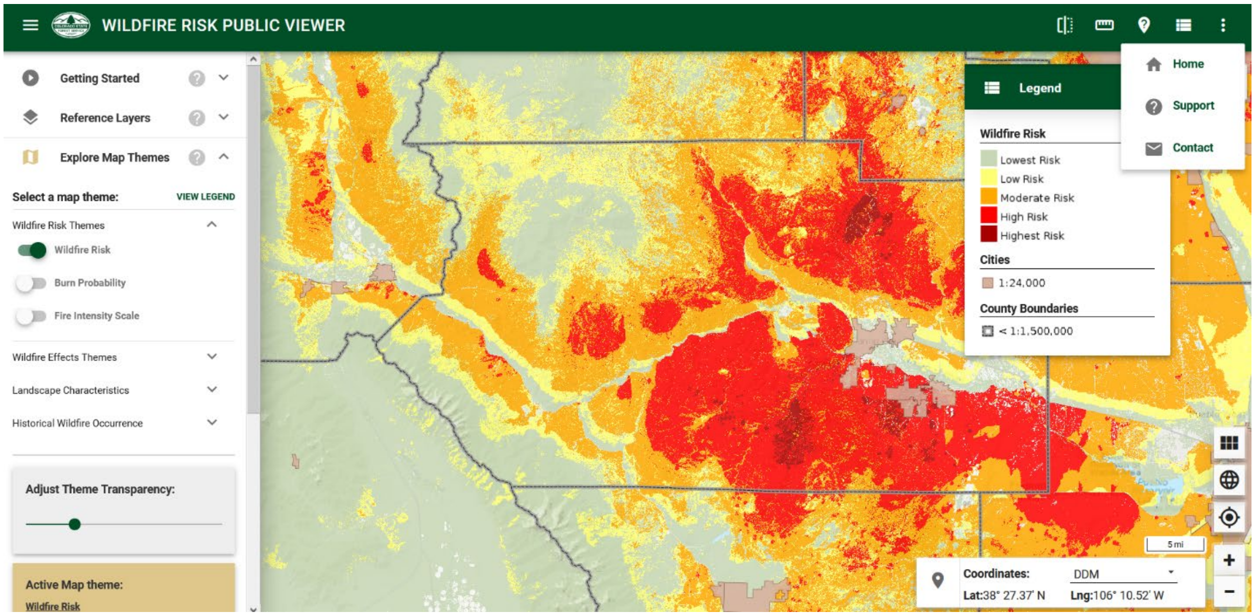
- **FEMA's Resilience Analysis and Planning Tool (RAPT)**: RAPT is a free GIS web map that allows communities to examine the interplay of census data, infrastructure locations, and hazards, including real-time weather forecasts, historic disasters and estimated annualized frequency of hazard risk.



- **Colorado Future Avoided Cost Explorer (FACE):** The FACE Viewer is a public web map that presents the results of a statewide study concerning the direct impacts of flood, drought, and wildfire on select sectors of the Colorado economy. It is intended to help inform preparedness and resilience policies, support recovery and adaptation investments, and provide decision-makers with tools to quantify the growing cost in inaction.



- **Colorado Forest Atlas – Wildfire Risk Viewer:** The Wildfire Risk Viewer is a web-mapping application that allows users to identify specific wildfire risk levels within a 1/2-mile radius of a home, or any other point of interest on the map. A risk level description and link to additional resources is provided for users wanting to know how to reduce their risk.



DAM / LEVEE FAILURE

Fremont County has ranked the risk from dam / levee failures to be Moderate. The previous HMP also ranked this hazard the same.

Moderate Risk

GENERAL BACKGROUND

Causes of Dam Failure

Dam failures in the United States typically occur in one of four ways:

- Overtopping of the primary dam structure, which accounts for 34 percent of all dam failures, can occur due to inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors.
- Foundation defects due to differential settlement, slides, slope instability, uplift pressures, and foundation seepage can also cause dam failure. These account for 30 percent of all dam failures.
- Failure due to piping and seepage accounts for 20 percent of all failures. These are caused by internal erosion due to piping and seepage, erosion along hydraulic structures such as spillways, erosion due to animal burrows, and cracks in the dam structure.
- Failure due to problems with conduits and valves, typically caused by the piping of embankment material into conduits through joints or cracks, constitutes 10 percent of all failures.

The remaining 6 percent of U.S. dam failures are due to miscellaneous causes. Many dam failures in the United States have been secondary results of other disasters. The prominent causes are earthquakes, landslides, extreme storms, massive snowmelt, equipment malfunction, structural damage, foundation failures, and sabotage.

Poor construction, lack of maintenance and repair, and deficient operational procedures are preventable or correctable by a program of regular inspections. Terrorism and vandalism are serious concerns that all operators of public facilities must plan for; these threats are under continuous review by public safety agencies.

Causes of Levee Failure

The following information is excerpted from the State of Colorado Flood Mitigation Plan.

> A levee breach occurs when part of a levee gives way, creating an opening through which floodwaters may pass. A breach may occur gradually or suddenly. The most dangerous breaches happen quickly during periods of high water. The resulting torrent can quickly swamp a large area behind the failed levee with little or no warning.

Earthen levees can be damaged in several ways. For instance, strong river currents and waves can erode the surface. Debris and ice carried by floodwaters—and even large objects such as boats or barges—can collide with and gouge the levee. Trees growing on a levee can blow over, leaving a hole where the root wad and soil used to be. Burrowing animals can create holes that enable water to pass through a levee. If severe enough, any of these situations can lead to a zone of weakness that could cause a levee breach. In seismically active areas, earthquakes and ground shaking can cause a loss of soil strength, weakening a levee and possibly resulting in failure. Seismic activity can also cause levees to slide or slump, both of which can lead to failure. Unfortunately, in the rare occurrence when a levee system fails or is overtopped, severe flooding can occur due to increased elevation differences associated with levees and the increased water velocity that is created. It is also important to remember that no levee provides protection from events for which it was not designed, and proper operation and maintenance are necessary to reduce the probability of failure. In some cases, flooding may not be directly attributable to a river, stream, or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall or snowmelt, saturated ground, and inadequate drainage. With no place to go, the water will find the lowest elevations – areas that are often not in a floodplain. This type of flooding, often referred to as sheet flooding, is becoming increasingly prevalent as development outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow. Flooding also occurs due to combined storm and sanitary sewers that cannot handle the amount of water.

The complicated nature of levee protection was made evident by events such as Hurricane Katrina. Flooding can be exacerbated by levees that are breached or overtopped. As a result, FEMA and the U.S. Army Corps of Engineers are re-evaluating their policies regarding enforcement of levee maintenance and post-flood rebuilding. Both agencies are also conducting stricter inspections to determine how much protection individual levees actually provide. The Colorado Water Conservation Board (CWCB) is committed to aiding local governments with the increased levels of compliance with federal regulations. CWCB will assist qualifying entities who are in good standing with the NFIP through technical and financial assistance. CWCB assistance may include grant funding, participation in levee inspections, assistance in developing Maintenance Deficiency Correction Plans, site visits, and participation in public hearings. In addition, the CWCB will also discourage the construction of new levees to protect new developments, and instead encourage other types of flood mitigation projects.

Regulatory Oversight

The potential for catastrophic flooding due to dam failures led to passage of the National Dam Safety Act (Public Law 92-367). The National Dam Safety Program requires a periodic engineering analysis of every major dam in the country. The goal of this FEMA-monitored effort is to identify and mitigate the risk of dam failure so as to protect the lives and property of the public.

Colorado Rules and Regulations for Dam Safety and Dam Construction

The Colorado Rules and Regulations for Dam Safety and Dam Construction (2-CCR 402-1, January 1, 2007) apply to any dam constructed or used to store water in Colorado. These rules apply to applications for review and approval of plans for the construction, alteration, modification, repair, enlargement, and removal of dams and reservoirs, quality assurance of construction, acceptance of construction, non-jurisdictional dams, safety inspections, owner responsibilities, emergency action plans, fees, and restriction of recreational facilities within reservoirs. Certain structures (defined in Rule 17) are exempt from these Rules. The purpose of the rules is to provide for the public safety through the Colorado Safety of Dams Program by establishing reasonable standards and to create a public record for reviewing the performance of a dam.

U.S. Army Corps of Engineers Dam Safety Program

The U.S. Army Corps of Engineers (USACE) is responsible for safety inspections of some federal and non-federal dams in the United States that meet the size and storage limitations specified in the National Dam Safety Act. USACE has inventoried dams and surveyed each state and federal agency's capabilities, practices, and regulations regarding design, construction, operation and maintenance of the dams; and developed guidelines for inspection and evaluation of dam safety (U.S. Army Corps of Engineers, 1997).

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) cooperates with a large number of federal and state agencies to ensure and promote dam safety. More than 3,000 dams are part of regulated hydroelectric projects in the FERC program. Two-thirds of these are more than 50 years old. As dams age, concern about their safety and integrity grows, so oversight and regular inspection are important. FERC inspects hydroelectric projects on an unscheduled basis to investigate the following:

- Potential dam safety problems
- Complaints about constructing and operating a project
- Safety concerns related to natural disasters

- Issues concerning compliance with the terms and conditions of a license.

Every 5 years, an independent engineer approved by the FERC must inspect and evaluate projects with dams higher than 32.8 feet (10 meters) or with a total storage capacity of more than 2,000 acre-feet.

FERC monitors and evaluates seismic research and applies it in investigating and performing structural analyses of hydroelectric projects. FERC also evaluates the effects of potential and actual large floods on the safety of dams. During and following floods, FERC visits dams and licensed projects, determines the extent of damage, if any, and directs any necessary studies or remedial measures the licensee must undertake. The FERC publication Engineering Guidelines for the Evaluation of Hydropower Projects guides the FERC engineering staff and licensees in evaluating dam safety. The publication is frequently revised to reflect current information and methodologies.

FERC requires licensees to prepare emergency action plans and conducts training sessions on how to develop and test these plans. The plans outline an early warning system if there is an actual or potential sudden release of water from a dam due to failure. The plans include operational procedures that may be used, such as reducing reservoir levels and reducing downstream flows, as well as procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that everyone knows what to do in emergency situations.

PAST EVENTS

Dams

Colorado has a history of dam failure, with more than 130 known dam failures since 1890[4]. A number of dams were breeched following the floods in September 2013, but none were in Fremont County. The Association of State Dam Safety Officials (ASDSO) reports[5] that since 1978, there have been 69 dam incidents statewide. Dam safety incidents are defined as situations at dams that require an immediate response by dam safety engineers. Of these, 14 have been dam failures. (It should be noted that a vast majority of the reported incidents in the ASDSO database are from 2011 to the present, with half of the incidents stemming from the state's 2013 flood event.)

There have been no reported dam failures in Fremont County since the failure of Shaeffer Dam in June of 1921. The U.S. Army Corps of Engineers describes the events that led to the dam failure as follows (Johnson, 2011).

[4] 2018 Colorado State Hazard Mitigation Plan
[5] https://www.damsafety.org/incidents

> Cloudbursts over the upper Arkansas River basin on 3 June 1921 caused a rapid rise in the Arkansas River and in Fountain Creek at Pueblo. They climbed as much as 3.5 feet in fifteen minutes and overtopped Pueblo's floodwalls and levees. The flood crested 6.5 feet over the levees and high velocity currents swept over the city, destroying bridges, water supply and sewage systems, telephone communications, and electric power lines. The flood washed out all but one bridge, destroyed five hundred buildings and drowned 156 people.
>
> Recovery efforts had just begun when Schaeffer Dam up Beaver Creek failed, releasing another wall of water. The resulting flood destroyed the towns of Portland and Swallows and because Pueblo's flood protection system was already breached, it disastrously inundated the city a second time.

If failure were to occur on dams outside of Fremont County that lie along the Arkansas River, Grape Creek, and Beaver Creek waterways, there would be significant impacts for the people and property within the county.

Levees

In 2015, a portion of the Arkansas River Walk Trail, which serves as a levee, was undermined. This occurred during high runoff events in May and June, upstream of South Reynolds Avenue where ~500' of the existing concrete retaining wall failed. Following this event, streambank stabilization engineering was performed, including mitigation efforts to avoid future recurrences.

A smaller section of the River Walk Trail was also undermined in 2019 following another high runoff event.

LOCATION

Dams

The Colorado Department of Water Resources Dam Safety program has identified 25 dams across the county (one of which is just south of the county boundary). Figure 42 and Figure 43 present these dam locations. Cañon City, Florence, and Cotopaxi are the first downstream areas for many of these dams.

There are also 'non-jurisdictional' dams on public and private lands in the county. These are small dams that normally do not store water but may impound water during heavy precipitation events. Because they are not monitored or maintained, there is potential for them to overtop or fail and cause localized flooding and property damage during a significant rainfall event. The extent and risk associated with these dams is not known.

The areas of the county most likely to be impacted by a dam failure are the Beaver Creek area and along the Arkansas River. Fremont County could be impacted by several high hazard dams that are located outside of the county, as their drainages enter Fremont County either by direct drainage through parts of the county or by inflow into the Arkansas River upstream from Fremont County. The DeWeese Reservoir would be one of these neighboring county dams to be aware of. This high hazard dam, located near Westcliff, is located on Grape Creek and the first downstream municipality is Cañon City. If a failure of one of these high hazard dams occurred, it could result in loss of life.

FIGURE 42: DAM LOCATIONS

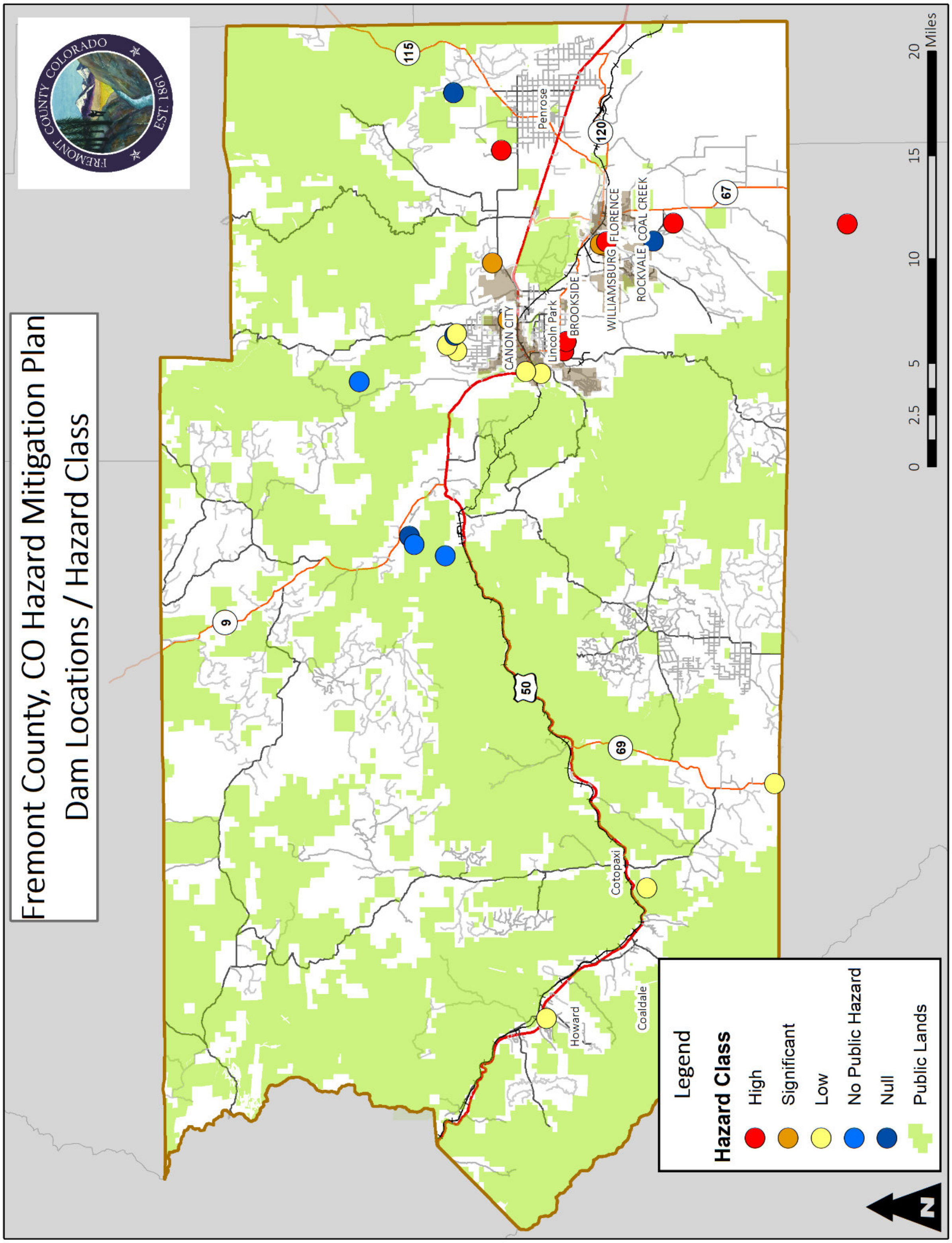
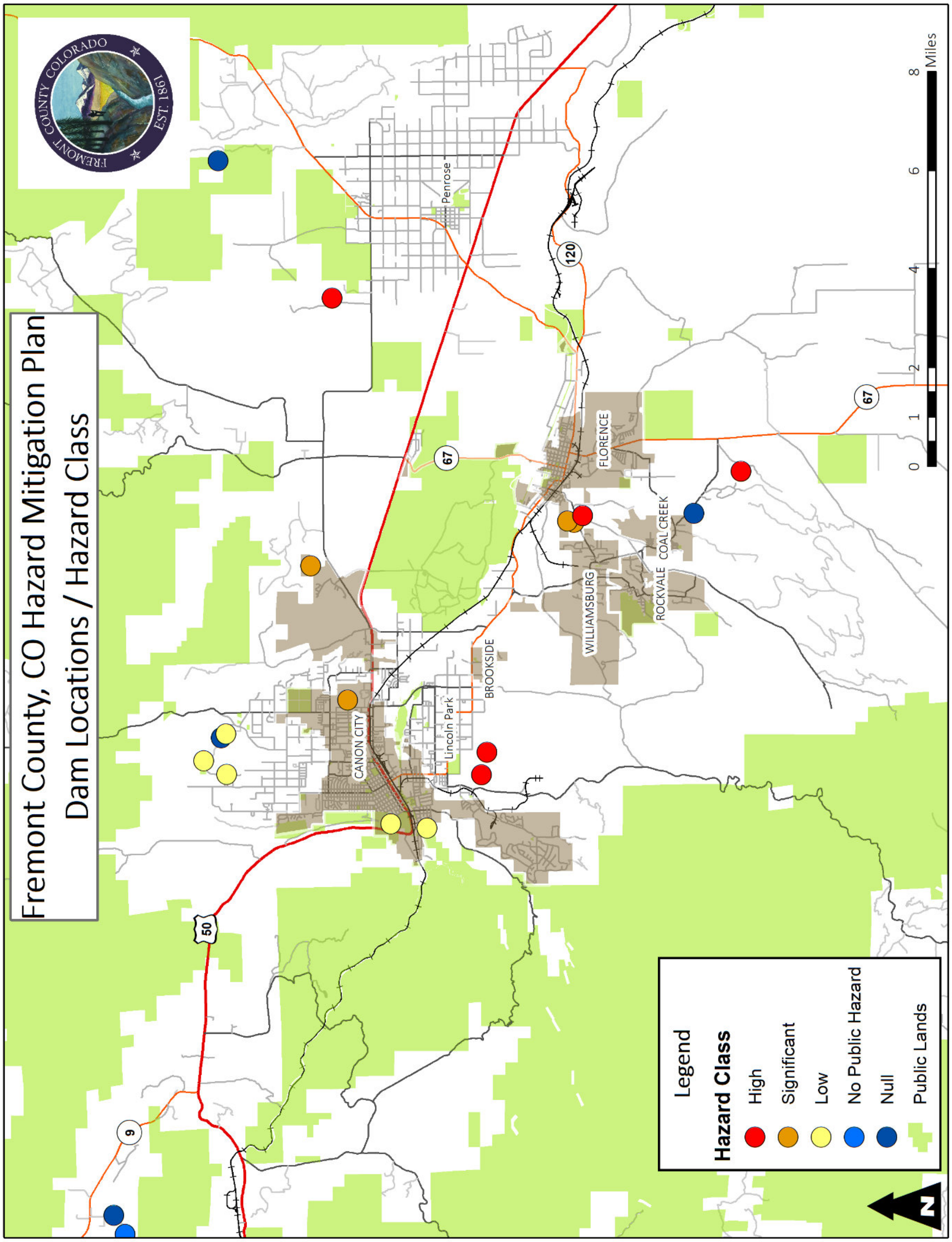


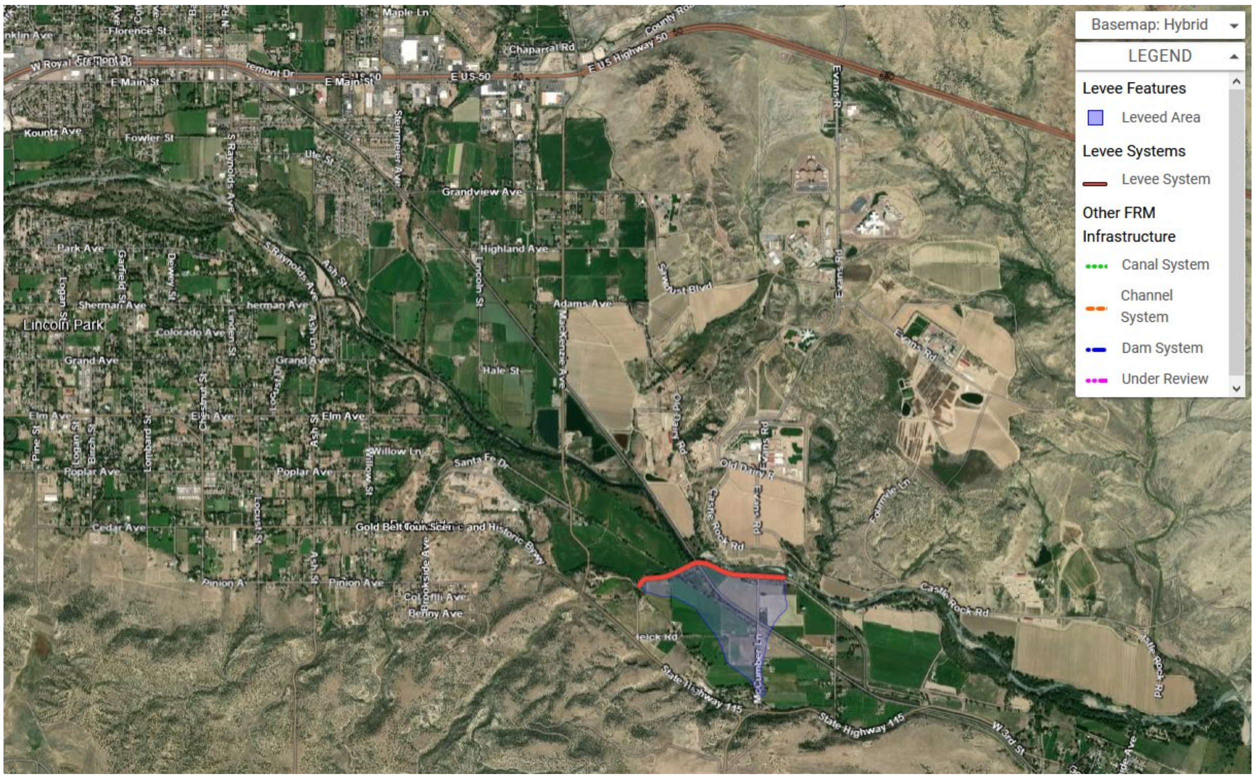
FIGURE 43: DAM LOCATIONS NEAR MUNICIPALITIES



Levees

The USACE National Levee Database[6] include one known levee, located in Williamsburg and shown in Figure 44. It is possible that there are levees located within the county that are not listed in these databases.

FIGURE 44: ARKANSAS RIVER LEVEE - WILLIAMSBURG



FREQUENCY

Based on one recorded occurrence of a dam or levee failure in the past 100 years in Fremont County, it is estimated that there is a 1% chance of future dam / levee failure events in any given year. The fact that much of this infrastructure is aging may increase this frequency going forward.

SEVERITY

The USACE developed the classification system shown in Table 22 for the hazard potential of dam failures. This hazard rating system is based only on the potential consequences of a dam failure and does not take into account the probability of such failures.

---

[6] https://levees.sec.usace.army.mil/#/

TABLE 22: DAM HAZARD POTENTIAL CLASSIFICATIONS

Hazard Category	Direct Loss of Life	Lifeline Losses	Property Losses	Environmental Losses
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

Figure 42 and Figure 43 present these dam classifications. Of the 25 dams shown, six are categorized as having High hazard potential and four having Significant.

WARNING TIME

Warning time for dam or levee failure varies depending on the cause of the failure. In events of extreme precipitation or massive snowmelt, evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, there may be no warning time. A dam's structural type also affects warning time. Earthen dams do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until either the reservoir water is depleted or the breach resists further erosion. Concrete gravity dams also tend to have a partial breach as one or more monolith sections are forced apart by escaping water. The time of breach formation ranges from a few minutes to a few hours (U.S. Army Corps of Engineers, 1997).

Emergency action plans for all high hazard dams that would affect Fremont County are on file with the Fremont County Office of Emergency Management. Additionally, possible evacuation routes, in the event of a failure, have been identified.

SECONDARY HAZARDS

Dam failure can cause severe downstream flooding and debris flow, depending on the magnitude of the failure. Other potential secondary hazards of dam failure are landslides around the reservoir perimeter, bank erosion on the rivers, and destruction of downstream habitat. Spillway overtopping, as dams are designed to do, may also cause downstream flooding in areas not known to be at risk to riverine flooding.

Levee failure can lead to flooding, potentially in areas that are not expected or prone to flooding due to the protection that the levee provides.

CLIMATE CHANGE IMPACTS

Per the 2018 Colorado State Hazard Mitigation Plan:

> With a potential for increase in extreme precipitation events, climate change may result in large floods that could stress dams and levees, and thus potentially increase the risk of failure of these structures. Dams and other hydrologic containment structures are designed based on calculations of a river's flow behavior, and any changes in weather patterns can have significant effects on the hydrologic information used for the design of a dam or levee. Climate change may alter the dam/levee profile and affect the designed margin of safety. If freeboard is reduced, dam operators may be forced to release increased volumes of water to maintain the required safety parameters. Such early releases can increase flood potential downstream and possibly involve the spillway. Additionally, the structural integrity of earthfill dams may be compromised by climate change impacts such as drought and severe storms. Changes in vegetation and prolonged drying due to drought, embankment erosion due to severe storms, and more extreme fluctuations in water levels due to severe storms and increased frequency of drought all make earthfill dams vulnerable to climate change. The structural integrity of non-erodible dams or levees, such as concrete, are less vulnerable to climate change, but extreme temperatures may lead to cracking or joint movement.

EXPOSURE AND VULNERABILITY

Overall, dam / levee failure impacts would be limited in Fremont County to the dam inundation and levee protected areas. Dam inundation mapping is not shown in this plan due to data restrictions but is available for jurisdictional use. A total of 2,809 structure across the county are within dam inundation areas, with a combined improved property value of $507M. Roads closed due to dam failure floods could result in serious transportation disruptions due to the limited number of roads in the county.

The USACE's National Levee Database assesses that 18 residents and eight structures, with a property value of $1.88M, are behind the lone levee identified in Fremont County.

Lifelines

As part of this vulnerability assessment, the county's Lifelines were assessed with the best available dam inundation and levee protected areas mapping data. Table 23 presents Lifeline exposure to these hazards. Individual assessments of exposed Lifelines can help to identify potential mitigation actions to consider implementing.

TABLE 23: LIFELINE EXPOSURE TO DAM / LEVEE FAILURE

Lifeline	Total Count	Count Exposed Dam	% Dam	Count Exposed Levee	% Levee
Medical Facilities	3	0	0%	0	0%
Schools	33	6	18%	0	0%
Sewage Facilities	1	0	0%	0	0%
Other Lifelines	174	29	17%	0	0%
Tier II Facilities	45	6	13%	0	0%
Transportation (miles)	563.0	1.4	0.24%	0.1	0.01%

Population

Those in the community with access and functional needs (AFN), that are downstream from dam failures (or within levee protected areas), may be incapable of evacuating the inundation area within the allowable time frame. This population includes elderly people, people with disabilities and mobility issues, those with independent living difficulty, those who are institutionalized and those without means of transportation. Non-English speaking populations are also included as communications and emergency messaging may not be available in languages other than English. In general, anyone who does not have adequate access to warnings from an emergency warning system may also be disproportionately impacted by the hazard.

Property

Vulnerable properties are those closest to the dam inundation or levee protected areas. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since they are where waters would collect. Transportation routes are vulnerable and have the potential to be wiped out, creating isolation issues. This includes all roads, railroads, and bridges in the path of the inundation. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas.

Environment

Reservoirs held behind dams, and rivers held behind levees affect many ecological aspects of a river. River topography and dynamics depend on a wide range of flows and rivers below dams often experience long periods of very stable flow conditions, or saw-tooth flow patterns, caused by releases followed by no releases. Water releases from dams usually contain very little suspended sediment; this can lead to scouring of riverbeds and banks.

The environment would be vulnerable to a number of risks in the event of dam failure. The inundation could introduce many foreign elements into local waterways. This could result in destruction of downstream habitat and could have detrimental effects on many species of animals.

Economy

Economic impacts for dam / levee failure could be quite significant depending on the extent of flooding. Businesses and homes may be damaged, as well as roads and infrastructure needed for day-to-day operations. The transport of goods and travel across the county could be impacted, affecting the supply chain for local industry and the ability for residents to commute.

FUTURE TRENDS IN DEVELOPMENT

Future population change across the county is expected to be 1.7% over the next five years. This is similar to the growth experienced over the last five years (1.9%). A majority of this growth is expected to occur as municipal infill. It is important for municipalities to fully understand the risk presented by dam and levee failures to those vulnerable areas to ensure new construction does not increase the county's risk to dam / levee failure.

DEBRIS FLOW

Fremont County has ranked the risk from debris flow events to be Moderate.

Moderate Risk

GENERAL BACKGROUND

Debris flows are among the most destructive geologic processes that occur in mountainous areas. A debris flow is a mass of water and earth materials that flows down a stream, ravine, canyon, arroyo, or gulch. Technically, if more than half of the solids in the mass are larger than sand grains (e.g., rocks, stones, boulders) the event is called a debris flow, otherwise it is called a mudslide or mudflow. For the purposes of this plan the term debris flow is meant to be a global term to include mudslides/mudflows. Many of Colorado's older mountain communities, built in major mountain valleys, are located on or near debris fans. A debris fan is a conical landform produced by successive mud and debris flow deposits, and the likely spot for a future event. Three of the five conditions necessary for debris flows to occur: (1) steep slopes, (2) loose rock and soil material, and (3) clay minerals, are adequately met by the geography and geology in the Fremont area. The last two conditions for debris-flow occurrence: (4) sufficient antecedent soil moisture, and (5) rainfall of sufficient intensity and duration to initiate slope movement, are provided by snowmelt and intense summer thunderstorms.

The debris flow problem can be exacerbated by wildfires which remove vegetation that serves to stabilize soil from erosion. Heavy rains on the denuded landscape can lead to rapid development of destructive mudflows.

PAST EVENTS

The Colorado Geological Survey's (CGS) Critical Landslides in Colorado, A Year 2002

Review and Priority List[7] was done as part of an update of the 1988 Colorado Landslide Mitigation Plan. This report provides the most recent status report on 49 locations believed to pose the most serious landslide risk in Colorado that were identified in the 1988 plan. The hazard areas (landslide/rockfall or debris flow) are categorized into three tiers. Tier one listings are serious cases needing immediate or ongoing action or attention because of the severity of potential impacts. Tier two listings are very significant but less severe; or where adequate information and/or some mitigation is in place; or where current development pressures are less extreme. The report lists the Lower reaches and alluvial fans of Arkansas River tributaries between Salida and Parkdale in Fremont County as a Tier two debris flow area.

This excerpt is from the report:

> Lower reaches and alluvial fans of Arkansas River tributaries between Salida and Parkdale, debris flows and flash flooding, Fremont County U.S. Hwy 50, CO Hwy 69, and county roads of this corridor have been flooded periodically with rock, mud, woody debris and floodwater from tributary streams, requiring frequent cleanup and roadway repairs after the larger events.
>
> Year 2002 evaluation and recommendations: Detailed study and hazard mapping are badly needed, as these events are both a serious safety problem and a source of excessive maintenance costs. With hazard maps and process studies in hand, more effective plans for mitigation could be devised by the CDOT and affected counties.

These debris flow events continue to occur across the county. Unfortunately, there is a lack of official records relating to past events and specifics on their impacts. There is one record of a debris flow event since the last plan update. This event occurred around Parkdale on 5/19/2015. Details provided on this event:

- Strong storms produced heavy rain and flooded roadways in western El Paso and Pueblo Counties. In addition, persistent rain caused debris flows across several roads in northeast Fremont County. Roads washed out and became debris filled when prolonged rain occurred. Some roads affected were High Park Road near State Highway 9, Shelf Road, Phantom Canyon Road, Oak Creek Road, and Beaver Creek Road.

[7] https://coloradogeologicalsurvey.org/publications/critical-landslides-colorado/

Since the Hayden Pass Wildfire in 2016, there have been multiple debris flow events impacting Hayden Pass, Cañon City, and other sections of the Arkansas River. These events continue through the time of this plan's writing.

LOCATION

As mentioned in the report, areas along U.S. Hwy 50, CO Hwy 69, and county roads of this corridor experience the most debris flow events.

FREQUENCY

Debris flows can occur rapidly with little warning during torrential rains. Debris and mudflows generally occur with floods and downpours associated with the late summer monsoon season. While there is little quantitative data available, it is expected that future debris flow events will continue to occur across the county regularly.

SEVERITY

In 2015, CDOT published a white paper entitled "The Economic Impacts of Geologic Hazard Events on Colorado Transportation Facilities" (CDOT 2015). The document presents a detailed quantitative assessment of how rockfalls, rockslides, landslides, debris flows, and sinkholes affect the state's transportation infrastructure. The statewide impacts from geologic hazards along CDOT highways can be grouped into two categories: (1) direct costs incurred by CDOT for maintenance, labor and equipment, engineering, and construction activities, and (2) indirect costs including but not limited to property damage, injury or fatalities, traveler delay, lost productivity, loss of revenue to businesses and communities, and environmental impacts.

WARNING TIME

Due to the sequential pattern of meteorological conditions needed to create debris flows, it is unusual for these events to occur without warning. The problem is knowing which precipitation events will trigger debris flows which can occur suddenly. Warning times for debris flows can be between 24 and 48 hours. Flash flooding caused debris flows can be less predictable, but potential hazard areas can be warned in advance of potential danger.

SECONDARY HAZARDS

Debris flow poses a secondary hazard of flooding due to the blockages that debris may create and trap water. The debris flow and flooding can also contribute to bank erosion. Debris flows may cause hazardous material releases if the debris were to damage storage tanks or infrastructure. Public health issues are a hazard as well, the impact to the drinking water supply from the debris flow and flooding could be dangerous, as well as any damage to sewer systems or wastewater spillage.

CLIMATE CHANGE IMPACTS

Although there is no consensus that annual mean precipitation will increase in Colorado due to climate change, it is possible that precipitation may increasingly come in the form of extreme storms. These high-intensity rainfall events could lead to increased flash flood conditions, which exacerbates the potential for debris flows. Additionally, climate change is contributing to an increased frequency of high-intensity wildfires across the western United States. These high-intensity wildfires can decimate vegetation, which increases the risk for debris flows during a rain event. The expected increased frequency of drought conditions can delay post-wildfire revegetation and also weaken vegetative bonds, potentially leading to increased debris flow events.

EXPOSURE AND VULNERABILITY

Debris flows can damage property, close roads, and cause injuries or death. A road closed due to debris flow activity can result in serious transportation disruptions due to the limited number of roads in the county.

Lifelines

Most debris flows will have little to no impact to Lifelines. In some cases, single events may have significant impact, resulting in deaths or causing extensive damage to public infrastructure.

Of the Lifelines, transportation systems will be most impacted. While no analysis is possible without mapped hazard areas, the likelihood of road closures and bridge damage in a debris flow event is high.

Population

In most debris flow events, there is limited or no deaths and injuries.

Property

While there may be damage in most events, there will be limited property damage to structures.

Environment

Debris flows can affect the environment by altering waterways with the sediment and other materials that are carried. This may impact water quality and any flooding that may have resulted from the debris flow also poses a risk to drinking water.

Economy

Economic impacts of debris flow events can be due to the obstruction of transporting goods and the costs of repairs to damaged areas and properties. However, greater impact to the overall economy of the county is not significant.

FUTURE TRENDS IN DEVELOPMENT

Future population change across the county is expected to be 1.7% over the next five years. This is similar to the growth experienced over the last five years (1.9%). A majority of this growth is expected to occur as municipal infill. As these areas are not at high risk from debris flow, future development is not expected to increase the risk to this hazard.

It is important for the county to fully understand the risk presented by this hazard to ensure any new subdivisions and infrastructure do not increase the county's risk to debris flow. Growth in many areas in mountain counties are constrained by federal lands and this sometimes forces growth onto alluvial fans and hillsides that might be prone to debris flow.

DROUGHT / EXTREME HEAT

Fremont County has ranked the risk from drought / extreme heat to be Moderate. The previous HMP also ranked this hazard the same.

Moderate Risk

GENERAL BACKGROUND

Drought

Drought is a normal phase in the climatic cycle of most geographical areas. According to the National Drought Mitigation Center, drought originates from a deficiency of precipitation over an extended period, usually a season or more. This results in a water shortage for some activity, group, or environmental sector. Drought is the result of a significant decrease in water supply relative to what is "normal" in each location. Unlike most disasters, droughts normally occur slowly but last a long time. There are four generally accepted operational definitions of drought (National Drought Mitigation Center, 2006):

- **Meteorological** drought is an expression of precipitation's departure from normal over some period of time. Meteorological measurements are the first indicators of drought. Definitions are usually region-specific and based on an understanding of regional climatology. A definition of drought developed in one part of the world may not apply to another, given the wide range of meteorological definitions.
- **Agricultural** drought occurs when there is not enough soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought happens after meteorological drought but before hydrological drought. Agriculture is usually the first economic sector to be affected by drought.
- **Hydrological** drought refers to deficiencies in surface and subsurface water supplies. It is measured as stream flow and as lake, reservoir, and groundwater levels. There is a time lag between lack of rain and less water in streams, rivers, lakes, and reservoirs, so hydrological measurements are not the earliest indicators of drought. After precipitation has been reduced or deficient over an extended period of time, this shortage is reflected in declining surface and subsurface water levels. Water supply is controlled not only by precipitation, but also by other factors, including evaporation (which is increased by higher than normal heat and winds), transpiration (the use of water by plants), and human use.
- **Socioeconomic** drought occurs when a physical water shortage starts to affect people, individually and collectively. Most socioeconomic definitions of drought associate it with the supply and demand of an economic good.

Defining when drought begins is a function of the impacts of drought on water users and includes consideration of the supplies available to local water users, as well as the stored water they may have available in surface reservoirs or groundwater basins. Different local water agencies have different criteria for defining drought conditions in their jurisdictions. Some agencies issue drought watch or drought warning announcements to their customers. Determinations of regional or statewide drought conditions are usually based on a combination of hydrologic and water supply factors.

Extreme Heat

Excessive heat events are defined by the U.S. EPA as "summertime weather that is substantially hotter or more humid than average for a location at that time of year" (EPA, 2006). Criteria that define an excessive heat event may differ among jurisdictions and in the same jurisdiction depending on the time of year. Excessive heat events are often a result of more than just ambient air temperature. Heat index tables (see Figure 45) are commonly used to provide information about how hot it feels, which is based on the interactions between several meteorological conditions. Since heat index values were devised for shady, light wind conditions, exposure to full sunshine can increase heat index values by up to 15°F. Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.

FIGURE 45: HEAT INDEX

NOAA's National Weather Service

Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

PAST EVENTS

Drought

Colorado has experienced multiple severe droughts, highlighted as 'dry' years in Table 24. The state is seemingly at the start of another dry period that began in 2018 and continues as of this plan's writing.

TABLE 24: HISTORICAL DRY AND WET PERIODS IN COLORADO[8]

Date	Dry	Wet	Duration (years)
1893-1905	X		12
1905-1931		X	26
1931-1941	X		10
1941-1951		X	10
1951-1957	X		6
1957-1959		X	2
1963-1965	X		2
1965-1975		X	10
1975-1978	X		3
1979-1999		X	20
2000-2006	X		6
2007-2010		X	3
2011-2013	X		2

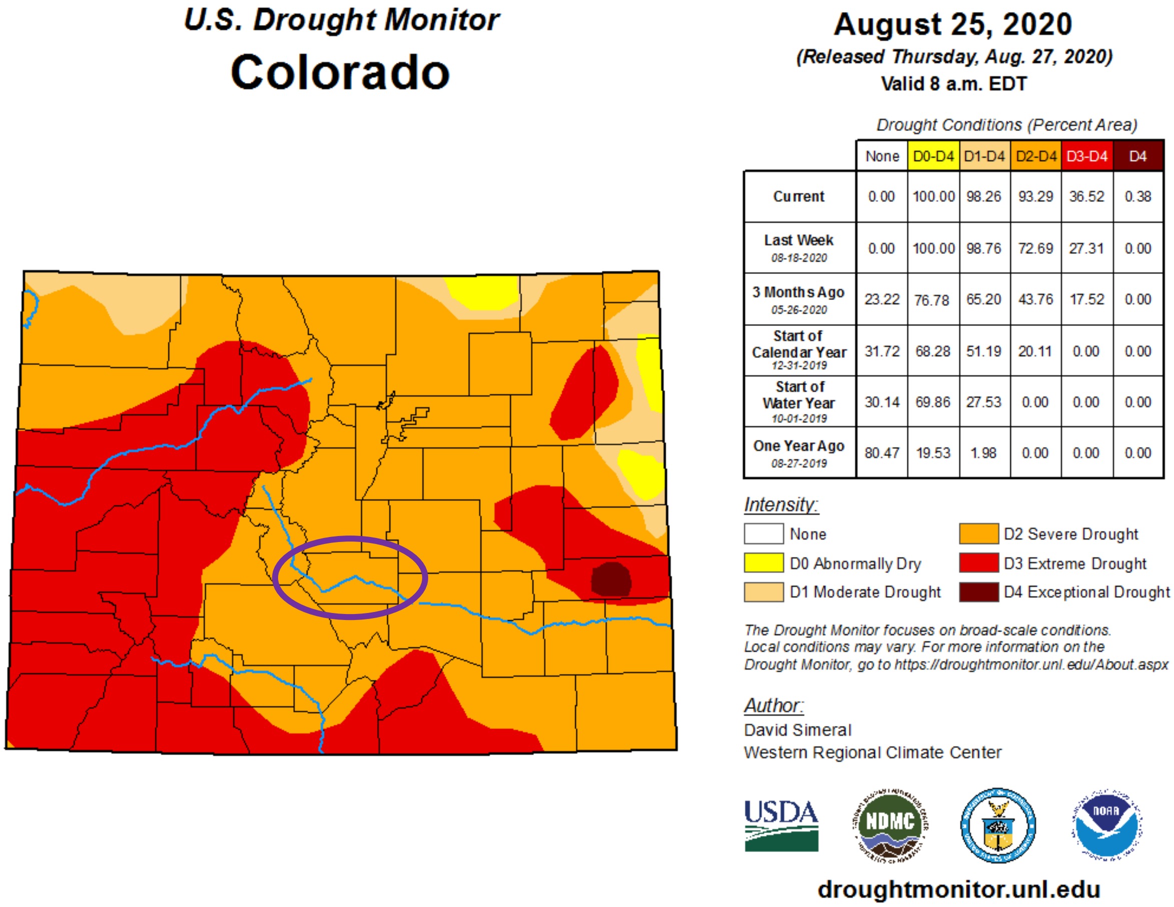
As presented in Table 19 earlier in this chapter, drought reported impacts in Fremont County have resulted in USDA Secretarial Disaster Declarations during roughly 60% of years since 2003. In order to receive these designations, damages and losses must have resulted in the production loss of at least 30 percent of one crop in the county as the result of a natural disaster (Colorado Water Conservation Board, 2013).

Water supplies are also at risk due to drought. In 2002, the water supply of Cañon City was threatened when it was only days away from a "river call" by senior water right holders downstream, such as the Highline Canal, emphasizing the City's lack of and need for water storage rights and infrastructure.

Figure 46 presents the current U.S. Drought Monitor report for the state. Fremont County is currently in a state of severe drought.

[8] 2018 Colorado Drought Mitigation and Response Plan

FIGURE 46: U.S. DROUGHT MONITOR (8/25/2020)



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	98.26	93.29	36.52	0.38
Last Week 08-18-2020	0.00	100.00	98.76	72.69	27.31	0.00
3 Months Ago 05-26-2020	23.22	76.78	65.20	43.76	17.52	0.00
Start of Calendar Year 12-31-2019	31.72	68.28	51.19	20.11	0.00	0.00
Start of Water Year 10-01-2019	30.14	69.86	27.53	0.00	0.00	0.00
One Year Ago 08-27-2019	80.47	19.53	1.98	0.00	0.00	0.00

The National Drought Mitigation Center developed the Drought Impact Reporter in response to the need for a national drought impact database for the United States. Information comes from a variety of sources: on-line drought-related news stories and scientific publications, members of the public who visit the website and submit a drought-related impact for their region, members of the media, and members of relevant government agencies. The Drought Impact Reporter[9] contains information on 58 impacts from droughts that affected Fremont County between 2000 and August 2020 (see Figure 47).

[9] https://droughtreporter.unl.edu/map/

FIGURE 47: DROUGHT IMPACTS

The Drought Impact Reporter found **58** Impacts matching your query.

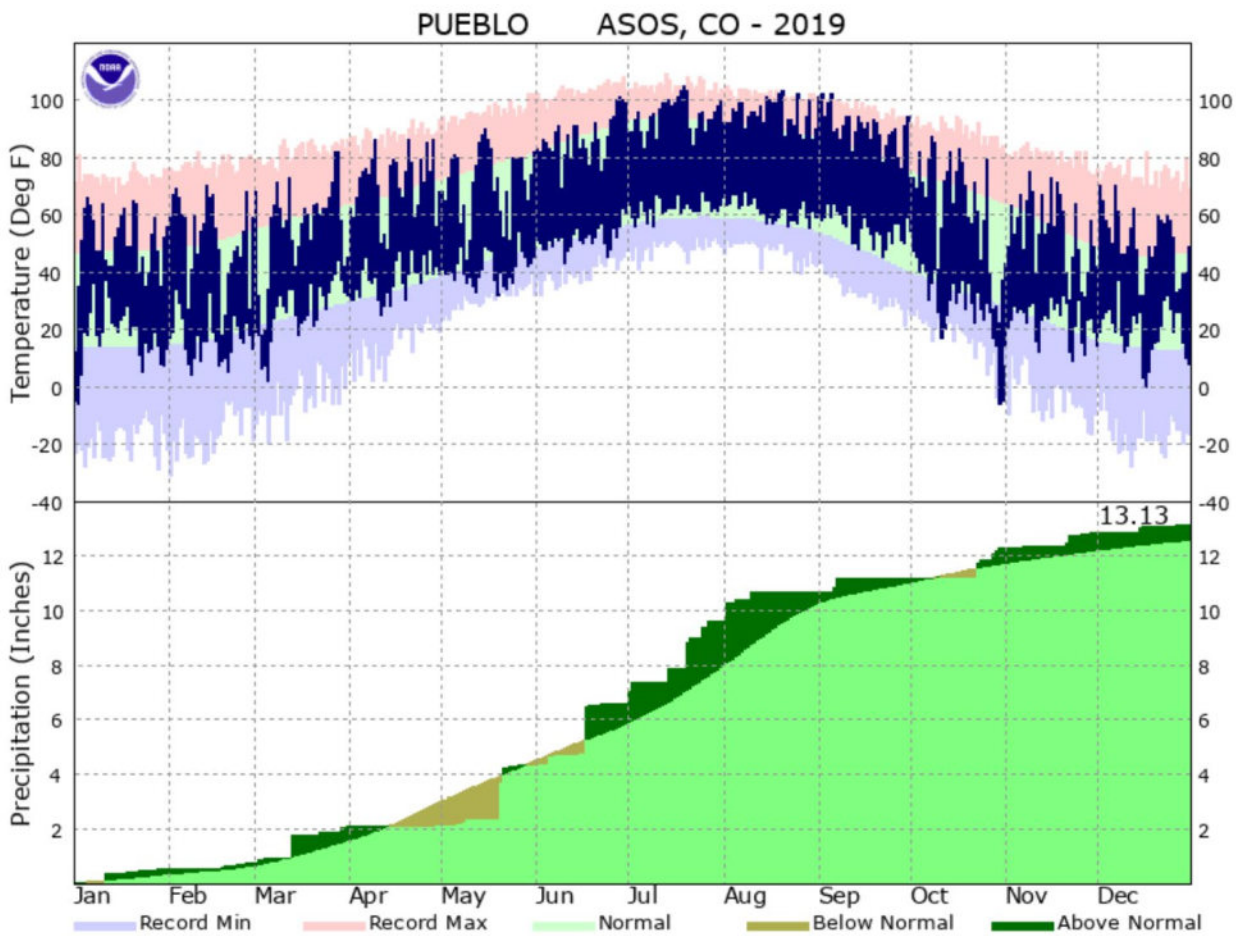
Category/ies

27 in Agriculture
3 in Business & Industry
0 in Energy
11 in Fire
10 in Plants & Wildlife
23 in Relief, Response & Restrictions
5 in Society & Public Health
5 in Tourism & Recreation
9 in Water Supply & Quality

Extreme Heat

The National Weather Service does not report data summaries from any stations in Fremont County, but does report summaries from a station in Pueblo (Pueblo Memorial Airport). Figure 48 contains temperature (and precipitation) summaries related to extreme heat (and drought) for the station, as compared to 2019's weather.

FIGURE 48: HISTORICAL TEMPERATURE AND PRECIPITATION



LOCATION

Drought

Due to Colorado's semiarid conditions, drought is a natural but unpredictable occurrence in the state. However, because of natural variations in climate and precipitation sources, it is rare for all of Colorado to be deficient in moisture at the same time. Single season droughts over some portion of the state are quite common.

The entire county is at risk to drought conditions. Drought is one of the few hazards that has the potential to impact every person, directly or indirectly, in the county as well as adversely affect the local economy.

Extreme Heat

The entire county is at risk to extreme heat events; however, these events may be exacerbated in urban areas, where reduced air flow, reduced vegetation, and increased generation of waste heat can contribute to temperatures that are several degrees higher than in surrounding rural or less urbanized areas. This phenomenon is known as urban heat island effect.

FREQUENCY

Drought

According to information from the 2018 Colorado Drought Mitigation and Response Plan, over 120 years (1893 to 2013) there were seven recorded drought incidents that totaled 41 dry years. Based on this historical information, the probability of a drought occurring in any given year is 34 percent. Short duration droughts occur much more frequently. According to a study cited in the Colorado Drought Mitigation and Response Plan, they occur somewhere in Colorado in nearly 9 out of every 10 years. (McKee and others, 2000).

Extreme Heat

There is no information available regarding the number of extreme heat events that have occurred in the county and, therefore, no way to assess the frequency of such events. Best available data reported in Pueblo shows the area can expect 60 days per year on average where temperatures exceed 90 degrees, and 7 days that exceed 100 degrees.

SEVERITY

Drought

Drought impacts are wide-reaching and may be economic, environmental, or societal. The most significant impacts associated with drought in Colorado are those related to water intensive activities such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation, and wildlife preservation. A reduction of electric power generation and water quality deterioration are also potential problems. Drought impacts increase with the length of a drought, as carry-over supplies in reservoirs are depleted and water levels in streams and groundwater decline.

Drought can have a widespread impact on the environment and the economy, depending upon its severity, although it typically does not result in loss of life or damage to property, as do other natural disasters. The National Drought Mitigation Center uses three categories to describe likely drought impacts:

- Agricultural – Drought threatens crops that rely on natural precipitation.
- Water supply – Drought threatens supplies of water for irrigated crops and for communities.
- Fire hazard – Drought increases the threat of wildfires from dry conditions in forest and rangelands.

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. Droughts are not usually associated with direct impacts on people or property, but they can have significant impacts on agriculture, which can impact people and communities indirectly.

When measuring the severity of droughts, analysts typically look at economic impacts on a planning area. A drought directly or indirectly impacts all people in affected areas. All people could pay more for water if utilities increase their rates due to shortages. Agricultural impacts can result in loss of work for farm workers and those in related food processing jobs. Other water- or electricity-dependent industries are commonly forced to shut down all or a portion of their facilities, resulting in further layoffs. A drought can harm recreational companies that use water (e.g., swimming pools, water parks, and river rafting companies) as well as landscape and nursery businesses because people will not invest in new plants if water is not available to sustain them.

The National Oceanic and Atmospheric Administration (NOAA) has developed several indices to measure drought impacts and severity:

- The Palmer Crop Moisture Index measures short-term drought on a weekly scale and is used to quantify drought's impacts on agriculture during the growing season.
- The Palmer Z Index measures short-term drought on a monthly scale.
- The Palmer Drought Severity Index (PDSI) measures the duration and intensity of long-term drought- inducing circulation patterns. Long-term drought is cumulative, so the intensity of drought during a given month is dependent on the current weather patterns plus the cumulative patterns of previous months.
- The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop and it takes longer to recover from them. The Palmer Hydrological Drought Index (PHDI), another long-term index, was developed to quantify hydrological effects. The PHDI responds more slowly to changing conditions than the PDSI.

Extreme Heat

Drought also is often accompanied by extreme heat. When temperatures reach 90°F and above, people are vulnerable to sunstroke, heat cramps, and heat exhaustion. Pets and livestock are also vulnerable to heat-related injuries. Crops can be vulnerable as well.

WARNING TIME

Drought

Droughts are climatic patterns that occur over long periods of time. Only generalized warning can take place due to the numerous variables that scientists have not pieced together well enough to make accurate and precise predictions. Empirical studies conducted over the past century have shown that meteorological drought is never the result of a single cause. It is the result of many causes, often synergistic in nature.

Currently, scientists do not know how to predict drought more than a month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades. How long they last depends on the interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale.

Colorado is semiarid, thus, drought is a regular and natural occurrence in the state. The main source of water supply in the state is precipitation and much of this occurs in the winter as snowfall. Although drought conditions are difficult to predict, low levels of winter snowpack may act as an indicator that drought conditions are occurring.

Extreme Heat

NOAA issues watch, warning, and advisory information for extreme heat.

SECONDARY HAZARDS

Drought

The secondary hazard most commonly associated with drought is wildfire. A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. According to the State of Colorado 2018 Drought Mitigation and Response Plan, economic impacts may also occur for industries that are water intensive such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation and wildfire preservation. Additionally, a reduction of electric power generation and water quality deterioration are also potential effects.

Drought conditions can also cause soil to compact, decreasing its ability to absorb water, making an area more susceptible to flash flooding and erosion. A drought may also increase the speed at which dead and fallen trees dry out and become more potent fuel sources for wildfires. Drought may also weaken trees in areas already affected by mountain pine beetle infestations, causing more extensive damage to trees and increasing wildfire risk, at least temporarily. An ongoing drought that severely inhibits natural plant growth cycles may impact critical wildlife habitats. Drought impacts increase with the length of a drought, as carry-over supplies in reservoirs are depleted and water levels in groundwater basins decline (Colorado Water Conservation Board, 2013).

Extreme Heat

Excessive heat events can cause failure of motorized systems such as ventilation systems used to control temperatures inside buildings. They can also further magnify drought conditions and effects, and increase wildfire risk.

CLIMATE CHANGE IMPACTS

The long-term effects of climate change on regional water resources are not fully understood, but global water resources are already experiencing the following stresses regardless of climate change:

- Growing populations
- Increased competition for available water
- Poor water quality
- Environmental claims
- Uncertain reserved water rights
- Groundwater overdraft
- Aging urban water infrastructure

With a warmer climate, droughts and extreme heat events could become more frequent, more severe, and longer lasting. More frequent extreme events, such as droughts, could end up being more cause for concern than the long-term change in temperature and precipitation averages.

EXPOSURE AND VULNERABILITY

Everything in the planning area would be exposed, to some degree, to the impacts of moderate to extreme drought conditions. Populations living in densely populated urban areas are likely to be more exposed to extreme heat events.

Drought produces a complex web of impacts which spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to the ability to produce goods and provide services. Drought can affect a wide range of economic, environmental, and social activities. The vulnerability of an activity to the effects of drought usually depends on its water demand, how the demand is met, and what water supplies are available to meet the demand. Extreme heat can exacerbate the effects of drought.

Lifelines

Drought directly impact the Lifeline of food, water, & shelter. Outside of those components, all other Lifelines will continue to remain operational during a drought.

Power outages may occur as a result of extreme heat events. Additionally, transportation systems may experience disruption in services. According to the State of Colorado Hazard Mitigation Plan, concrete pavements have experienced "blowouts or heaves" both on local highway and the higher volume parkway and interstate systems. Blowouts occur when pavements expand and cannot function properly within their allotted spaces. Pavement sections may rise up several inches during such events. These conditions can cause motor vehicle accidents in their initial stages and can shut down traffic lanes or roadways entirely until such times as the conditions are mitigated.

Population

The planning partnership has the ability to minimize any impacts on residents and water consumers in the county should several consecutive dry years occur. No significant life or health impacts are anticipated as a result of drought within the planning area.

According to the U.S. EPA the individuals with the following combinations or characteristics are typically at greater risk to the adverse effects of excessive heat events: individuals with physical or mobility constraints, cognitive impairments, economic constraints, and social isolation.

Property

No structures will be directly affected by drought conditions. Droughts can have significant impacts on landscapes, which could cause a financial burden to property owners. However, these impacts are not considered critical in planning for impacts from the drought hazard.

The only impact extreme heat has on general building stock is increased demand on air conditioning equipment, which in turn may cause strain on electrical systems.

Environment

Environmental losses from drought are associated with damage to plants, animals, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

Extreme heat is a natural phenomenon that the environment has evolved to cope with. Extended periods of extreme heat do have the ability to impact all living things temporarily. Increased algal blooms are one issue that could impact water sources.

Economy

Economic impact from drought will be largely associated with industries that use water or depend on water for their business. For example, landscaping businesses were affected in the droughts of the past as the demand for service significantly declined because landscaping was not watered. Agricultural industries will be impacted if water usage is restricted for irrigation. The tourism sector may also be impacted.

Extreme heat events will not have direct impacts on the economy.

FUTURE TRENDS IN DEVELOPMENT

Vulnerability to drought will increase as population growth increases, putting more demands on existing water supplies. Future water use planning should consider increases in population as well as potential impacts of climate change. Vulnerability to extreme heat will increase as the population grows and will be partially dictated by future demographic trends.

EARTHQUAKE

Fremont County has ranked the risk from earthquake to be Low The previous HMP also ranked this hazard the same.

Low Risk

GENERAL BACKGROUND

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

Earthquakes tend to reoccur along faults, which are zones of weakness in the crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake could still occur.

Geologists classify faults by their relative hazards. Active faults, which represent the highest hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 11,000 years). Potentially active faults are those that displaced layers of rock from the Quaternary period (the last 1,800,000 years). Determining if a fault is "active" or "potentially active" depends on geologic evidence, which may not be available for every fault.

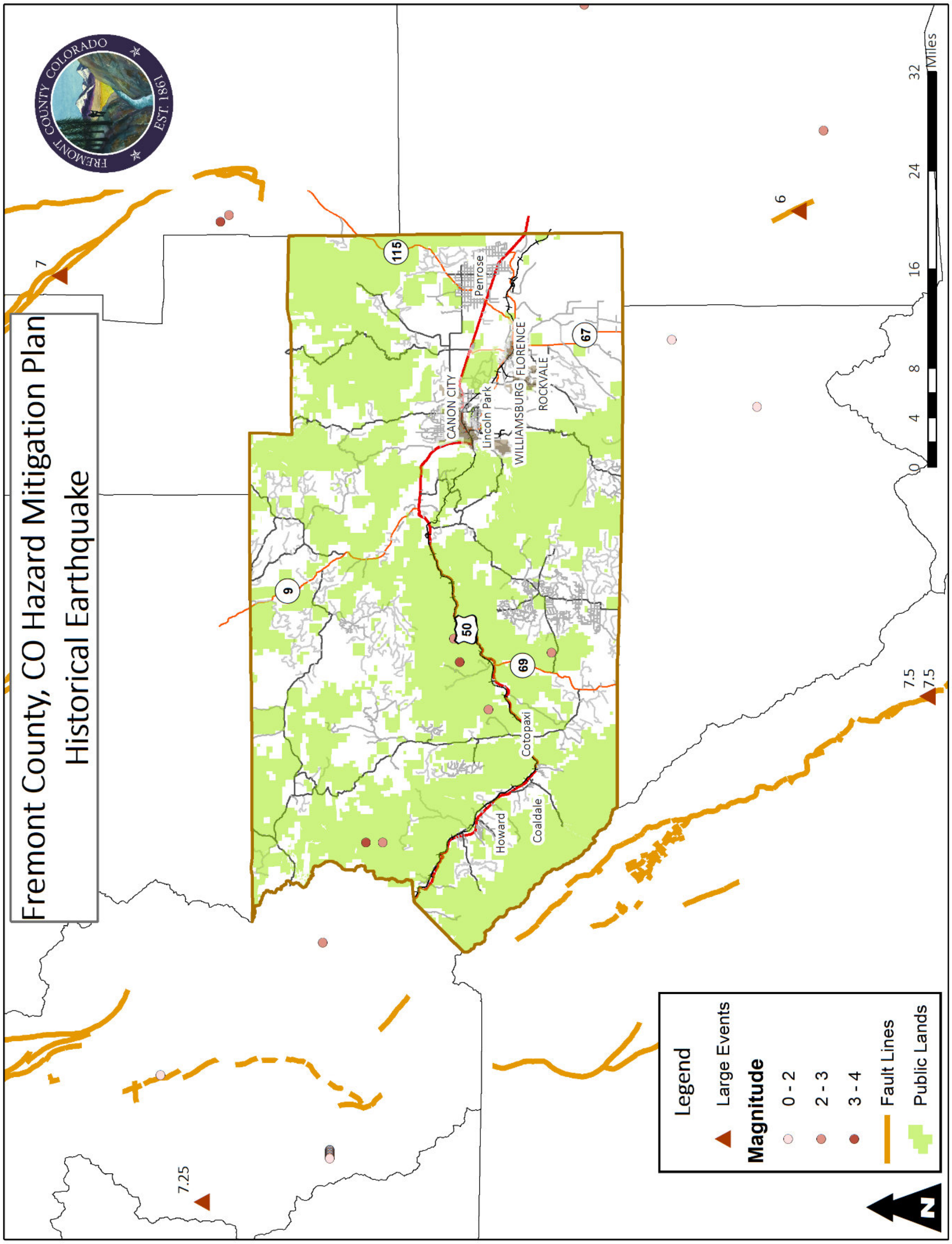
Faults are more likely to produce earthquakes if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve accumulating tectonic stresses. A direct relationship exists between a fault's length, location, and its ability to generate damaging ground motion at a given site. In some areas, smaller, local faults produce lower magnitude quakes, but ground shaking can be strong, and damage can be significant as a result of the fault's proximity to the area. In contrast, large regional faults can generate great magnitudes but, because of their distance and depth, may result in only moderate shaking in the area.

PAST EVENTS

Colorado has a relatively short period of historical records for earthquakes. Figure 49 depicts the location of historical epicenters across the county and potentially active faults in the region. Additionally, some of the state's larger earthquake epicenters are shown. The map shows the following recorded earthquake events in Fremont County:

- March 16, 1985 – Salida area, Magnitude 3.2
- April 16, 1987 – Howard area, Magnitude 2.7
- January 26, 2008 – 8 miles northeast of Cotopaxi, Magnitude 3.1
- July 26, 2008 – 17 miles east of Cañon City, Magnitude 2.6
- September 12, 2008 – 15 miles north-northwest of Westcliffe, Magnitude 2.5

FIGURE 49: HISTORICAL EARTHQUAKES AND FAULTS



LOCATION

Known named faults in Fremont County include: the Ilse Fault, the Pleasant Valley Fault, the Currant Creek Fault Zone, the Rice Mountain Fault, the Alvarado Fault, the Box Canyon and Quarry Faults, the Dead Mule Gulch Fault, the Westcliffe Fault, the Fourmile Creek Fault, the Texas Creek Fault, the High Park Fault Zone and Bare Hills Fault, the Parkdale Faults, and the Wet Mountain Fault. All are classified as Late Cenozoic (activity is older than 23.7 million years ago), the oldest classification of fault and are considered inactive.

FREQUENCY

Research based on Colorado's earthquake history suggests that an earthquake of 6.3 or larger has a one percent (1 percent) probability of occurring each year somewhere in Colorado (Charlie, Doehring, Oaks Colorado Earthquake Hazard Reduction Program Open File Report 93-01, 1993). According to the U.S. Geological Survey, the probability that a magnitude 5 or greater earthquake will occur in the next 50 years in Fremont County is 10 percent or less. Small earthquakes that cause no or little damage are more likely.

SEVERITY

Earthquakes can last from a few seconds to over 5 minutes; they may also occur as a series of tremors over several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties generally result from falling objects and debris, because the shocks shake, damage, or demolish buildings and other structures. Disruption of communications, electrical power supplies and gas, sewer and water lines should be expected. Earthquakes may trigger fires, dam failures, landslides, or releases of hazardous material, compounding their disastrous effects.

Small, local faults produce lower magnitude quakes, but ground shaking can be strong and damage can be significant in areas close to the fault. In contrast, large regional faults can generate earthquakes of great magnitudes but, because of their distance and depth, they may result in only moderate shaking in an area.

The impact of an earthquake is largely a function of the following components:

- Ground shaking (ground motion accelerations)
- Liquefaction (soil instability)
- Distance from the source (both horizontally and vertically).

Earthquakes can cause structural damage, injury, and loss of life, as well as damage to infrastructure networks, such as water, power, communication, and transportation lines. Damage and life loss can be particularly devastating in communities where buildings were not designed to withstand seismic forces (e.g., older or historic structures). Other damage-causing effects of earthquakes include surface rupture, fissuring, settlement, and permanent horizontal and vertical shifting of the ground.

Earthquakes are typically classified in one of two ways: By the impact on people and structures, measured as intensity; or by the amount of energy released, measured as magnitude. Table 25 presents the Modified Mercalli Intensity Scale aligned with the Richter Scale Magnitude to show how these classifications approximately align.

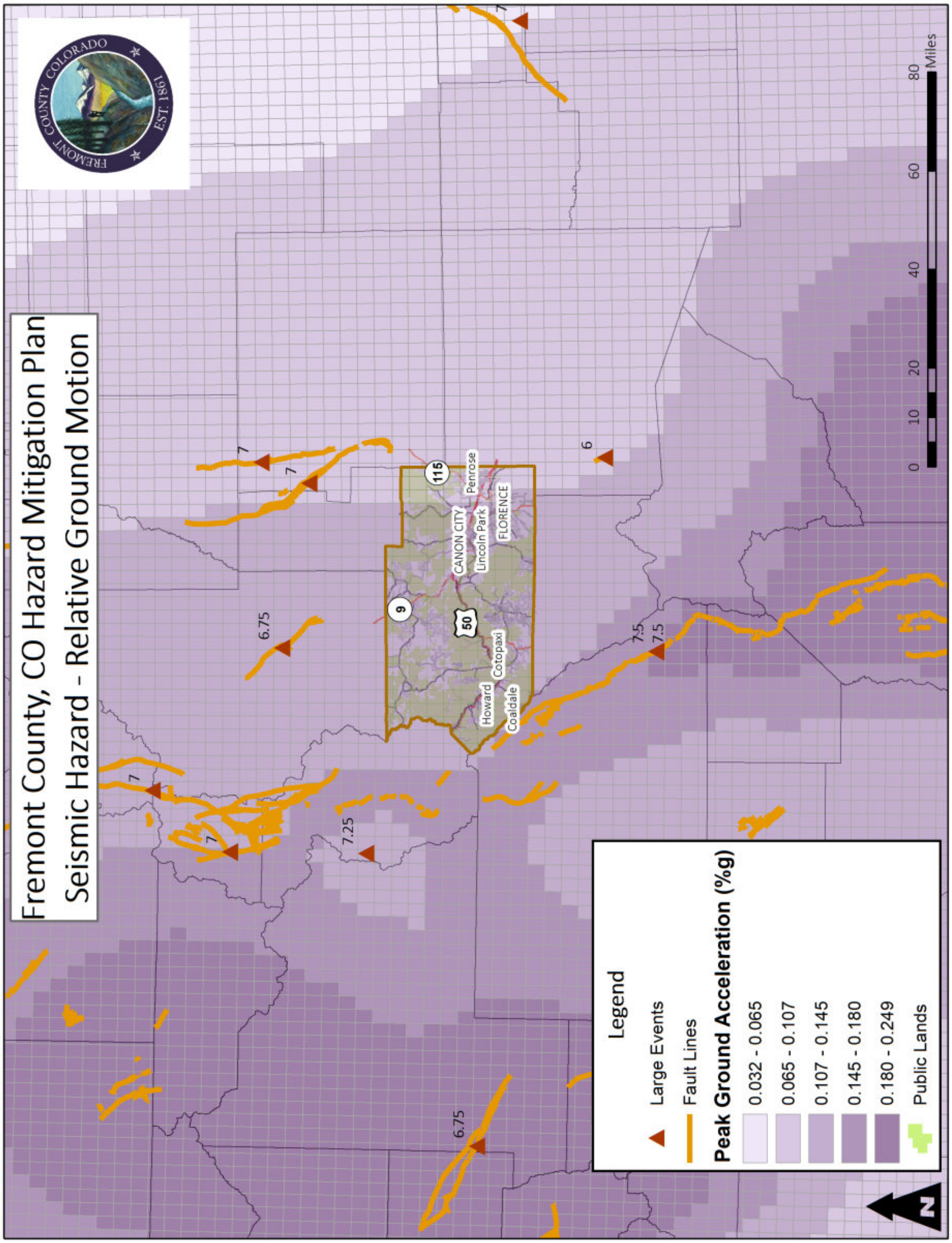
TABLE 25: MODIFIED MERCALLI INTENSITY SCALE

SCALE	INTENSITY	DESCRIPTION OF EFFECTS	PGA (g)	RICHTER SCALE MAGNITUDE
I	**Instrumental**	Detected only on seismographs	< 0.0017	< 4.2
II	**Feeble**	Some people feel it	0.0018 – 0.014	
III	**Slight**	Felt by people resting, like a truck rumbling by		
IV	**Moderate**	Felt by people walking	0.015 – 0.039	
V	**Slightly Strong**	Sleepers awake, church bells ring	0.040 – 0.092	< 4.8
VI	**Strong**	Trees sway, suspended objects swing, objects fall off shelves	0.093 – 0.18	< 5.4
VII	**Very Strong**	Mild alarm, walls crack, plaster falls	0.19 – 0.34	< 6.1
VIII	**Destructive**	Moving cars uncontrollable, masonry fractures, poorly constructed buildings damaged	0.34 – 0.65	< 6.9

SCALE	INTENSITY	DESCRIPTION OF EFFECTS	PGA (g)	RICHTER SCALE MAGNITUDE
IX	Ruinous	Some houses collapse, ground cracks, pipes break open	0.65 – 1.24	
X	Disastrous	Ground cracks profusely, many buildings destroyed, liquefaction and landslides widespread	> 1.24	< 7.3
XI	Very Disastrous	Most buildings and bridges collapse, roads, railways, pipes and cables destroyed, general triggering of other hazards	> 1.24	< 8.1
XII	Catastrophic	Total destruction, trees fall, ground rises and falls in waves	> 1.24	> 8.1

Intensity represents the observed effects of ground shaking on people, buildings, and natural features. The USGS has created ground motion maps based on current information about several fault zones. These maps show the peak ground acceleration (PGA) that has a 2% probability of being exceeded in a 50-year period (also referred to as the 2,500 year return period), as shown in Figure 50. The PGA is measured in numbers of g's (the acceleration associated with gravity). The 2,500 year return period form the basis of seismic zone maps that are included in building codes, such as the International Building Code. Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake.

FIGURE 50: RELATIVE GROUND MOTION AND LARGE HISTORIC EARTHQUAKES



Magnitude is related to the amount of seismic energy released at the hypocenter of an earthquake. It is calculated based on the amplitude of the earthquake waves recorded on instruments. Whereas intensity varies depending on location with respect to the earthquake epicenter, magnitude is represented by a single, instrumentally measured value for each earthquake event.

In simplistic terms, the severity of an earthquake event can be measured in the following terms:

- How hard did the ground shake?
- How did the ground move? (horizontally or vertically)
- How stable was the soil?
- What is the fragility of the built environment in the area of impact?

WARNING TIME

Part of what makes earthquakes so destructive is that they generally occur without warning. The main shock of an earthquake can usually be measured in seconds, and rarely lasts for more than a minute. Aftershocks can occur within the days, weeks, and even months following a major earthquake.

By studying the geologic characteristics of faults, geoscientists can often estimate when the fault last moved and estimate the magnitude of the earthquake that produced the last movement. Because the occurrence of earthquakes is relatively infrequent in Colorado and the historical earthquake record is short, accurate estimations of magnitude, timing, or location of future dangerous earthquakes in Colorado are difficult to estimate.

There is currently no reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with warning systems that use the low energy waves that precede major earthquakes. These potential warning systems give approximately 40 seconds notice that a major earthquake is about to occur. The warning time is very short, but it could allow for someone to get under a desk, step away from a hazardous material they are working with, or shut down a computer system.

SECONDARY HAZARDS

Earthquakes can cause large and sometimes disastrous landslides and mudslides. Stream and river valleys are vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction occurs when water-saturated sands, silts, or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Earthen dams and levees are highly susceptible to seismic events and the impacts of their eventual failures can be considered secondary risks for earthquakes.

CLIMATE CHANGE IMPACTS

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes (NASA, 2004).

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms could experience liquefaction during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts.

EXPOSURE AND VULNERABILITY

Everything in the planning area would be exposed, to some degree, to the impacts of a large seismic event. The impact of an earthquake on structures and infrastructure is largely a function of ground shaking, distance from the source of the quake, and liquefaction, a secondary effect of an earthquake in which soils lose their shear strength and flow or behave as liquid, thereby damaging structures that derive their support from the soil.

Lifelines

All Lifelines in the planning area are exposed to the earthquake hazard. Hazardous materials releases can occur during an earthquake from fixed facilities or transportation-related incidents. Facilities holding hazardous materials are of particular concern because of possible isolation of neighborhoods surrounding them should a release occur. Transportation corridors, communication systems, and energy systems can be disrupted during an earthquake.

Hazus

The most appropriate risk assessment methodology for seismic hazards involves scenario modeling using FEMA's Hazus loss estimation software. Hazus is a very useful planning tool because it provides an acceptable means of forecasting earthquake damage, loss of function of infrastructure, and casualties, among many other factors.

Utilizing Hazus 4.2, an updated earthquake analyses was conducted for Fremont County. The Hazus earthquake scenario modeled a magnitude 7 probabilistic event using a 2,500 year return period. This return period equates to a 2% probability of occurrence in 50 years and is the return period used by the International Building Code as the basis for seismic building design. This scenario was used because it represents the "worst case scenario" for Fremont County communities.

According to the Hazus inventory, there are an estimated 19,000 buildings in Fremont County with a total building replacement value (excluding contents) of over $3.7 Billion. Approximately 92% of the buildings (and 79% of the building value) are associated with residential housing.

Figure 51 and Figure 52 detail the estimated total economic losses based upon the modeled event. The Hazus tool performs its earthquake analysis at the Census Tract level. In Fremont County, the largest losses are expected to occur in Cañon City. This is caused by the higher population densities in these areas, coupled with the age and type of building stocks present across those communities. Higher losses are also seen in the western portion of the county, but these results are a bit skewed due to the large size of that census tract.

A number of variables are included in Hazus analyses in order to arrive at the estimated values of loss. For this reason, it is important to note that the Hazus loss estimates detailed below should not be used as a precise measure, but rather viewed from the perspective of the potential magnitudes of expected losses.

FIGURE 51: HAZUS EARTHQUAKE ESTIMATED LOSSES

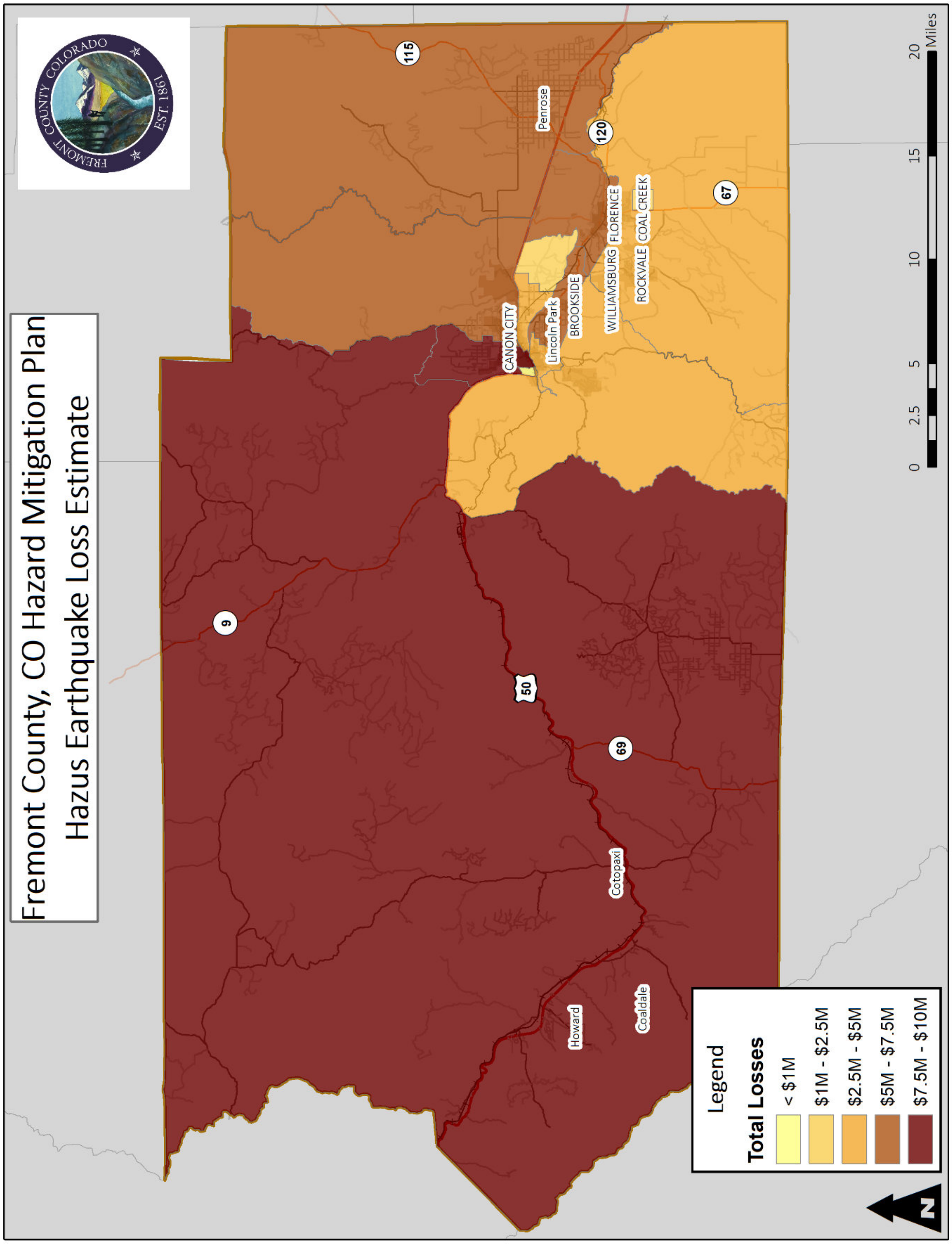
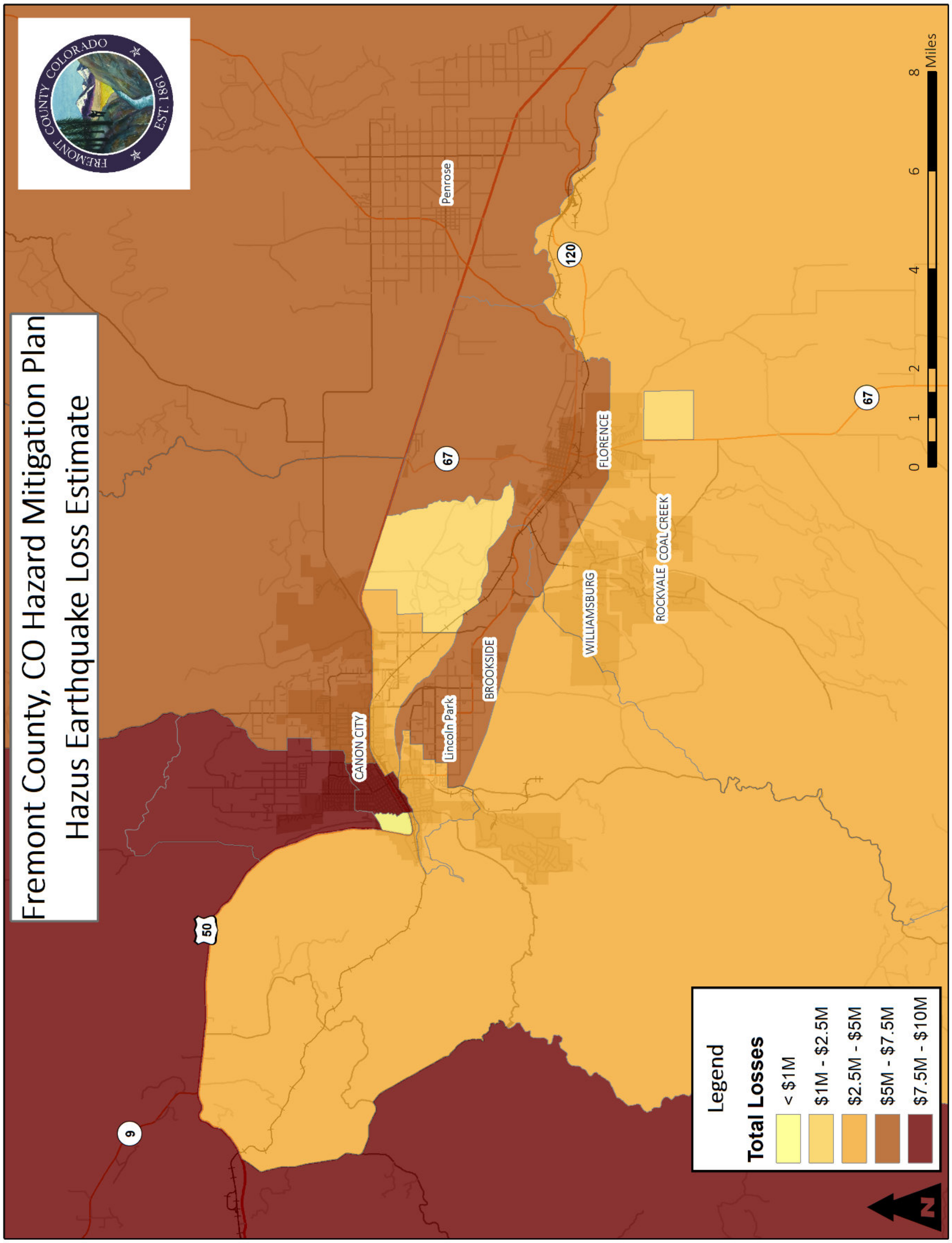


FIGURE 52: HAZUS EARTHQUAKE ESTIMATED LOSSES – MUNICIPAL SCALE



Other loss estimates from the Hazus scenario worth noting include:

- Building-related economic losses are estimated to be $68 Million.
- Transportation system economic losses are calculated to be $920,000.
- Utility system economic losses were assessed to be close to $42 Million.
- The vast majority of damages are expected to affect residential housing.
- Unreinforced masonry structures will experience ~62% of the expected complete building damages.
- No major damages are modeled for any "Essential Facilities", which includes hospitals, schools, fire and police stations, and EOCs.
- No major damages are expected to any transportation systems or utility facilities, though a number of water utility pipeline leads and breaks are anticipated.
- 19,000 tons of debris are expected to be generated from this type of event (760 estimated 25-ton truckloads).
- Only 17 households are modeled as being displaced by this event.

For additional loss estimates and further details see Appendix D: Earthquake Hazus Risk Report.

Population

The entire population of Fremont County is potentially exposed to direct and indirect impacts from earthquakes. The degree of exposure is dependent on many factors, including the age and construction type of the structures people live in, the soil type their homes are constructed on, their proximity to fault location, etc. The entire population will have to deal with the consequences of earthquakes to some degree. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself.

Property

All structures are vulnerable to the impacts from an earthquake. Buildings not constructed to current building codes are the most vulnerable to damages from the ground motion of an event. For Fremont County, both downtown Florence and Cañon City both contain older building stock that would experience increased losses as compared to other portions of the county.

Environment

Secondary hazards associated with earthquakes will likely have some of the most damaging effects on the environment. Earthquake-induced landslides can significantly impact surrounding habitat. It is also possible for streams to be rerouted after an earthquake. This can change the water quality, possibly damaging habitat and feeding areas. There is a possibility of streams fed by groundwater drying up because of changes in underlying geology.

Economy

Earthquakes have the potential to impact the economy on a large scale. Depending on the magnitude and location of the earthquake there could be extensive damage to infrastructure, buildings, and roads. Major damage to any of these would disrupt daily operations and require considerable construction and repairs. The duration of recovery could have a significant effect on the ability of businesses to reopen.

FUTURE TRENDS IN DEVELOPMENT

Future population change across the county is expected to be 1.7% over the next five years. This is similar to the growth experienced over the last five years (1.9%). A majority of this growth is expected to occur as municipal infill. Vulnerability to earthquakes will increase as population growth increases, but if structures are built to the latest building codes the degree of risk will be reduced.

FLOOD

Fremont County has ranked the risk from flood to be High. The previous HMP also ranked this hazard the same.

High Risk

GENERAL BACKGROUND

A flood is a general and temporary condition of partial or complete inundation of normally dry land areas from:

- the overflow of stream banks,
- the unusual and rapid accumulation of runoff of surface waters from any source, or
- mudflows or the sudden collapse of shoreline land.

Flooding results when the flow of water is greater than the normal carrying capacity of the stream channel. Rate of rise, magnitude (or peak discharge), duration, and frequency of floods are a function of specific physiographic characteristics. Generally, the rise in water surface elevation is quite rapid on small (and steep gradient) streams and slow in large (and flat sloped) streams.

The causes of floods relate directly to the accumulation of water from precipitation, rapid snowmelt, or the failure of manmade structures, such as dams or levees. Floods caused by precipitation are further classified as coming from: rain in a general storm system, rain in a localized intense thunderstorm, melting snow, rain on melting snow, and ice jams. Floods may also be caused by structural or hydrologic failures of dams or levees. A hydrologic failure occurs when the volume of water behind the dam or levee exceeds the structure's capacity resulting in overtopping. Structural failure arises when the physical stability of the dam or levee is compromised due to age, poor construction and maintenance, seismic activity, rodent tunneling, or myriad other causes. For more information on floods resulting from dam and levee failure refer to Chapter 8 of this plan.

In the past, Fremont County has had significant seasonal floods along the Arkansas River; however, these floods have been greatly reduced by the construction of large reservoirs along the Colorado Front Range. Additionally, many streams and creeks in the area have been diverted into irrigation ditches for agricultural uses. This has also helped to reduce the impacts of seasonal floods in the planning area.

Flooding in the county is now predominantly the result of snowmelt and cloudbursts which result in flash flooding. Severe flash flooding poses the greatest risk. These rain events are most often microbursts, which produce a large amount of rainfall in a short amount of time. Flash floods, by their nature, occur suddenly but usually dissipate within hours. Despite their sudden nature, the National Weather Service is usually able to issue advisories, watches, and warnings in advance of a flood. In mountainous, rugged terrain, runoff can damage drainage systems or cause them to fail.

The potential for flooding can change and increase through various land use changes and changes to land surface. A change in environment can create localized flooding problems inside and outside of natural floodplains by altering or confining watersheds or natural drainage channels. These changes are commonly created by human activities (e.g., development). These changes can also be created by other events such as wildfires. Wildfires create hydrophobic soils, a hardening or "glazing" of the earth's surface that prevents rainfall from being absorbed into the ground, thereby increasing runoff, erosion, and downstream sedimentation of channels.

Potential flood impacts include loss of life, injuries, and property damage. Floods can also affect infrastructure (water, gas, sewer, and power utilities), transportation, jobs, tourism, the environment, and ultimately local and regional economies.

PAST EVENTS

Table 26 illustrates SHELDUS (Spatial Hazard Events and Losses Database for the United States) data for flood events in Fremont County and provides details regarding reported damages per decade since 1960.

TABLE 26. HISTORICAL FLOOD EVENTS (1960-2019)

Date Range	Number of Events	Injuries	Deaths	Property Damage*	Crop Damage*
1960-1969	1	0	0	$ 30,660,195	$ 0

Date Range	Number of Events	Injuries	Deaths	Property Damage*	Crop Damage*
1970-1979	1	0	0	$ 915	$ 0
1980-1989	1	0	0	$ 1,061	$ 0
1990-1999	6	1	2	$ 9,581,932	$ 542,608
2000-2009	3	0	0	$ 2,584,465	$ 0
2010-2019	3	0	0	$ 48,181	$ 0

*Adjusted to 2018 US Dollars

The National Centers for Environmental Information's (NCEI) Storm Events Database includes flood events that happened in Fremont County between 1991 and 2019. It should be noted there are some reported damage discrepancies between NCEI and SHELDUS, which stems from each source's reporting methodologies. Notable incidents are described below:

- August 1991 - Cañon City received as much as 6 inches of rain in 45 minutes. Prior to the storm, the ground had been saturated from previous storms causing an ideal environment for flooding. No deaths or injuries were reported, but the damage to structures and facilities was calculated to be $554,202.
- June 14, 1996 - Rainfall rates of 1 to 2 inches per hour produced a reported 15-foot wall of water to cascade down Bernard Creek, north of the town of Cotopaxi, which forced people to evacuate their homes, washed out a bridge, and derailed four empty rail cars.
- August 1 – 2, 1996 - In 20 minutes, 1.5 inches of rain fell and washed out Copper Gulch Road, washing one vehicle off the road into Copper Gulch. The vehicle and two uninjured passengers were washed downstream for 1 mile. The roadway received damage from the wall of mud and water. ($40,000 in property damages)
- August 8, 1996 - Strong thunderstorms moved across eastern Fremont County, producing rainfall totals ranging from 2.5 to 5 inches. The heavy rainfall caused extensive damage to structures and roads in Cañon City. The flood caused damage to 22 businesses and 162 homes, with damages estimated to be approximately $500,000.
- June 10, 1997 - Heavy rain in the Red Creek and Beaver Creek drainage basins caused the creeks to flood from their source to the Arkansas River. Some campers and residents had to be evacuated, but no known widespread damage to property occurred.
- August 6, 1997 - Heavy rain caused small stream and urban flooding in the Cañon City area. Two young boys playing in an irrigation ditch were swept to their deaths shortly after 1:00 p.m.
- July 5, 2006 - Four to 6 inches of rain fell in approximately 2 hours on already saturated ground and caused significant flash flooding over a part of eastern Fremont County. The drainage basins of Beaver, Brush Hollow, and Eightmile Creeks were overwhelmed, while several roads (County Roads 123 and 132, Phantom Canyon Road, State Highway 115) and bridges were washed out or damaged. Brush Hollow Creek was particularly destructive, overwhelming the culvert at State Highway 115 between Penrose and Florence. For a time, the fast-flowing water was over 200 yards wide across the road. That portion of Highway 115 over the culvert was completely destroyed and remained closed for 6 weeks. County Road 123 was severely damaged by Eightmile Creek. All the water from the Eightmile and Brush Hollow drainage basins emptied into the Arkansas River upstream from the Portland River gage. The resulting river rise was extraordinary; in fact, a record crest for that part of the Arkansas River (13 feet) was measured.

The gage's instruments were completely submerged for a time, and debris nearly destroyed the gage. Severe flooding occurred on Beaver Creek, which empties into the Arkansas River downstream of the Portland gage. A paleo-hydrologist, with the USGS in Denver, estimated that the flow in Beaver Creek went from a trickle to about 13 feet in less than 15 minutes – a true "wall of water" flash flood. ($2 Million in property damages)

- July 26, 2008 - Heavy rain caused extreme runoff which undermined and washed away three sections of Copper Gulch Road. Around a dozen motorists were stranded on the road as 4 to 6 feet of water was running across the road. Seven miles of the road were closed during the cleanup and repair. There were no injuries. The Deer Mountain flood destroyed sections of County Road 28 causing disruption to access of the Deer Mountain area until road crews repaired the damaged sections. ($80,000 in property damages)
- July 31, 2012 - Heavy rain caused flash flooding south of Florence. The normally dry Mineral Creek flooded and undermined a bridge on State Highway 67, 5 miles south of Florence. The bridge had to be rebuilt. The road was reopened on August 26, 2012. ($30,000 in property damages)
- August 15, 2013 – As background information, very heavy rainfall of around 1.5 inches (with rainfall rates up to 5 inches per hour) occurred across the Waldo and Williams Canyon watersheds, producing flooding on U.S. Highway 24 and in Manitou Springs. Flash flooding occurred from Cascade to Waldo Canyon along U.S. Highway 24. One man drowned in the debris flow near the mouth of Waldo Canyon. In Fremont County, water flowed deeper than 6 inches across U.S. Highway 50 on the Parkdale hill. County Road 132 was blocked as a result of this event. ($600,000 in property damages)
- September 12, 2013 - An area of heavy rain moved from northeast Fremont County to western El Paso County, causing flash flooding. County roads were flooded on either side of State Highway 115.
- August 25, 2014 – A severe storm brought torrential rain and flash flooding between Cañon City and Florence, south of US Highway 50. Severe thunderstorms produced flash flooding and a tornado near Florence as well as one inch diameter hail near Calhan during the afternoon and evening of the 25th. ($5,000 in property damages)
- July 15, 2017 – A flash flood caused significant rises in Hayden, Wolf, Cottonwood, Butter, and Little Cottonwood Creeks. A significant flash flood occurred on the Hayden Pass burn scar, which prompted the evacuation of a camping resort and residents. County Roads in and around the burn scar sustained some damage. There were no injuries. One residence was destroyed and another was damaged (along with several outbuildings). $10,000 in reported property damages, $3 million was spent on restoration efforts.

LOCATION

Fremont County is in the Arkansas River basin. All streams in the county are either direct or indirect tributaries of the Arkansas River, which runs west to east across the county and closely parallels Highway 50. Small creeks in the county that flow into the Arkansas River include: Four Mile Creek, Grape Creek, Badger Creek, and Texas Creek. These streams normally flow year-round, although they may dry up during unusually dry years. Additionally, large irrigation canals also contribute to local flooding. There may be additional small pockets within Cañon City that may experience flooding on a regular basis.

Figure 84 and Figure 54 show FEMA's special flood hazard areas (SFHA) that have been mapped across Fremont County. An interactive map of this data can be found at [FEMA's National Flood Hazard Layer viewer](). It is worth noting that since the 2015 HMP, some floodplains have been updated within the municipalities.

FIGURE 53: FEMA FLOODPLAINS

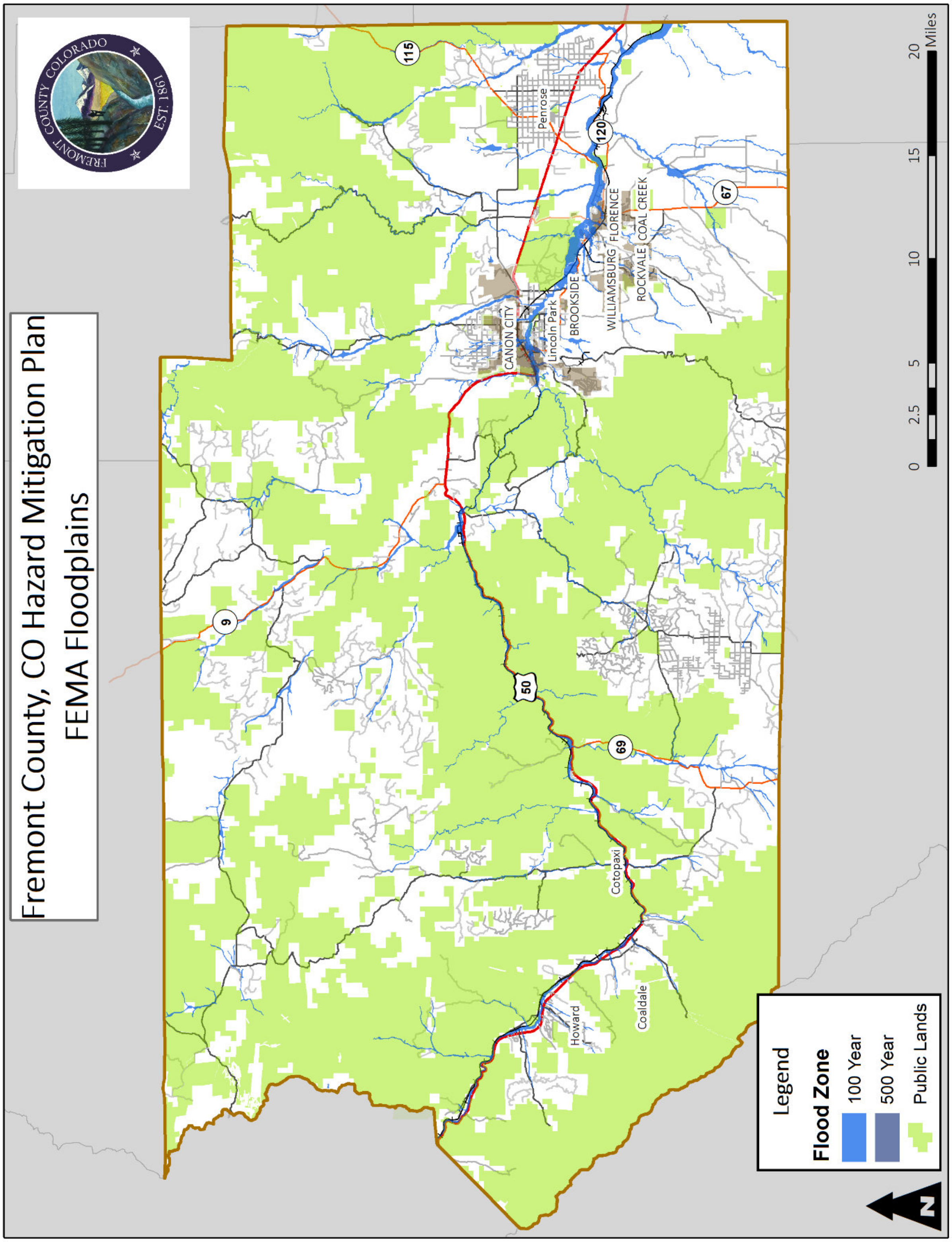
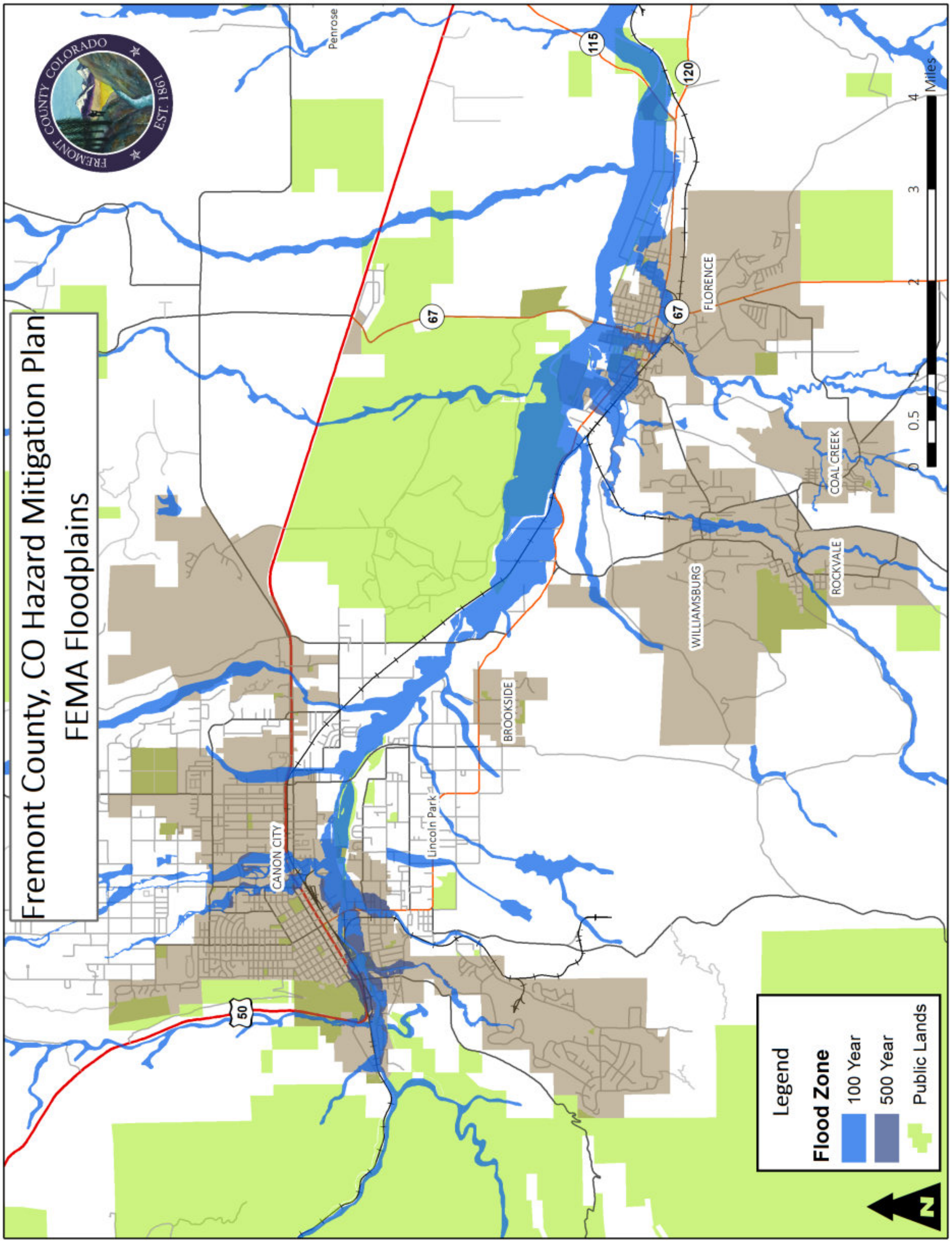


FIGURE 54: FEMA FLOODPLAINS – MUNICIPAL SCALE



FREQUENCY

Seasonal flooding on the Arkansas River has been decreasing through time due to the increased attention to water management issues along the Arkansas River drainage basin. Flash floods, however, are still considered to be highly likely to occur.

Based on 20 recorded occurrences of damaging flooding since 1965, it is estimated that there is a 37% chance of future damaging flood events in any given year.

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to estimate the probability of occurrence for the different discharge levels. The 100-year discharge has a 1- percent chance of being equaled or exceeded in any given year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short period. The same flood can have different recurrence intervals at different points on a river.

The extent of flooding associated with a 1-percent annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by FEMA and many other agencies. Also referred to as the special flood hazard area (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities.

SEVERITY

The depth and velocity of floodwaters determine the severity of an event, coupled with the length of time areas remain inundated with water. Many SFHA's also provide water-surface elevations which describe the elevation of water that will result from a given discharge level. This is one of the most important factors used in estimating flood damage.

WARNING TIME

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can oftentimes be warned, in advance, of potential flash flooding danger.

SECONDARY HAZARDS

The most problematic secondary hazard for flooding is debris flow. Another would be bank erosion, which in some cases can be more harmful than actual flooding. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides when high flows over-saturated soils on steep slopes, causing them to fail. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers, or storm sewers.

CLIMATE CHANGE IMPACTS

Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example, historical data are used for flood forecasting models and to forecast snowmelt runoff for water supply. This method of forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events, such as floods. Going forward, model calibration or statistical relation development must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted. Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management, and ecosystem functions.
- Extreme climatic events have become more frequent, necessitating improvement in flood protection, drought preparedness, and emergency response.

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain area to contribute to peak storm runoff. High frequency flood events (e.g., 10-year floods) in particular, will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

As hydrology changes, what is currently considered a 100-year flood may strike more often, leaving many communities at greater risk. Planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams, floodways, bypass channels, and levees, as well as the design of local sewers and storm drains.

EXPOSURE AND VULNERABILITY

Many developed areas of the county intersect floodplains and are therefore vulnerable to flooding. This includes those floodplains that have been mapped and some that have not.

Lifelines

It is important to identify who may be at risk if infrastructure is damaged by flooding. Roads or railroads that are blocked or damaged can isolate residents and can prevent access throughout the county. This is especially critical for those needing emergency service providers or getting crews in to make repairs. Bridges washed out or blocked by floods or debris also can cause isolation.

The major roads in the planning area that pass through the 100-year floodplain and thus are exposed to flooding are U.S. Highway 50 and State Highways 115, 120, 67, 69 and 9. In severe flood events, these roads can be blocked or damaged, preventing access to some areas.

Water and sewer systems can be affected by flooding. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing wastewater to spill into homes, neighborhoods, rivers, and streams. Underground utilities can also be damaged.

As part of this vulnerability assessment, the county's Lifelines were assessed with the 100-year floodplain. Table 27 presents Lifeline exposure to these hazards. Individual assessments of those exposed Lifelines can help to identify potential mitigation actions to consider implementing.

Table 27: Lifeline Exposure to Flood

Lifeline	Total Count	Count Exposed 100-Year	% 100-Year	Count Exposed 500-Year	% 500-Year
Medical Facilities	3	0	0%	0	0%
Schools	33	5	15%	5	15%
Sewage Facilities	1	0	0%	0	0%
Other Lifelines	174	20	11%	27	16%
Tier II Facilities	45	1	2%	2	4%
Transportation (miles)	563.0	3.8	0.67%	8.1	1.4%

Hazus

The most appropriate risk assessment methodology for flooding involves scenario modeling using FEMA's Hazus loss estimation software. Hazus is a very useful planning tool because it provides an acceptable means of forecasting flood damage, loss of function of infrastructure, and casualties, among many other factors.

Utilizing Hazus 4.2, an updated flood analysis was conducted for Fremont County. The Hazus flood scenario modeled a countywide 1% annual chance flood event (100-year event). According to the Hazus inventory, there are an estimated 19,000 buildings in Fremont County with a total building replacement value (excluding contents) of over $3.7 Billion. Approximately 92% of the buildings (and 79% of the building value) are associated with residential housing.

Figure 55 and Figure 56 detail the estimated total economic losses based upon the 1% annual chance flood scenario. The Hazus tool performs its flood analysis at the Census Block level. It is clear some of the larger estimated flood losses correlate to those floodprone areas with higher population and building densities. A number of variables are included in Hazus analyses in order to arrive at the estimated values of loss. For this reason, it is important to note that the Hazus loss estimates should not be used as a precise measure, but rather viewed from the perspective of the potential magnitudes of expected losses.

FIGURE 55: HAZUS FLOOD ESTIMATED LOSSES

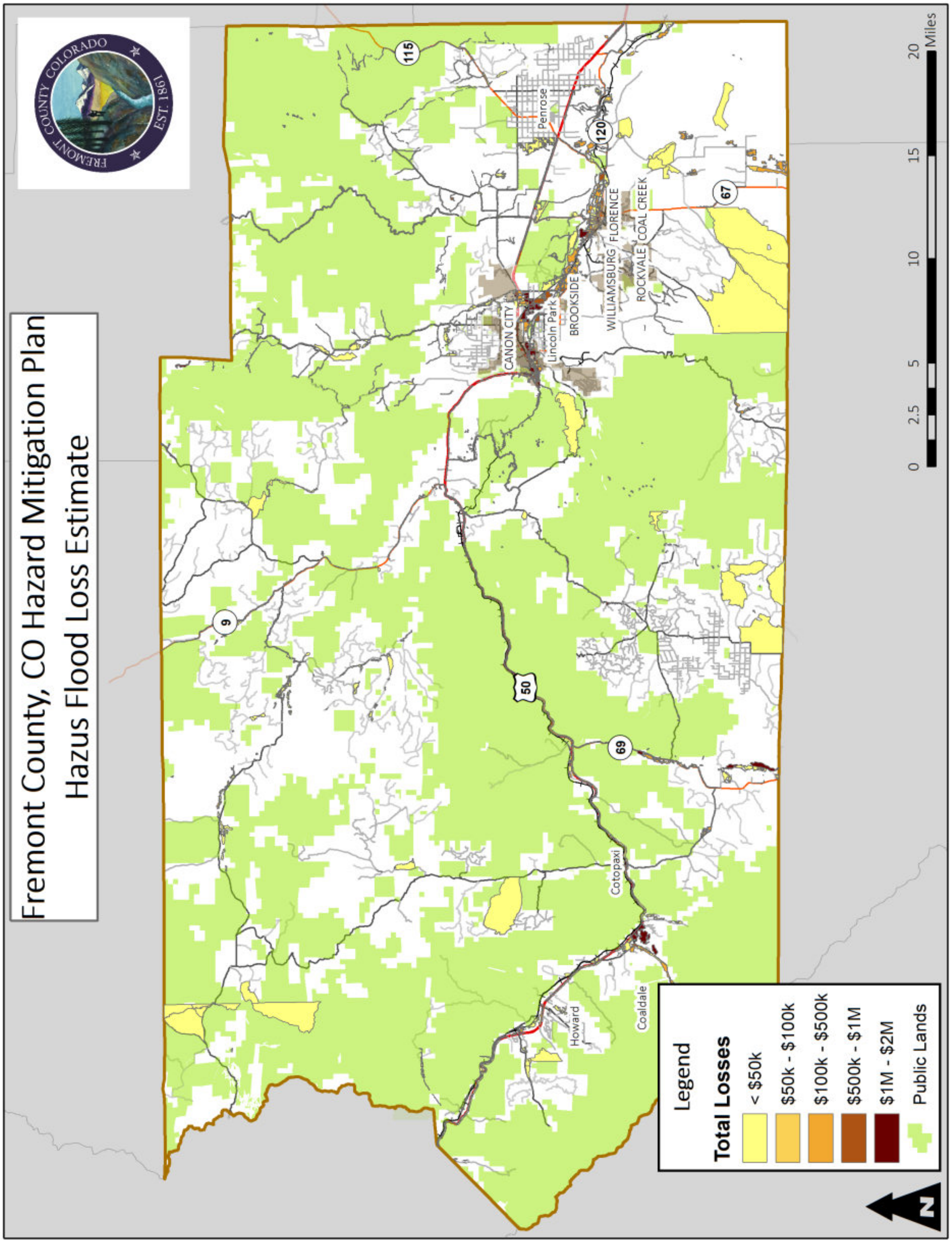
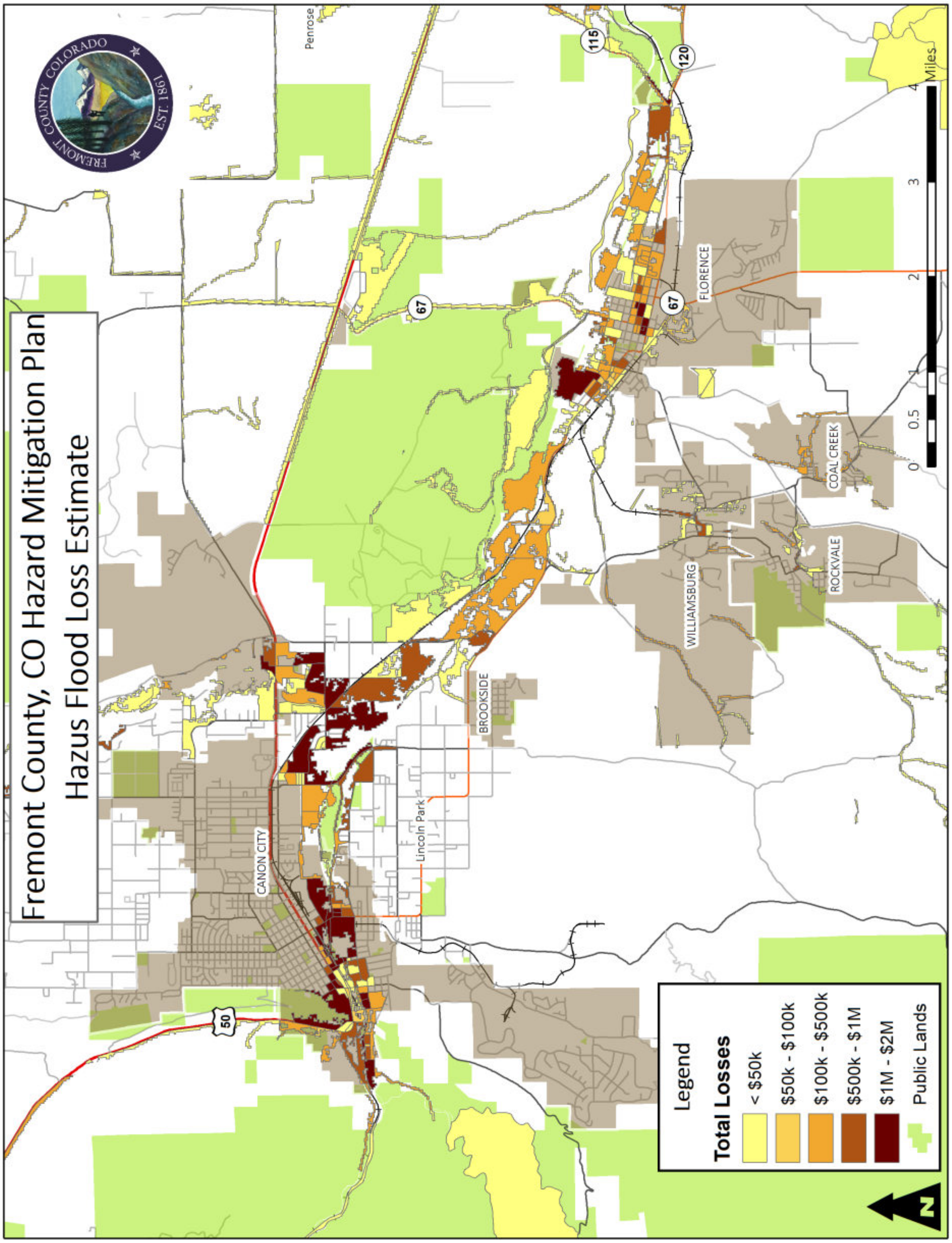


Figure 56: Hazus Flood Estimated Losses – Municipal Scale



Other loss estimates from the Hazus scenario to note include:

- 227 buildings will be at least moderately damaged, 68 will be completely destroyed.
- Damages are modeled for "Essential Facilities", which includes hospitals, schools, fire & police stations, and EOCs. The analysis modeled the following damages:
    - The loss of use of two fire stations and one school.
    - Substantial damages to one fire station.
    - Moderate damages to another fire station and one school.
- The model estimates ~2,300 people (770 households) will be displaced due to the flooding, with 94 residents seeking shelter.
- Total building-related losses are estimated to be ~$99 Million.
- Total of ~$90 Million in estimated business interruption losses

For additional loss estimates and further details see Appendix C: Flood Hazus Risk Report.

Population

Those in the community with access and functional needs (AFN), may be incapable of evacuating the flood area within the allowable time frame. This population includes elderly people, people with disabilities and mobility issues, those with independent living difficulty, those who are institutionalized and those without means of transportation. Non-English speaking populations are also included as communications and emergency messaging may not be available in languages other than English. In general, anyone who does not have adequate access to warnings from an emergency warning system may also be disproportionately impacted by the hazard.

The dangers of flash flooding pose an even greater risk to this population, as they may not be able to extricate themselves from an immediate situation. The need for emergency responders to place these populations as a priority is crucial to the best possible outcomes.

Property

Many properties in the county are vulnerable to flooding, including those that may not be within a mapped floodplain. While some properties make be flood proofed, the majority are likely to be significantly damaged if in the flooded area. Properties near waterways may have stability issues as the flood waters erode the banks and carry debris, while properties in low-lying areas are more vulnerable as this is where water will collect. Bridges and roads are vulnerable to wash out and utilities including power lines, cable and phone lines may be knocked down or rendered unusable by the waters.

Environment

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, with human development factored in, flooding can impact the environment in negative ways. Migrating fish can wash into roads or over dikes into flooded fields, with no possibility of escape. Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams. During floods, these can settle onto normally dry soils, polluting them for agricultural uses.

Economy

Flooding can have a long-term economic impact on individuals and the county. Homes that are damaged may require extensive repairs, which can take place over a long duration, especially if mold develops. The cost of infrastructure repair for utilities, roads, and bridges, as well as the components of Lifelines may extend over multiple years as projects are prioritized and funds are acquired. Costs for debris clean-up can be considerable and can be a burden to property owners.

Returning to normal operations and daily life can take time, which affects the day-to-day economy of the flooded area. Some businesses may struggle with repair costs and whether they can reopen at all.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities. Base flood elevations and the boundaries of the 100- and 500-year floodplains are shown on Flood Insurance Rate Maps (FIRM), which are the principal tool for identifying the extent and location of the flood hazard. FIRMs are the most detailed and consistent data source available, and for many communities they represent the minimum area of oversight under their floodplain management program.

Participants in the NFIP must, at a minimum, regulate development in floodplain areas in accordance with NFIP criteria. Before issuing a permit to build in a floodplain, participating jurisdictions must ensure that three criteria are met:

- New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 100-year flood.
- New floodplain development must not aggravate existing flood problems or increase damage to other properties.
- New floodplain development must exercise a reasonable and prudent effort to reduce its adverse impacts on threatened salmonid species.

Fremont County and all its incorporated communities, except Brookside, participate in the NFIP program. All will continue to comply with all NFIP requirements, including enforcing all locally adopted floodplain management regulations concerning existing structure improvements and new construction. The effective date for the current countywide FIRM is July 3, 2012. The county and participating communities are currently in good standing with the provisions of the NFIP and will continue compliance, which is monitored by FEMA regional staff. Maintaining compliance under the NFIP is an important component of flood risk reduction. Table 28 provides an overview of participating community use of the program.

TABLE 28: NFIP SUMMARY INFORMATION

Jurisdiction	Date of Entry / Initial Firm ID	# Flood Policies	# Flood Claims since 1978	Total Coverage	Claims Paid since 1978
Cañon City	11/3/1982	107	56	$ 23,926,400	$ 182,734
Coal Creek	9/19/2007				
Florence	12/4/1984	56	2	$ 9,228,000	$ 15,068
Rockvale	10/15/1985				
Unincorporated County	9/29/1989	101	14	$ 23,008,700	$ 145,785
Williamsburg	9/19/2007				

Repetitive Loss

A repetitive loss property is defined by FEMA as an NFIP-insured property that has experienced any of the following since 1978, regardless of any changes in ownership:

- Four or more paid losses in excess of $1,000
- Two paid losses in excess of $1,000 within any rolling 10-year period
- Three or more paid losses that equal or exceed the current value of the insured property.

Repetitive loss properties make up a small fraction of flood insurance policies in force nationally, yet they account for a large portion of the nation's flood insurance claim payments. The government has instituted programs encouraging communities to identify and mitigate the causes of repetitive losses. **Cañon City has experienced five repetitive loss events**. One single-family residence has incurred three losses and a second single-family residence has experienced two.

The Community Rating System

The CRS is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions meeting the following three goals of the CRS:

- Reduce flood losses
- Facilitate accurate insurance rating
- Promote awareness of flood insurance

For participating communities, flood insurance premium rates are discounted in increments of 5 percent. For example, a Class 1 community would receive a 45 percent premium discount, and a Class 9 community would receive a 5 percent discount. (Class 10 communities are those that do not participate in the CRS; they receive no discount.) The CRS classes for local communities are based on certain creditable activities in the following categories:

- Public information
- Mapping and regulations
- Flood damage reduction
- Flood preparedness

Fremont County and the City of Cañon City participate in the CRS program. Cañon City has been participating since October 1992 and has a current rating class of 8. Fremont County has been participating since October 1993 and has a current rating class of 9.

FUTURE TRENDS IN DEVELOPMENT

Future population change across the county is expected to be 1.7% over the next five years. This is similar to the growth experienced over the last five years (1.9%). A majority of this growth is expected to occur as municipal infill. It is important for municipalities to fully understand the risk presented by flood to those vulnerable areas to ensure new construction does not increase the county's collective risk.

All municipal planning partners, with the exception of Brookside - which has no mapped flood risk, are participants in the NFIP and have adopted flood damage prevention ordinances in response to its requirements. With communities in the county participating in the CRS program, there is incentive to adopt consistent, appropriate, higher regulatory standards in communities with the highest degree of flood risk.

LANDSLIDE / ROCKFALL

Fremont County has ranked the risk from landslide / rockfall to be Low. The previous HMP also ranked this hazard the same.

Low Risk

GENERAL BACKGROUND

A landslide is a general term for a variety of mass-movement processes that generate a downslope movement of soil, rock, and vegetation under gravitational influence. Some of the natural causes of ground instability are stream and lakeshore erosion, heavy rainfall, and poor quality natural materials. In addition, many human activities tend to make the earth materials less stable and, thus, increase the chance of ground failure. Human activities contribute to soil instability through grading of steep slopes or overloading them with artificial fill, extensive irrigation, construction of impermeable surfaces, excessive groundwater withdrawal, and removal of stabilizing vegetation. Landslides typically have a slower onset and can be predicted, to some extent, by monitoring soil moisture levels and ground cracking or slumping in areas of previous landslide activity.

Landslides are caused by one or a combination of the following factors: change in slope of the terrain, increased load on the land, shocks and vibrations, change in water content, groundwater movement, frost action, weathering of rocks, and removing or changing the type of vegetation covering slopes. In general, landslide hazard areas are where the land has characteristics that contribute to the risk of the downhill movement of material, such as the following:

- A slope greater than 30 percent.
- A history of landslide activity or movement during the last 10,000 years.
- Stream activity, which has caused erosion, undercut a bank, or cut into a bank to cause the surrounding land to be unstable.
- The presence or potential for snow avalanches.
- The presence of an alluvial fan, indicating vulnerability to the flow of debris or sediments.
- The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel.

Slides and earth flows can pose serious hazard to property in hillside terrain. They tend to move slowly and thus rarely threaten life directly. When they move—in response to such changes as increased water content, earthquake shaking, addition of load, or removal of downslope support—they deform and tilt the ground surface. The result can be destruction of foundations, offset of roads, breaking of underground pipes, or overriding of downslope property and structures.

A rockfall is the falling of a detached mass of rock from a cliff or down a very steep slope. Weathering and decomposition of geological materials produce conditions favorable to rockfalls. Rockfalls are caused by the loss of support from underneath through erosion or triggered by ice wedging, root growth, or ground shaking. Changes to an area or slope, such as cutting and filling activities, can also increase the risk of a rockfall. Rocks in a rockfall can be of any dimension, from the size of baseballs to houses. Rockfalls can threaten human life, impact transportation corridors and communication systems, and result in other property damage. Spring is typically the landslide/rockfall season in Colorado as snow melts saturates soils and temperatures enter into freeze/thaw cycles. Rockfalls and landslides are influenced by seasonal patterns, precipitation, and temperature patterns. Earthquakes could trigger rockfalls and landslides too.

PAST EVENTS

The National Centers for Environmental Information's (NCEI) Storm Events Database does not list any landslide / rockfall events that impacted Fremont County between 1996 and 2019. Additionally, SHELDUS lists no records of landslide events within the county.

However, a rockfall event occurred in Cotopaxi in western Fremont County in 2011. This fall knocked out power lines and closed Highway 50 for a week. Because this road is the only road open through all four seasons, that runs east and west through the county, local schools were closed until the highway

FIGURE 57: COTOPAXI ROCKFALL CLEANUP (2011)

could be reopened. A multi-day cleanup involved removal of more than 7,000 tons of rock that fell to the roadway.

Numerous other past events have occurred, but there are currently no official records relating to past events and specifics on their impacts.

LOCATION

According to the State of Colorado Hazard Mitigation Plan, "Many of Colorado's landslides occur along transportation networks because soil and rock along the transportation corridor has been disturbed by roadway construction. Construction along roads can occur with or without proper landslide hazard mitigation procedures. The cost to maintain, cleanup, monitor, and repair roads and highways from landslide activity is difficult to assess, but the best records come from CDOT, which is responsible for maintaining Colorado roads and highways".

The best available predictor of where movement of slides and earth flows might occur is the location of past movements. Past landslides can be recognized by their distinctive topographic shapes, which can remain in place for thousands of years. Most landslides recognizable in this fashion range from a few acres to several square miles. Most show no evidence of recent movement and are not currently active. A small proportion of them may become active in any given year, with movements concentrated within all or part of the landslide masses or around their edges.

The recognition of ancient dormant mass movement sites is important in the identification of areas susceptible to flows and slides because they can be reactivated by earthquakes or exceptionally wet weather. Also, because they consist of broken materials and frequently involve disruption of groundwater flow, these dormant sites are vulnerable to construction-triggered sliding.

The geographic location of identified landslide / rock fall areas is scattered throughout Fremont County. Figure 58 and Figure 59 show these hazard areas. The only incorporated area in the county with mapped landslide / rockfall risk is Cañon City. Rockfalls that have occurred in Fremont County are most typically associated with canyons. The areas most affected by rockfalls include Highway 50 in Big Horn Sheep Canyon, as well as tributary roads leading into Big Horn Sheep Canyon and Highway 50. Some county roads throughout the area are susceptible to minor rockfalls.

FIGURE 58: LANDSLIDE / ROCKFALL RISK

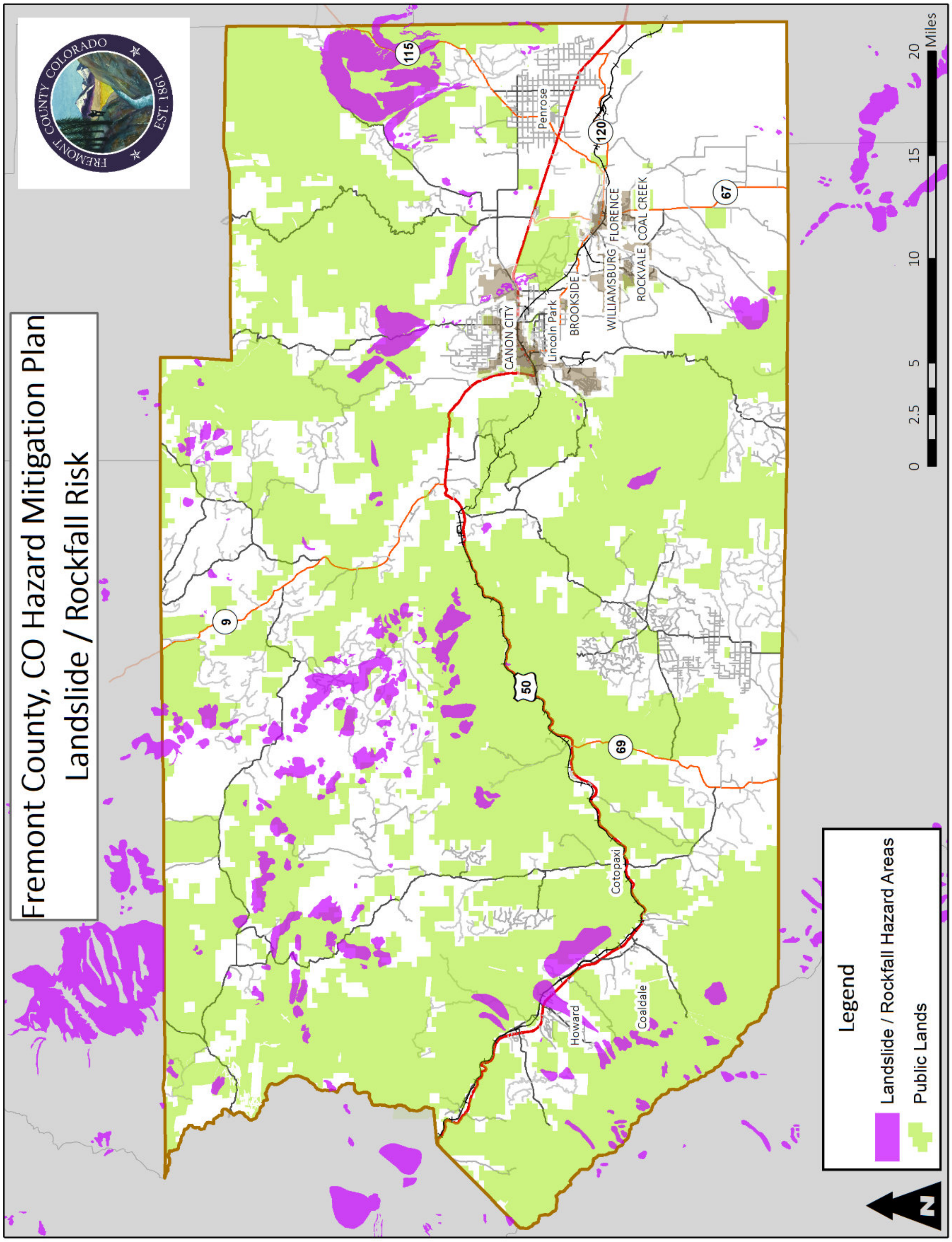
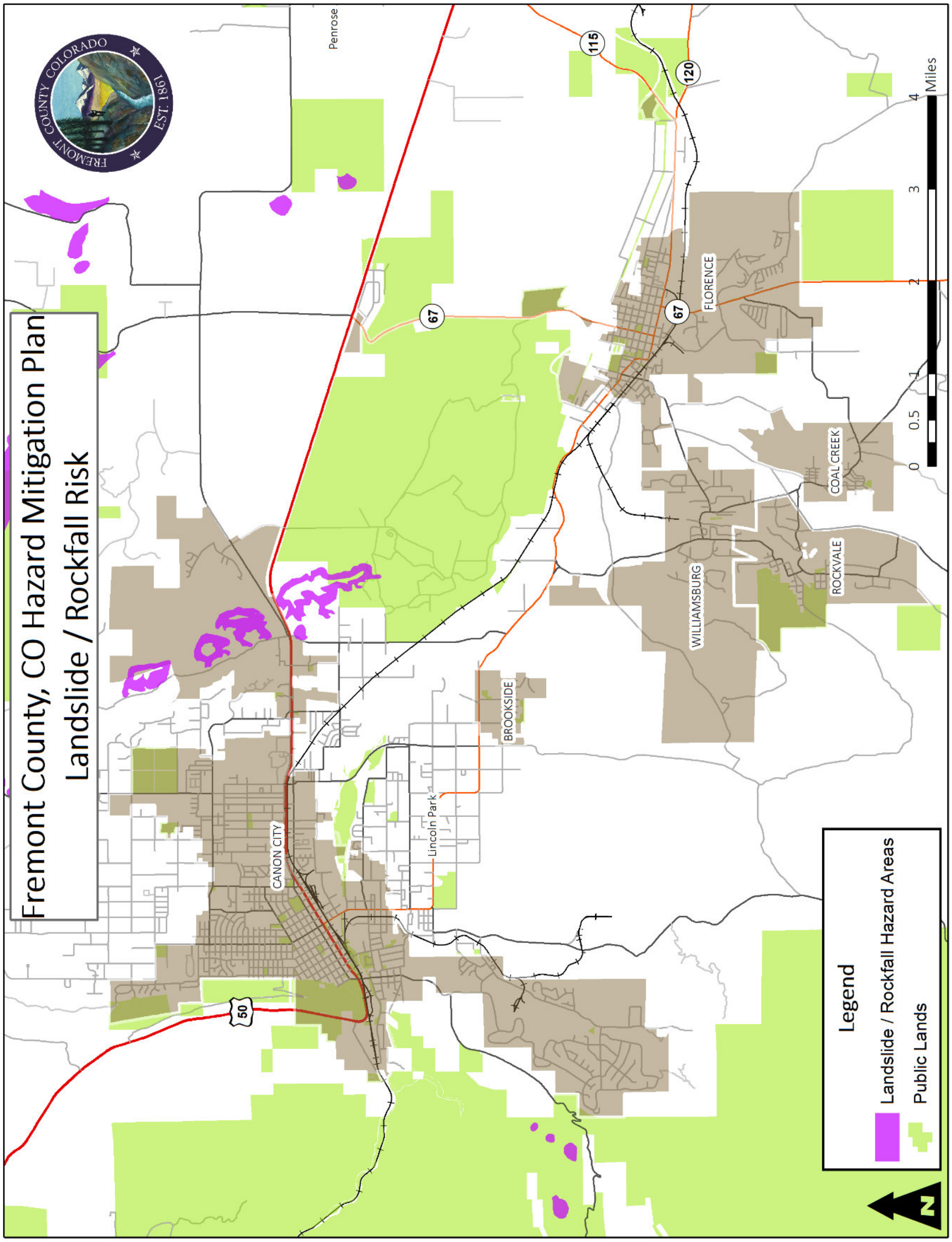


FIGURE 59: LANDSLIDE / ROCKFALL RISK – MUNICIPAL SCALE



FREQUENCY

The frequency of landslide events within the county are difficult to ascertain due to a lack of information regarding past events. For the purposes of this plan, it will be assumed that landslide / rockfall events are likely to occur in any given year.

SEVERITY

Landslides destroy property and infrastructure and can take the lives of people. It is likely that past events have resulted in isolated deaths or multiple injuries, as well as major or long-term property damage.

WARNING TIME

Mass movements can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material, and water content. Some methods used to monitor mass movements can provide an idea of the type of movement and the amount of time prior to failure. It is also possible to identify what areas are at risk during general time periods. Assessing the geology, vegetation, and amount of predicted precipitation for an area can help in these predictions. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis and respond after the event has occurred.

SECONDARY HAZARDS

Landslides can cause several types of secondary effects, such as blocking access to roads, which can isolate residents and businesses and delay commercial, public, and private transportation. This could result in economic losses for businesses. More significantly, landslides can limit the ability of emergency response services to access and serve portions of the county and Highway 50. Additionally, rockfalls to the river can create blockages causing flooding, damage to rivers or streams. Other potential problems resulting from landslides are power and communication failures, which can also occur when vegetation or poles on slopes are knocked over. Landslides have the potential of destabilizing the foundation of structures, which may result in monetary loss for residents.

Figure 60: Cotopaxi Rockfall on Highway 50 in 2011

CLIMATE CHANGE IMPACTS

Climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. Increase in global temperature could affect the snowpack and its ability to hold and store water. Warming temperatures may increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. All of these factors would increase the probability for landslide occurrences.

EXPOSURE AND VULNERABILITY

Landslide / rockfalls can damage property, close roads, and cause injuries or death. A road closed due to hazard activity can result in serious transportation disruptions due to the limited number of roads in the county.

Lifelines

Several types of infrastructure are exposed to mass movements, including transportation, water and sewer, and power infrastructure. Highly susceptible areas of the county include mountain roads and transportation infrastructure. At this time, all infrastructure and transportation corridors identified as exposed to the landslide hazard are considered vulnerable until more information becomes available.

As part of this vulnerability assessment, the county's Lifelines were assessed with the hazard risk areas. Table 29 presents Lifeline exposure to these hazards. Individual assessments of those exposed Lifelines can help to identify potential mitigation actions to consider implementing.

TABLE 29: LIFELINE EXPOSURE TO LANDSLIDE / ROCKFALL

Lifeline	Total Count	Count Exposed	%
Medical Facilities	3	0	0%
Schools	33	0	0%
Sewage Facilities	1	0	0%
Other Lifelines	174	0	0%
Tier II Facilities	45	0	0%
Transportation (miles)	563.0	12.8	2.3%

Population

Exposure to landslide hazard areas is likely limited. The only mapped hazard areas within incorporated jurisdictions are in the eastern portion of Cañon City. Individuals in recreation areas or driving on roadways may also be exposed to landslide hazards. In general, all persons exposed to landslide hazard areas are considered to be vulnerable.

Property

Properties can be damaged by landslide events, however much of the areas where these events occur do not contain a significant amount of properties. Roads and bridges are of the highest concern when considering landslide and damage can be extensive.

Environment

Environmental problems, as a result of mass movements, can be numerous. Landslides that fall into streams may significantly impact fish and wildlife habitat, as well as affecting water quality and spawning habitat. Hillsides that provide wildlife habitat can be lost for prolonged periods of time due to landslides.

Economy

Economic impacts of landslides can be due to the obstruction of transporting goods and the costs of repairs to damaged areas. However, greater impact to the overall economy of the county is not significant.

FUTURE TRENDS IN DEVELOPMENT

The severity of landslide problems is directly related to the extent of human activity in hazard areas. Adverse effects can be mitigated by early recognition and avoiding incompatible land uses in these areas, or by corrective engineering. The mountainous topography of the county presents considerable constraints to development, most commonly in the form of steeply sloped areas. These areas are vulnerable to disturbance and can become unstable. Most of these areas are adjacent to roadway systems that are heavily used.

Future population change across the county is expected to be 1.7% over the next five years. This is similar to the growth experienced over the last five years (1.9%). A majority of this growth is expected to occur as municipal infill. As these areas are not at high risk from landslide / rockfall, future development is not expected to greatly increase the risk to this hazard.

Continued adherence to the land development codes and regulations in the planning area will decrease the risk of future development to landslide hazard areas. Most construction has been limited to areas that are not in these hazard areas.

PANDEMIC

Fremont County has ranked the risk from pandemic to be High.

High Risk

GENERAL BACKGROUND

Pandemics and epidemics have the potential to cause serious illness and death, especially among those who have compromised immune systems due to age or underlying medical conditions. The mode of transmission, the amount of contact between infected and non-infected persons, and how easily the illness spreads are factors for the extent and speed in which a population will see high infection rates.

According to the CDC, pandemics are epidemics which have spread across country borders and in some cases continents. While epidemics are not as widespread as pandemics and typically stay within a population, community, or region, they also pose a significant threat. Due to the wide reach of pandemics, there are typically more deaths, social disruption, and economic loss than with epidemics. However, impacts of both types of events can range from school and business closings to the interruption of basic services such as public transportation, health care, and access to food.

Pandemics are most often, but not always, caused by new subtypes of viruses or bacteria, such as zoonotic diseases, for which humans have little or no natural resistance. Zoonotic diseases can be spread from animals to humans and can be caused by bacteria, viruses, parasites, and fungi that are carried by animals and insects.

PAST EVENTS

As of this plan's writing, the county is in the midst of a pandemic with a new virus, which emerged in China in December 2019 and was named the 2019 Novel Coronavirus (COVID-19). In Fremont County, the first

COVID case presented on March 23rd, 2020. As of 2/11/2021 there have been 5,248 reported cases across Fremont County, resulting in 41 deaths.

Currently, the COVID-19 pandemic has affected over 409,000 in Colorado, with over 5,781 deaths. Additional details pertaining to this on-going event will be included in the next plan update.

The pandemic of the 2009-2010 Swine Flu (H1N1) was detected in the U.S. in April 2009. All 50 U.S. states reported cases of 2009 H1N1 by June 19th, 2009. A vaccine was created and distribution began in the U.S. in October 2009. By the time the pandemic was declared over, on August 11th, 2010, Colorado saw 1,321 confirmed cases which resulted in 70 deaths. This virus caused 14,286 deaths worldwide and 2,117 laboratory-confirmed deaths in the U.S. according to the CDC.

LOCATION

Pandemics do not follow geographic boundaries and may begin with an infection across the globe or within the United States. Travel is one of the most common causes of spread, whether internationally or within the country. Once the infection is inside the country, exposure to others, in their daily lives, can lead to rapid spread through a town, the county, the state, and ultimately the country.

In the case of COVID-19, all 64 counties in Colorado have had confirmed cases and during the 2009 H1N1 influenza, 54 counties were affected, including Fremont County.

In any pandemic or epidemic, it is likely that most counties and communities in Colorado would be affected, either directly or by secondary impacts. Disruptions to supply chains, diversion of resources, and increased strain on the health care system are likely impacts.

FREQUENCY

Globally, the frequency of pandemics is expected to increase as exposure to new viruses occurs around the world. While pandemics are expected to happen more often in the future, there is no way to predict when, where, or how a virus arises to infect people.

Future planning should consider a new pandemic as highly likely to occur in the near future and plan accordingly with a whole community approach.

SEVERITY

The severity of this hazard is difficult to predict. A variety of biological factors determine how quickly a virus spreads, how infectious it is, and how deadly it may be to the population. Other factors contribute significantly as well, such as availability of medical care and protective equipment, and level of understanding of the disease.

With these factors, an infectious illness can affect a relatively small amount of the global population and cause minimal disruptions, or it may affect millions and result in the significant interruption or halting of day-to-day operations. The global economic impact can be considerable, as sectors around the world are affected simultaneously.

Another critical component of the severity of a pandemic is whether or not medications to cure or treat the disease are available. In many cases, a new vaccine must be designed, produced, and distributed to affected areas. Depending on the type of virus or bacteria, there may be vaccines available, but creation of a new vaccine can be a lengthy process.

The severity also depends on the duration of the pandemic, the longer the illness spreads the more strain on resources and the workforce, especially medical supplies and healthcare providers. The supply chain and economy must repair and improve from the initial disruption or the effects of the outbreak will be felt on a greater scale as time passes.

WARNING TIME

The warning time for a pandemic depends on a variety of factors. Once a virus has become an epidemic somewhere in the world, surveillance begins through national and global public health organizations. In some cases, this may help to slow the spread of the virus and alert other countries and organizations of the risk of infection. Warning time can vary from a day to months, depending on how quickly a virus is discovered and proximity to the location of the initial outbreak.

SECONDARY HAZARDS

While there may not be specific hazards secondary to a pandemic, the impact on some Lifelines and day-to-day operations can be considerable. As the population is affected by the virus, either illness or limitations on their ability to function normally, workforce shortages can disrupt supply chains and keep essential workers from being able to complete critical tasks. Pandemics drastically impact the ability for people to travel which may also affect transportation of goods and staff.

CLIMATE CHANGE IMPACTS

Climate change is one of the leading factors in the spread of viruses. As climate change has impacted environments and habitats around the world, it has increased the interaction between humans and animals. This increased interaction has exposed more populations to zoonotic diseases, which can be spread from animals to humans.

As climate change continues further damaging of environments and habitats, the likelihood of future events increases. Considering many of these areas of initial infection may be remote, the resources to control the spread early may not exist. Those with the fewest resources are typically the most negatively impacted, not only those in remote areas but also populations in urban areas that are marginalized.

Climate change is likely to increase exposure of known diseases as well. Pandemics can be caused by a virus that is known in some parts of the world but may be carried to a location with little or no resistance where it can spread. The World Health Organization describes this with a virus called leptospirosis, the infections of which are closely linked to the environment and climate change which will lead to an escalation of the global burden of the disease, increasing the frequency and intensity of outbreaks.

EXPOSURE AND VULNERABILITY

The global population is vulnerable to exposure of a pandemic disease. Planning with local medical facilities and public health agencies regarding prevention and response can minimize vulnerability. Inclusive and informational communication efforts can also help to educate the community about who is most vulnerable and limit exposure.

Lifelines

The most affected Lifeline is Health and Medical, as hospitals, physicians, and public health agencies are hit quickly with increased demand once the infection is detected in the area. As infections increase, the strain on the existing system can quickly overwhelm the capabilities of a facility or organization. If surge continues, the effects on the supply chain and extended burden on staff can be detrimental to care.

A possible lack of essential workforce, due to the illness, could cause disruptions in communications, power, and transportation. Disruptions to these Lifelines could affect healthcare capabilities, the supply chain for essential resources, and the ability to have timely, accurate information about the disease.

A critical consideration in the community is the education system, which serves not only as a place to teach children, but also as childcare for working caregivers. If schools close or are impacted in their schedule and capacity, the effects may be felt in other sectors as the workforce adjusts to care for children at home.

Population

The whole population of Fremont County is susceptible to contracting a pandemic disease. While every disease is different, the oldest, youngest, and those with underlying medical conditions tend to be the most vulnerable to the effects of infection.

Less densely populated areas may benefit from reduced transmission, but there are often less resources to test and treat illnesses if the disease does spread into those rural communities.

Property

Property is not directly impacted in a pandemic.

Environment

Impacts to the environment during a pandemic are not likely. However, due to the lack of travel and daily commuting during COVID-19 there have been reduced emissions around the world. This has led to noticeable improvements in air quality.

Economy

Pandemic disease can have a direct economic impact through costs to the community. This may be response costs for agencies, in the form of increased staff and supply needs, as well as for individuals. Those in the community may experience medical costs for treatment and business owners may incur costs as business operations are adapted. The closing of borders and limiting of travel could have an impact on tourism, trade, and commerce.

An indirect economic impact can be seen in loss of people in the workforce, as parents may need to stay home due to childcare and school closures. If people are leaving their houses less, shopping less locally and struggling with low income, the impact on the local economy may be seen in commodity and retail sales.

FUTURE TRENDS IN DEVELOPMENT

Future development is not expected to significantly impact this hazard, however, as urbanization continues and lands are developed the risk of transmission may increase, especially in cities. With urban sprawl continuing towards rural areas, increased interaction with wild animals and livestock poses an issue.

SEVERE WINTER WEATHER

Fremont County has ranked the risk from pandemic to be Moderate. The previous HMP also ranked this hazard the same.

Moderate Risk

GENERAL BACKGROUND

Winter storms can include heavy snow, ice, and blizzard conditions. Heavy snow can immobilize a region, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse roofs and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. The cost of snow removal, damage repair, and business losses can have a tremendous impact on cities and towns.

Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days until damage can be repaired. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians.

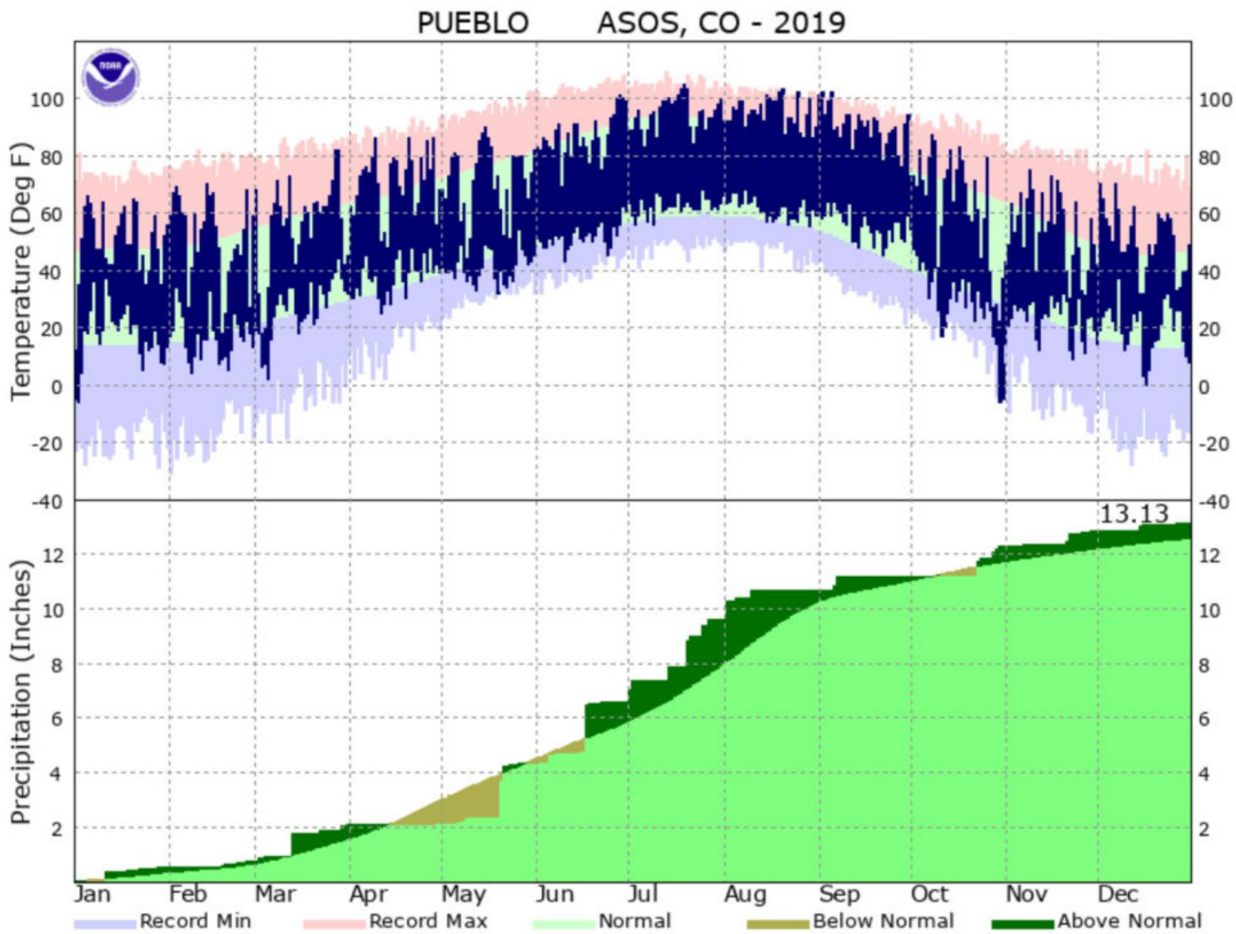
Some winter storms are accompanied by strong winds, creating blizzard conditions with blinding wind-driven snow, severe drifting, and dangerous wind chills. Strong winds with these intense storms and cold fronts can knock down trees, utility poles, and power lines. Blowing snow can reduce visibilities to only a few feet in areas where there are no trees or buildings. Serious vehicle accidents can result in injuries and deaths.

Fremont County receives varying amounts of snow throughout the area. Totals remain on average below 2 feet of snow per year on the eastern half and up to 3 feet of snow on the higher western half of the county. Generally falling a few inches at a time and then melting off, the ground is not covered in snow for any length of time with the exceptions of north-facing areas and higher elevations.

Extreme cold often accompanies a winter storm or is left in its wake. It is most likely to occur in the winter months of December, January, and February. A wind chill watch is issued, by the NWS, when wind chill warning criteria are possible in the next 12 to 36 hours. A wind chill warning is issued for wind chills of at least negative 25 degrees on the plains and negative 35 degrees in the mountains and foothills.

The National Weather Service does not report data summaries from any stations in Fremont County, but does report summaries from a station in Pueblo (Pueblo Memorial Airport). Figure 61 contains temperature and precipitation summaries for the station, as compared to 2019's weather.

FIGURE 61: HISTORICAL TEMPERATURE AND PRECIPITATION



PAST EVENTS

SHELDUS provides details pertaining to severe winter weather events that caused reported damages in Table 30.

TABLE 30. HISTORICAL SEVERE WINTER WEATHER EVENTS (1960-2019)

Date Range	Number of Events	Injuries	Deaths	Property Damage*	Crop Damage*
1960-1969	8	0	0	$ 1,401,480	$ 94,329
1970-1979	7	0	0	$ 39,379	$ 26,519
1980-1989	9	0	0	$ 2,388,309	$ 283,126
1990-1999	6	0	0	$ 282,071	$ 244

Date Range	Number of Events	Injuries	Deaths	Property Damage*	Crop Damage*
2000-2009	1	0	0	$ 47,937	$ 0
2010-2019	0	0	0	$ 0	$ 0

*Adjusted to 2018 US Dollars

The following are descriptions of noteworthy past hazard events, according to the National Centers for Environmental Information (NCEI) and SHELDUS. It should be noted there are some reported damage discrepancies between NCEI and SHELDUS, which stems from each source's reporting methodologies.

- September 28, 1959 – The worst winter storm event in Florence's history: 26 inches of snow, downing trees, power and telephone lines. Approximately half of the City was without power for 5 days. The estimate of damage in 1959 was over $1,000,000.
- October 3, 1969 – A storm brought 19.7 inches of snow. The storm resulted in $1.3 million in property damages and over $9,000 in crop damages.
- 1982 – A winter storm caused over $ 2 million in property damages and $20,000 in crop damage.
- March 18, 2003 – A severe winter storm positioned itself over much of Colorado and dropped a significant amount of heavy, wet snow on the state. As much as 4 to 6 feet of snow fell in the Upper Arkansas Area. Most of the local schools were closed for 2 to 3 days. In addition, many offices and portions of the state highways were closed. Rescues were made all over the region to help stranded motorists and assist residents who lost power and services. Some isolated parties needed immediate medical attention while others had run out of propane and thus had no heat. Road crews worked long hours clearing highways and main roads and emergency services were used to handle emergencies in areas where roads were not cleared.

LOCATION

The entire county is susceptible to severe winter storms; although severe winter weather is primarily found in the higher elevations of the county and include the Tallahassee area and upper reaches of the U.S. Highway 50 corridor through Big Horn Sheep Canyon. Ice accumulation becomes a hazard by creating dangerous travel conditions. U.S. Highway 50, State Highway 115, and State Highway 69 are extremely important corridors to move people, supplies, and equipment into the region and to reach medical facilities outside of the county. Many portions of these roads are narrow and curved and an accident on these roads can cause a major disruption to travel.

FREQUENCY

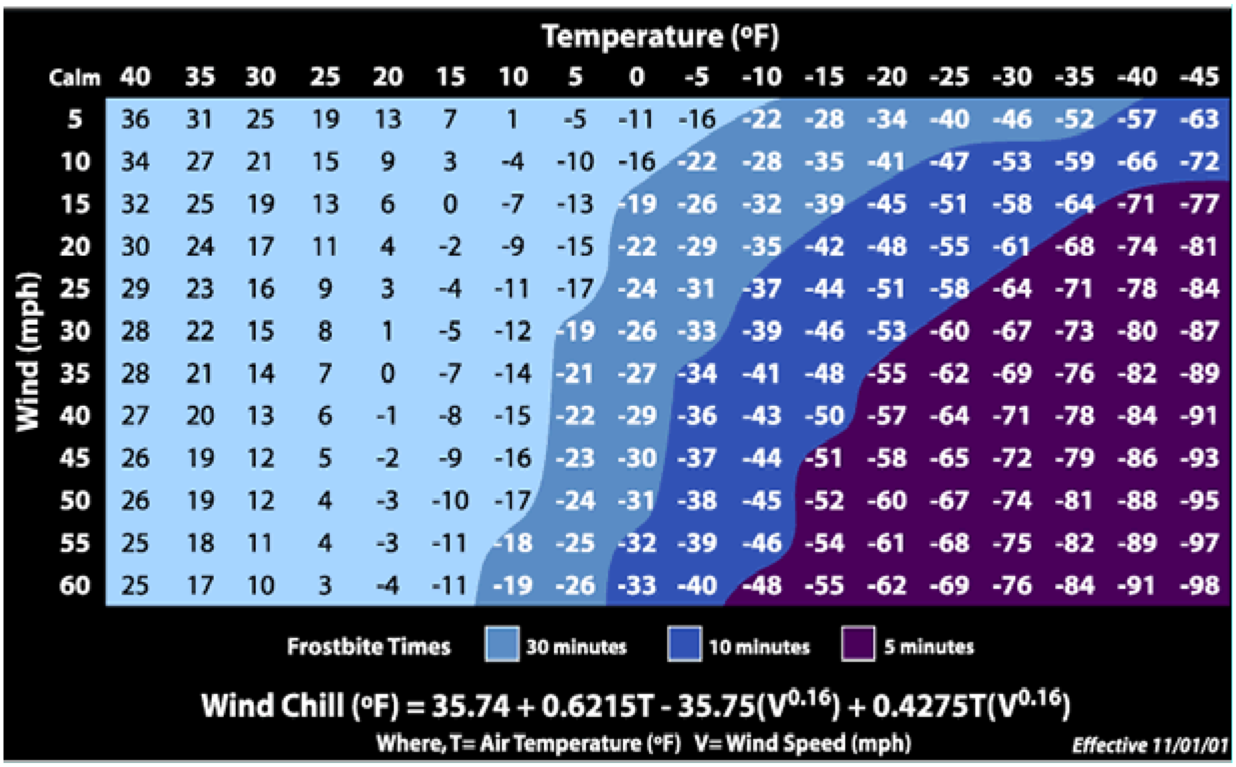
Severe winter storms happen nearly every year in Fremont County. December, January, and February are when severe winter weather occur most frequently in the county.

SEVERITY

Severe winter weather in Fremont County can result in injuries and illnesses, deaths, property damage, or interruption of essential facilities and services.

In 2001, the NWS implemented an updated wind chill temperature index (see Figure 62). This index describes the relative discomfort or danger resulting from the combination of wind and temperature. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

FIGURE 62: NATIONAL WEATHER SERVICE WIND CHILL CHART


Temperature (°F)

Wind (mph) / Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill } (^\circ F) = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

WARNING TIME

Meteorologists can often predict the likelihood of a severe winter storm; however, forecasts for Fremont County are rather limited. Residents generally rely on weather forecasts for Pueblo or Colorado Springs. When forecasts are available, they can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours of warning time.

SECONDARY HAZARDS

The most significant secondary hazards associated with severe winter storms are falling and downed trees, landslides, and downed power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes becomes oversaturated and fails. Additionally, the storms may result in closed highways and blocked roads. It is not unusual for motorists and residents to become stranded. Annually, heavy snow loads and frozen pipes cause damage to residences and businesses. Late season heavy snows will typically cause some plant and crop damage.

CLIMATE CHANGE IMPACTS

Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. Historical data shows that the probability for severe weather events increases in a warmer climate (see Figure 13-2). The changing hydrograph, caused by climate change, could have a significant impact on the intensity, duration, and frequency of storm events. All of these impacts could have significant economic consequences.

EXPOSURE AND VULNERABILITY

Everything in the planning area would be exposed, to some degree, to the impacts of severe winter weather. Certain areas are more exposed due to geographic location and local weather patterns.

Lifelines

All Lifelines are likely exposed to severe winter weather. The most common problems associated with this hazard are utility losses. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water and sewer systems may not function. Roads may become impassable due to ice or snow. Ice accumulation on roadways can create dangerous driving conditions. There are limited county roads that are available to move people and supplies throughout the region. Many of these roads are narrow and curved.

Incapacity and loss of roads are the primary transportation failures resulting from severe winter weather, mostly associated with secondary hazards. Snowstorms can significantly impact the transportation system and the availability of public safety services. Of particular concern are roads providing access to isolated areas and those with access and functional needs. Prolonged obstruction of major routes can disrupt the shipment of goods and other commerce. Large, prolonged storms can have negative economic impacts for an entire region.

Severe windstorms, downed trees, and ice can create serious impacts on power and above-ground communication lines. Freezing of power and communication lines can cause them to break, disrupting electricity and communication. Loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance. Extreme cold can disrupt or impair communications facilities.

Population

The populations most likely to suffer the negative effects of extreme cold are the elderly, young children, people with chronic health and mobility issues, those with independent living difficulty, low income families, non-English speaking residents, and those who live in areas that are isolated from major roads. These populations face isolation and exposure during severe winter weather events and could suffer more secondary effects of the hazard. Power outages can be life threatening to those dependent on electricity for medical equipment or other health needs. Commuters who are caught in storms may be vulnerable to carbon monoxide poisoning or hypothermia. Additionally, individuals engaged in outdoor recreation during a severe winter event may be difficult to locate and rescue.

Prolonged exposure to the cold can cause frostbite or hypothermia and can become life-threatening. Infants and the elderly are most susceptible, as body temperature regulation is more difficult for them. Pipes may freeze and burst in homes or buildings that are poorly insulated or without heat. Extreme cold can disrupt or impair communications facilities.

Property

It is estimated that 66 percent of the residential structures across the county were built without the influence of a structure building code with provisions for wind loads. All of these buildings are considered to be exposed to severe winter weather, but structures in poor condition or in particularly vulnerable locations (located on hilltops or exposed open areas) may risk the most damage. Those that are located under or near overhead lines, or near large trees may be vulnerable to falling ice or may be damaged in the event of a collapse. The frequency and degree of damage will depend on specific locations.

Environment

The environment is highly exposed to severe weather events. Natural habitats such as streams and trees risk major damage and destruction. Flooding events caused by snowmelt can produce river channel migration or damage riparian habitat.

Economy

Economic impact from severe winter weather is possible. Damage to property, crops, and livestock can result in costs, both direct and indirect. Direct costs for the value lost and indirect costs for the loss of work which comes from harvest and livestock transport, as well as the overhead that may result during repair or reconstruction of properties.

Short term impacts may occur if roads are shut down and businesses must close.

FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by severe storms. The vulnerability of community assets to severe winter storms is increasing over time as more people enter the planning area. The ability to withstand impacts lies in consistent enforcement of codes and regulations for new construction.

SUBSIDENCE / EROSION

Fremont County has ranked the risk from subsidence / erosion events to be Low. The previous HMP also ranked this hazard the same.

Low Risk

GENERAL BACKGROUND

Subsidence

According to the Colorado State Hazard Mitigation Plan, "ground subsidence is the sinking of land over human caused or natural underground voids and the settlement of native low density soils". Subsidence can occur gradually over time or virtually instantaneously. There are many different types of subsidence; however, in Colorado, there are three types of subsidence that warrant the most concern: settlement related to collapsing soils, sinkholes in karst areas, and the ground subsidence over abandoned mine workings.

Collapsible Soils

Collapsible soils are a group of soils that can rapidly settle or collapse the ground. The most common type of collapsible soil is hydrocompactive soil. According to the Colorado Geological Survey (CGS), "hydrocompactive soils form in semi-arid to arid climates in the western U.S. and large parts of Colorado in specific depositional environments" (CGS, 2014). These soils are low in density and in moisture content and are loosely packed together. Agents that bind these loosely packed particles together, such as clay and silk buttresses, are water sensitive. When water is introduced to these soils, the binding agents may quickly break down, soften, disperse, or dissolve. This results in a reorganization of the soil particles in a more dense arrangement, which in turn results in a net volume loss indicated by resettlement or subsidence at the surface (CGS, 2014). Volume loss can be between 10 to 15 percent, which can result in several feet of surface-level displacement.

Karst Areas

Most sinkholes in Colorado are related to the dissolution of evaporite minerals or limestone. Evaporite minerals dissolve in water and include gypsum and halite. Rocks containing limestone also form sinkholes based on dissolution by water. The term "karst" describes a landscape that has been shaped by the dissolution of these types of bedrock (CGS, 2014). According to a newsletter issued by the CGS, "two characteristics of evaporative bedrock are important. One is that evaporative minerals can flow, like a hot plastic, when certain pressures and temperatures are exceeded. The second, and most important to land use and development is that evaporative minerals dissolve in the presence of freshwater. It is this dissolution of the rock that creates caverns, open fissures, streams out letting from bedrock, breccia pipes, subsidence sags and depressions, and sinkholes" (CGS, 2001).

Factors leading to the formation of sinkholes in these landscapes may be natural or may be induced by human activities. Natural contributing factors include the downward percolation of surface water through the rock formation or the lateral movement of water within a water table. Human activities that may contribute to such subsidence include stream channel changes, irrigation ditches, land irrigation leaking or broken pipes, temporary or permanent ponding of surface waters, and mining of soluble materials by means of forced circulation of water (CGS, 2014).

Abandoned Mine Workings

The underground removal of minerals and rock can undermine underground support systems and lead to void spaces. These voids can then be affected by natural and man-made processes such as caving, changes in flowage, or changes in overlying rock and soil material resulting in collapse or subsidence. Hazards from these abandoned sites are complicated by the fact that many "final mine maps" are inaccurate or incomplete (CGS, 2014). Mines operating after August 1997 were required by federal and state law to take potential surface subsidence into account; however, mining has been an activity in the state since the 1860s (CGS, 2001). There are some mapped, known mine hazard areas in Colorado and in Fremont County; however, it is likely that there are additional hazard areas for which no records exist.

Soil Erosion and Deposition

The CGS defines erosion as "the removal and simultaneous transportation of earth materials from one location to another by water, wind, waves, or moving ice" and deposition as "the placing of eroded material in a new location". According to the CGS, all material that is eroded is later deposited in another location. Both erosion and deposition are continually occurring phenomenon, although the rate of erosion and deposition varies tremendously and can be affected by a variety of factors including rate of scour, type of material being eroded, and the presence or absence of vegetation.

PAST EVENTS

Subsidence

There is no known database of subsidence and sinkhole events that have occurred within Fremont County; however, the CGS has undergone mapping studies in an effort to identify existing sinkholes and areas that are prone to subsidence events. According to GIS data from CGS there have been ten sinkholes identified in the county, all of which are located in the Coaldale area.

Specific events that have been documented include:

- September 2013 – During a flooding event impacting Cañon City, a small sinkhole opened up on Central Avenue (Hopper, 2013).
- April 2004 – An investigation of the C-4 dam in Cañon City indicated that cracks and holes had appeared in the dam. According to an article published in 2011 by Benjamin Doerge and others, "The primary cause of the cracking was determined to be differential settlement due to collapse of the foundation materials upon wetting. During the original construction of the dam, a surface layer of highly collapsible aeolian/colluvial soil had been removed, but a lower layer of moderately collapsible alluvium was left in place" (Doerge and others, 2011).

Soil Erosion and Deposition

Soil erosion and deposition events are continually occurring throughout the county.

LOCATION

Subsidence

In Fremont County, there are three mapped areas of evaporite-bearing bedrock as well as nine areas where it is known that gypsum mining has occurred. Additionally, there are number of open mine holes on forest service lands. Figure 63 shows the evaporite-bearing bedrock areas, known gypsum mining sites and areas with recorded sinkholes. According to a publication from CGS, there is also evidence of collapsible soils around Cañon City, although spatial data was not available for mapping purposes (CGS, 2001). CGS has also identified areas across the state that have an elevated potential for subsidence presented in Figure 64. The Colorado Division of Reclamation, Mining, and Safety also provides locations of mining permits. Figure 65 presents these locations, which are scattered across the entire county. Additional potential undermined areas were identified by CGS and are shown in Figure 66.

FIGURE 63: SUBSIDENCE RISK

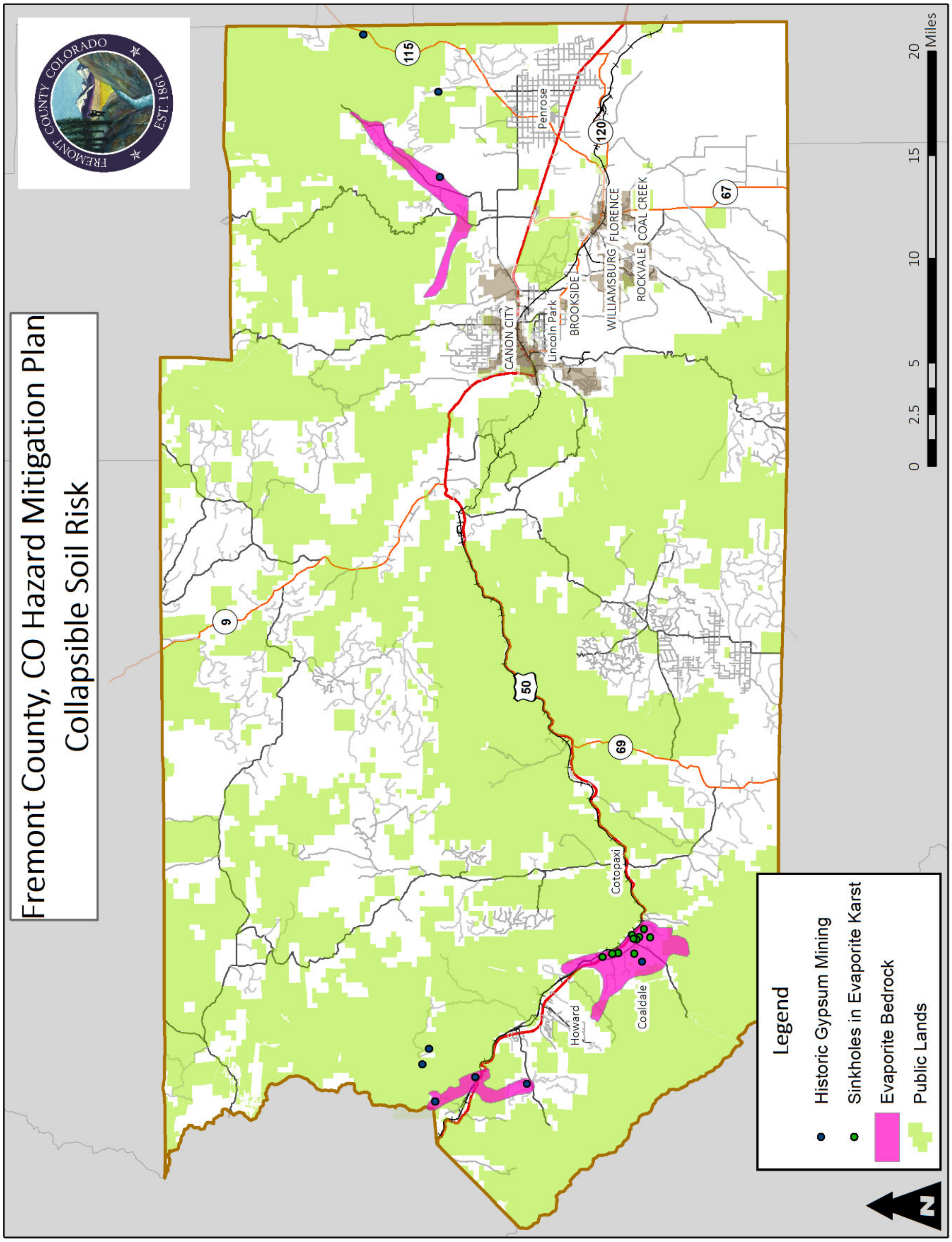


FIGURE 64: POTENTIAL SUBSIDENCE AREAS

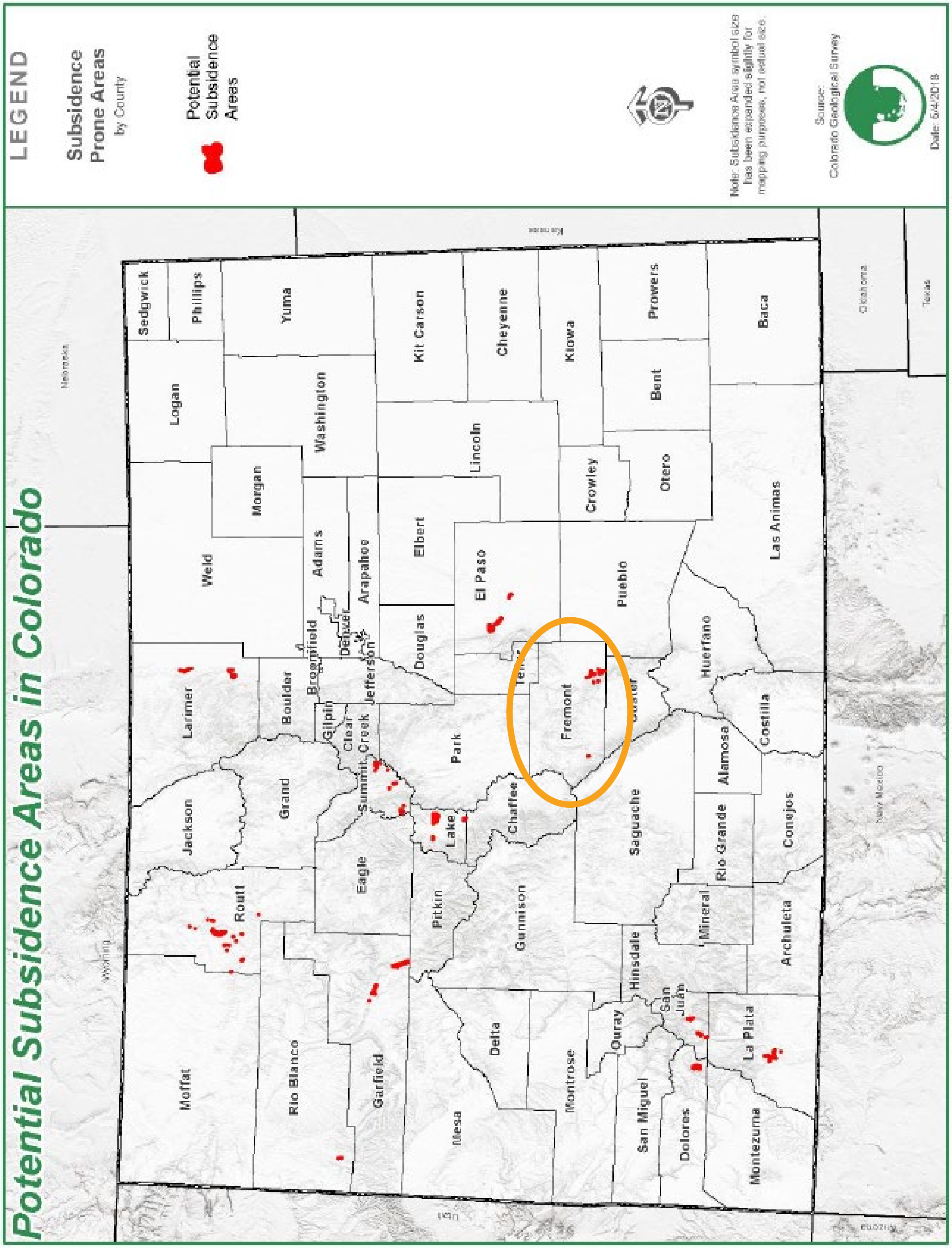


FIGURE 65: MINING PERMITS

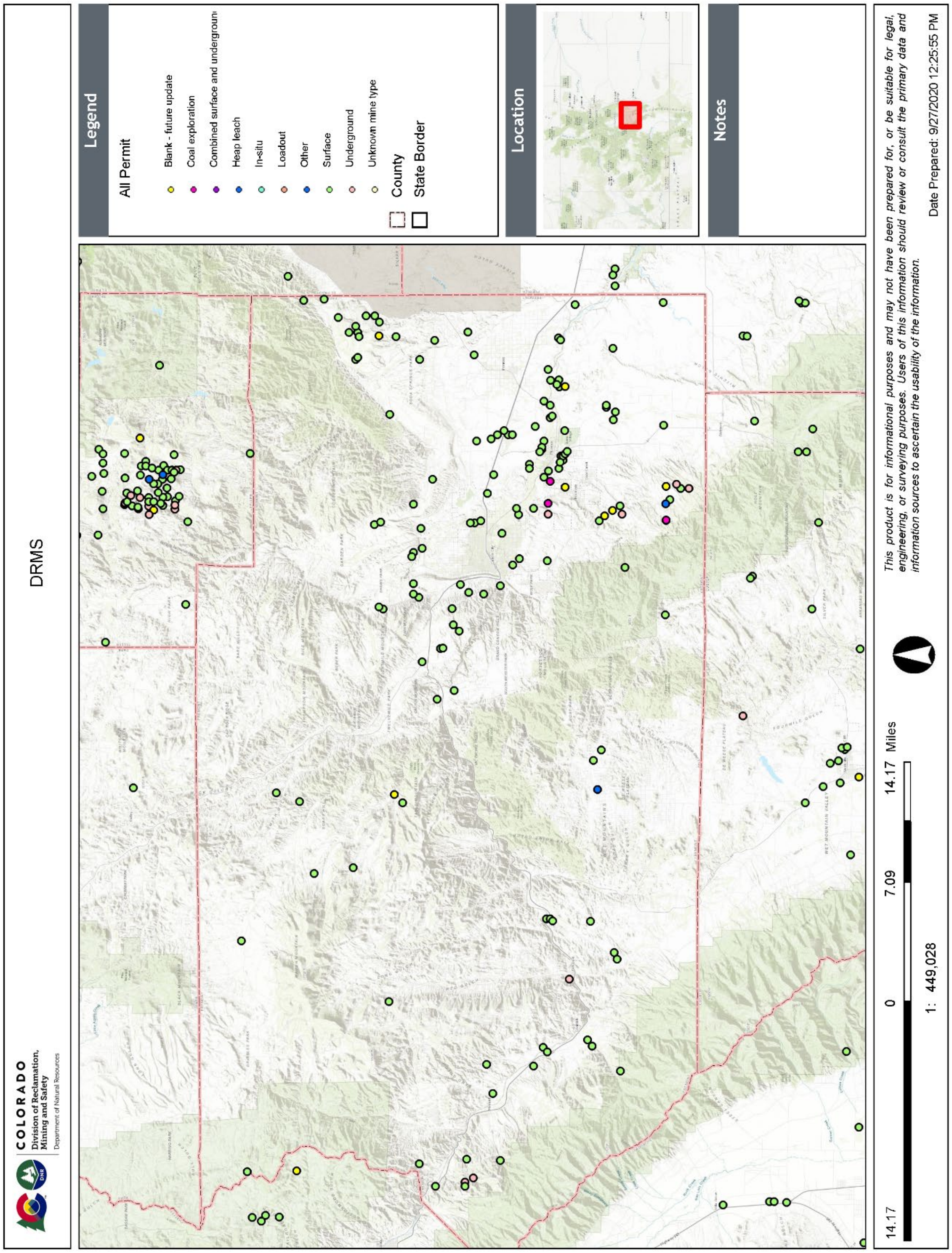
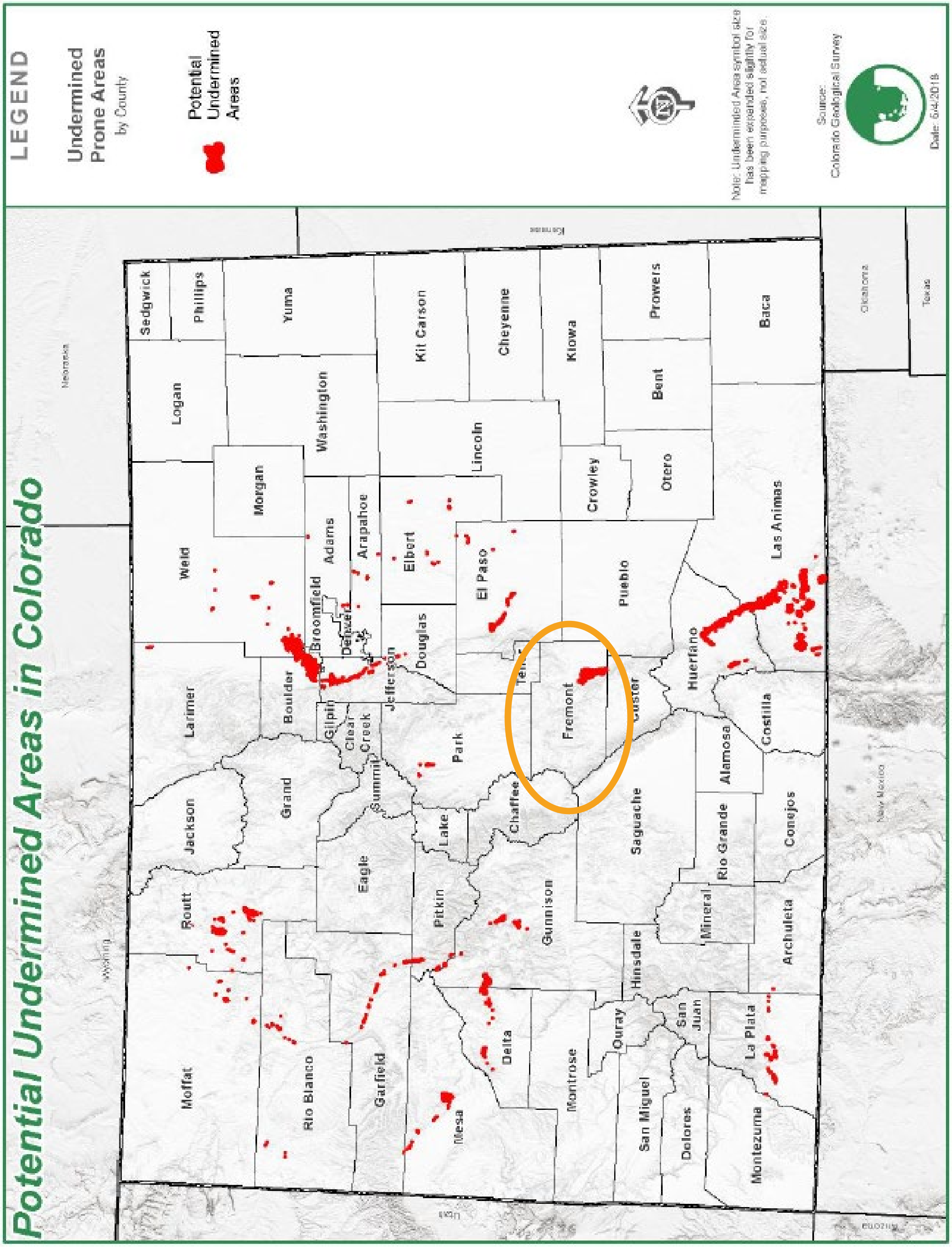


FIGURE 66: POTENTIAL UNDERMINED AREAS



Erosion and Deposition

Soil erosion and deposition occur in all parts of the county. Point sources of erosion often occur in areas where humans interact with exposed areas of the earth's surface, such as construction sites. Waterways are continually involved in erosion and deposition processes. Erosion and deposition may be exacerbated in areas where wildfires have occurred. According to the State of Colorado's Hazard Mitigation Plan, "there is a high risk for erosion in the aftermath of a wildfire event. As a fire burns, it destroys plant material and the layers of litter that blanket the floor of an ecosystem. These materials, as well as trees, grasses, and shrubs, buffer and stabilize the soil from intense rainstorms. The plant materials slow runoff to give rainwater time to percolate into the ground. When fire destroys this protective layer, rain and wind wash over the unprotected soil and erosion occurs". Areas in Fremont County that were recently burned are more susceptible to exacerbated erosion and deposition.

FREQUENCY

Subsidence and sinkholes, as well as soil erosion and deposition, are occurring continuously throughout the county. Large precipitation events and human activity may influence the frequency of these events within the county.

SEVERITY

The severity of subsidence and sinkholes, as well as soil erosion and deposition, is largely related to the extent and location of areas that are impacted. Such events can cause property damage and in some cases loss of life; however, events may also occur in remote areas of the county where there is little to no impact to people or property. According to the CGS, "In general, the type and severity of surface subsidence is governed by the amount of ground surface and the location of removal or compression, and the geological conditions of a particular site".

WARNING TIME

Subsidence can happen suddenly and without warning or can occur gradually over time. Soil erosion and deposition generally occurs gradually over time; however, these processes may be intensified as a result of natural or human-induced activities. There are some instances where the rate of subsidence can be calculated, particularly subsidence that occurs due to mining activities (Colorado Geological Survey, 2001).

SECONDARY HAZARDS

Events that cause damage to improved areas can result in secondary hazards, such as explosions from natural gas lines and loss of utilities, such as water and sewer, due to shifting infrastructure. These events could also cause potential failures of reservoir dams. Additionally, these events may occur simultaneously with other natural hazards such as flooding. Erosion can cause undercutting which can result in an increase in landslide or rockfall hazards. Additionally, erosion can result in the loss of topsoil, which can affect agricultural production in the area. Deposition can have impacts that aggravate flooding, bury crops, or reduce capacities of water reservoirs.

CLIMATE CHANGE IMPACTS

Changes in precipitation events and the hydrological cycle may result in changes in the rate of subsidence and soil erosion. According to a 2003 paper published by the Soil and Water Conservation Society (Soil and Water Conservation, 2003):

> The potential for climate change – as expressed in changed precipitation regimes – to increase the risk of soil erosion, surface runoff, and related environmental consequences is clear. The actual damage that would result from such a change is unclear. Regional, seasonal, and temporal variability in precipitation is large both in simulated climate regimes and in the existing climate record. Different landscapes vary greatly in their vulnerability to soil erosion and runoff. Timing of agricultural production practices creates even greater vulnerabilities to soil erosion and runoff during certain seasons. The effect of a particular storm event depends on the moisture content of the soil before the storm starts. These interactions between precipitation, landscape, and management mean the actual outcomes of any change in precipitation regime will be complex.

EXPOSURE AND VULNERABILITY

Overall, subsidence / erosion impacts would be limited in Fremont County. These hazards are very localized and exposure is entirely based upon the physical location of assets.

Lifelines

Any Lifelines located on or near areas prone to subsidence or soil erosion are exposed to risk from the hazard. Deposition may result in additional exposure.

Subsidence can result in serious structural damage to critical facilities and infrastructure such as, roads, irrigation ditches, underground utilities and pipelines. According to CGS, large ground displacements caused by collapsing soils can completely destroy roads and structures and alter surface drainage. Minor cracking and distress may result as the improvements respond to small adjustments in the ground beneath them. Erosion can also impact structures, such as bridges and roads, by undermining their foundations. Structures and underground utilities found in areas prone to subsidence or soil erosion can suffer from distress.

As part of this vulnerability assessment, the county's Lifelines were assessed with the evaporative bedrock areas shown in Figure 63. Table 31 presents Lifeline exposure to these hazards. Individual assessments of those exposed Lifelines can help to identify potential mitigation actions to consider implementing.

TABLE 31: LIFELINE EXPOSURE TO SUBSIDENCE / EROSION

Lifeline	Total Count	Count Exposed	%
Medical Facilities	3	0	0%
Schools	33	0	0%
Sewage Facilities	1	0	0%
Other Lifelines	174	1	1%
Tier II Facilities	45	0	0%
Transportation (miles)	563.0	12.8	2.3%

Population

Individuals living or travelling in areas prone to subsidence and erosion are exposed to the hazard. The risk of injury or fatalities as a result of these hazards are limited, but possible. Spontaneous collapse and opening of voids are rare, but still may occur resulting in death or injury to any people in the area at the time. It is likely that any such injuries would be highly localized to the area directly impacted by an event. Wind erosion can adversely impact populations who have respiratory issues by reducing air quality, so those with existing respiratory issues are likely to be more vulnerable. Erosion caused by water can directly impact individuals near streams and bodies of water.

Property

Structures and other improvements located in areas prone to subsidence or erosion are exposed to risk from these hazards. Additionally, deposition may result in damage to structures and property. Property exposed to subsidence and erosion can sustain minor damages or can result in complete destruction. According to CGS, merely an inch of differential subsidence beneath a residential structure can cause several thousand dollars of damage. Structures may be condemned due to this damage, resulting in large losses. FEMA estimates that there are over $125 million in losses in the U.S. annually, as a result of subsidence.

Environment

Subsidence and erosion are all naturally occurring processes which can still cause damage to the natural environment. Environments located in areas prone to subsidence and erosion are exposed. Ecosystems that are exposed to increased sedimentation from erosion and deposition can experience degraded habitat. However, some erosion and deposition are required for healthful ecosystem functioning. Ecosystems that are already exposed to other pressures, such as encroaching development, may be more vulnerable to impacts from these hazards.

Economy

Damage to infrastructure, critical facilities, and property due to subsidence and erosion could have long term impacts on the economy. If Lifelines are disrupted, such as power, the day-to-day operations of the county may be on hold until the component is restored. The potential loss of property could affect individual businesses or a larger portion of the community. Any prolonged delays in repairing damages could result in losses for businesses, industry, and the local economy.

FUTURE TRENDS IN DEVELOPMENT

The severity of landslide problems is directly related to the extent of human activity in hazard areas. Adverse effects can be mitigated by early recognition and avoiding incompatible land uses in these areas or by corrective engineering. In areas where hazards may be present, permitting processes should require geotechnical investigations to access risk and vulnerability to hazard areas.

Future population change across the county is expected to be 1.7% over the next five years. This is similar to the growth experienced over the last five years (1.9%). A majority of this growth is expected to occur as municipal infill. As these areas are not at high risk from subsidence / erosion, future development is not expected to greatly increase the risk to this hazard.

THUNDERSTORM (HAIL, HIGH WIND, LIGHTNING)

Fremont County has ranked the risk from thunderstorms and associated events to be High. The previous HMP also ranked this hazard the same.

High Risk

GENERAL BACKGROUND

Thunderstorm / Lightning

A thunderstorm is a rain event that includes thunder and lightning. A thunderstorm is classified as "severe" when it contains one or more of the following: hail with a diameter of three-quarter inch or greater, winds gusting in excess of 50 knots (57.5 mph), or tornado.

Three factors cause thunderstorms to form: moisture, rising unstable air (air that keeps rising when disturbed), and a lifting mechanism to provide the disturbance. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise (hills or mountains can cause rising motion, as can the interaction of warm air and cold air or wet air and dry air) it will continue to rise as long as it weighs less and stays warmer than the air around it.

As the air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice and some of it turns into water droplets. Both have electrical charges. Ice particles usually have positive charges, and rain droplets usually have negative charges. When the charges build up enough, they are discharged in a bolt of lightning, which causes the sound waves we hear as thunder.

Cloud-to-ground lightning is the most damaging and dangerous form of lightning. This type of lightning is particularly dangerous for several reasons. It frequently strikes away from the rain core, either ahead or behind the thunderstorm. It can strike as far as 5 or 10 miles from the storm in areas that most people do not consider to be a threat. Positive lightning also has a longer duration, so fires are more easily ignited.

U.S. lightning statistics compiled by the National Oceanic and Atmospheric Administration indicate that most lightning incidents occur during the summer months of June, July, and August and during the afternoon hours from between 2 and 6 p.m.

Hail

Hail occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice. Eventually, the hailstones encounter downdraft air and fall to the ground. Colorado's damaging hail season runs from April through September.

High Wind

Damaging winds are classified as those exceeding 60 mph. Damage from such winds accounts for half of all severe weather reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 mph and can produce a damage path extending for hundreds of miles. There are seven types of damaging winds:

- Straight-line winds—Any thunderstorm wind that is not associated with rotation; this term is used mainly to differentiate from tornado winds. Most thunderstorms produce some straight-line winds as a result of outflow generated by the thunderstorm downdraft.
- Downdrafts—A small-scale column of air that rapidly sinks toward the ground.
- Downbursts—A strong downdraft with horizontal dimensions larger than 2.5 miles resulting in an outward burst or damaging winds on or near the ground. Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- Microbursts—A small, concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally less than 2.5 miles across and short-lived, lasting only 5 to 10 minutes, with maximum wind speeds up to 168 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
- Gust front—A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.
- Derecho—A derecho is a widespread thunderstorm wind caused when new thunderstorms form along the leading edge of an outflow boundary (the boundary formed by horizontal spreading of thunderstorm-cooled air). The word "derecho" is of Spanish origin and means "straight ahead." Thunderstorms feed on the boundary and continue to reproduce. Derechos typically occur in summer when complexes of thunderstorms form over plains, producing heavy rain and severe wind. The damaging winds can last a long time and cover a large area.
- Bow Echo—A bow echo is a linear wind front bent outward in a bow shape. Damaging straight-line winds often occur near the center of a bow echo. Bow echoes can be 200 miles long, last for several hours, and produce extensive wind damage at the ground.

PAST EVENTS

Historical record of hazard events can be found in the tables and figures below. The data on property and crop damage figures is from the SHELDUS database. The SHELDUS data does not represent all events that have occurred, only those that caused reported damages.

Severe storm events which resulted in damages are listed by decade in Table 32. Data indicates that there have not been events categorized as severe storms that have caused damage since 1992.

TABLE 32. HISTORICAL SEVERE STORM EVENTS (1960-1999)

Date Range	Number of Events	Injuries	Deaths	Property Damage*	Crop Damage*
1960-1969	8	0	0	$ 1,641,351	$ 24,304
1970-1979	5	0	0	$ 101,702	$ 0
1980-1989	7	0	0	$ 1,784,614	$ 1,726,480
1990-1999	2	0	0	$ 4,886	$ 0

*Adjusted to 2018 US Dollars

Hail

The National Centers for Environmental Information's (NCEI) Storm Events Database lists 61 hail events in Fremont County between 1996 and 2020. Of the eleven reported events that occurred since this plan's last update, there were no reports of damages or injuries. Figure 67 and Figure 68 display the locations of historical events across the county. Table 33 illustrates the events that resulted in damages by decade, using SHELDUS data.

TABLE 33. HISTORICAL HAIL EVENTS (1960-199)

Date Range	Number of Events	Injuries	Deaths	Property Damage*	Crop Damage*
1960-1969	7	0	0	$ 247,324	$ 56,625
1970-1979	2	0	0	$ 4,408	$ 724
1980-1989	3	0	0	$ 1,923	$ 112,445
1990-1999	1	0	0	$ 955	$ 0

*Adjusted to 2018 US Dollars

FIGURE 67: HISTORICAL HAIL

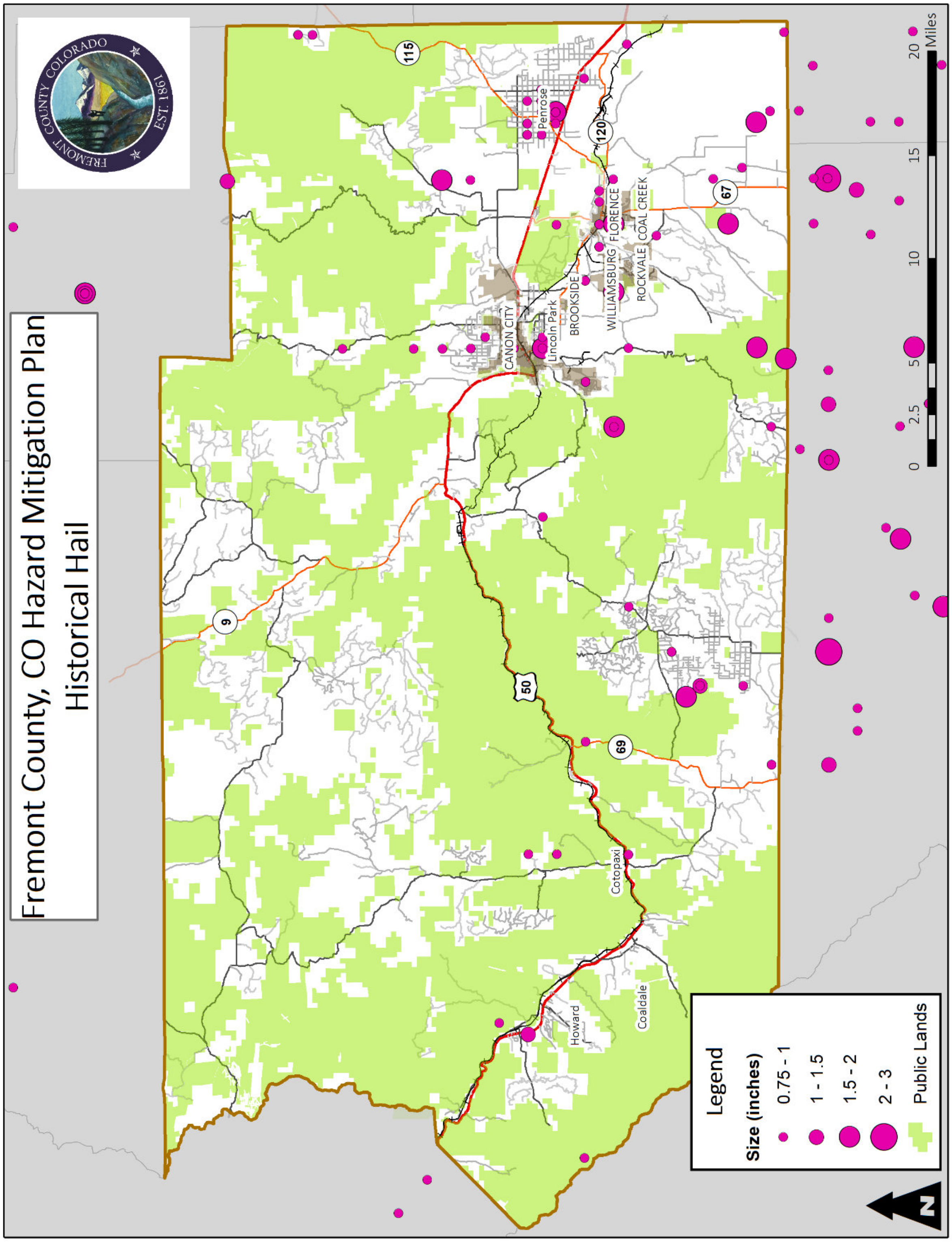
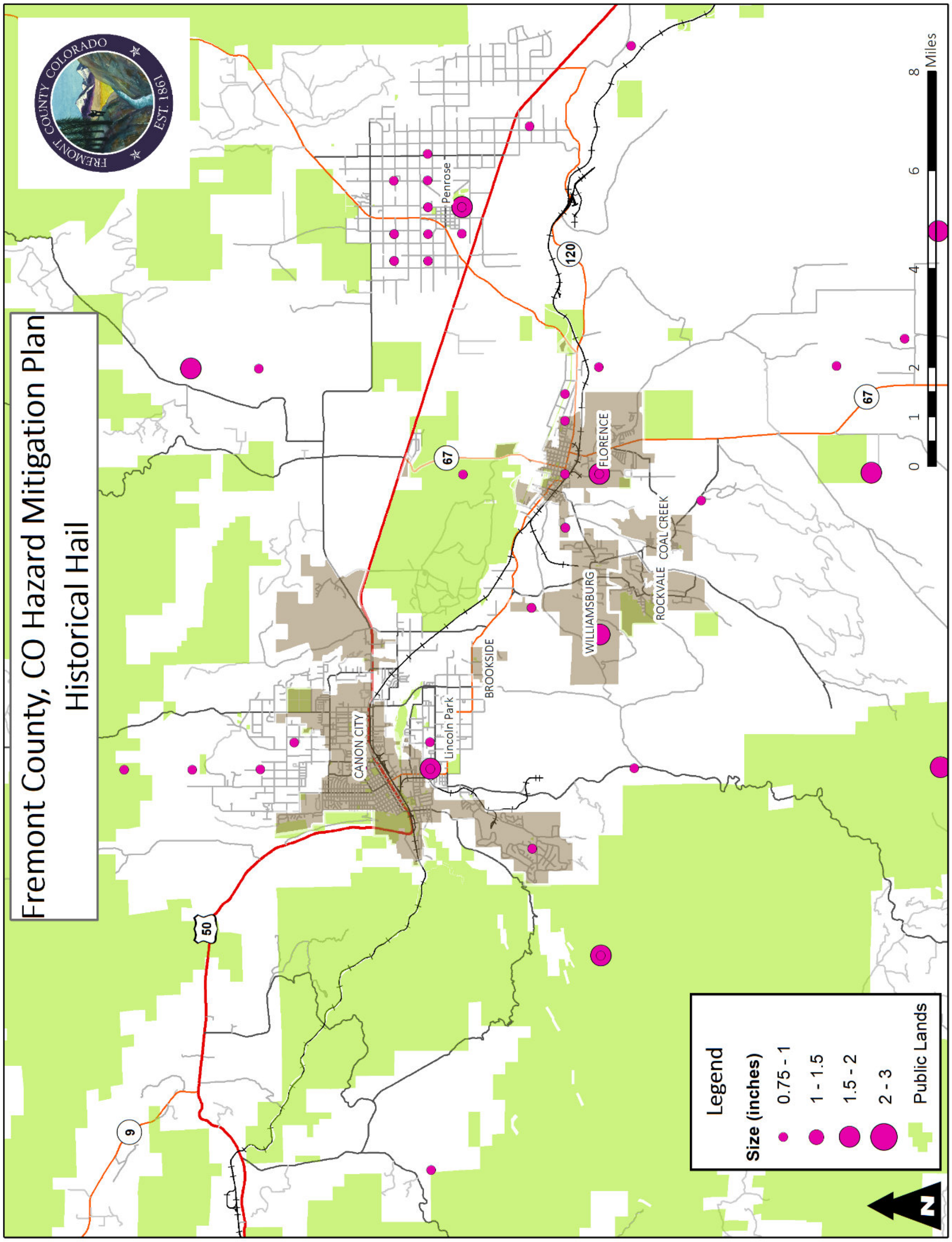


Figure 68: Historical Hail – Municipal Scale



High Wind

Historical severe weather data from the Storm Events Database includes 38 high wind events and seven thunderstorm wind events in Fremont County between 1996 and 2020. Of the 25 reported events that occurred since this plan's last update, there were no reports of damages or injuries. Figure 69 and Figure 70 display the locations of historical events across the county.

Data from SHELDUS, in Table 34, illustrates the property and crop damages resulting from high wind events since 1960.

TABLE 34. HISTORICAL HIGH WIND EVENTS (1960-2019)

Date Range	Number of Events	Injuries	Deaths	Property Damage*	Crop Damage*
1960-1969	7	0	0	$ 272,208	$ 4,604
1970-1979	8	0	0	$ 716,077	$ 26,556
1980-1989	10	0	0	$ 697,423	$ 56.607
1990-1999	8	0	0	$ 474,155	$ 0
2000-2009	4	0	0	$ 832,603	$ 0
2010-2019	1	0	0	$ 3,281	$ 0

*Adjusted to 2018 US Dollars

FIGURE 69: HISTORICAL HIGH WIND

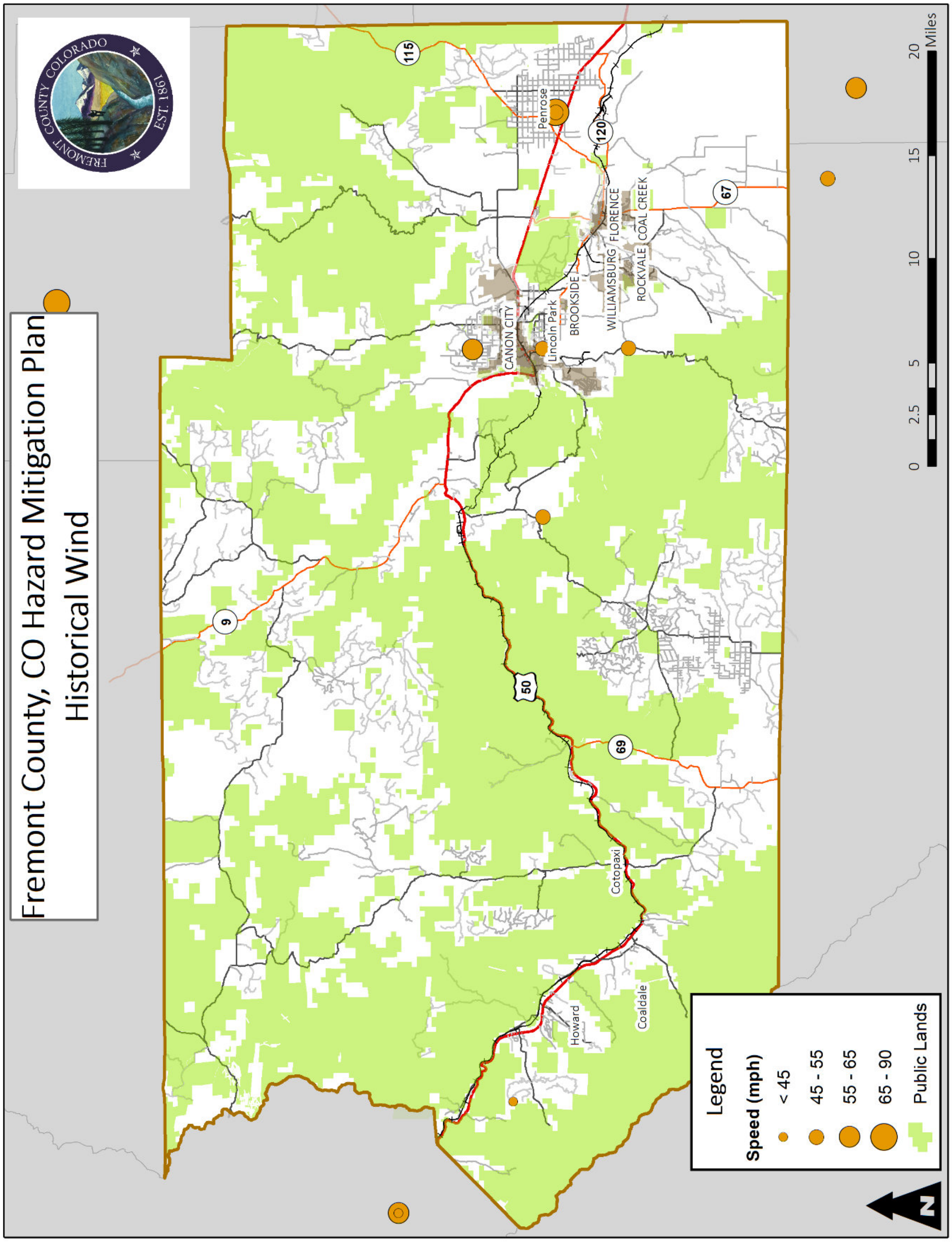
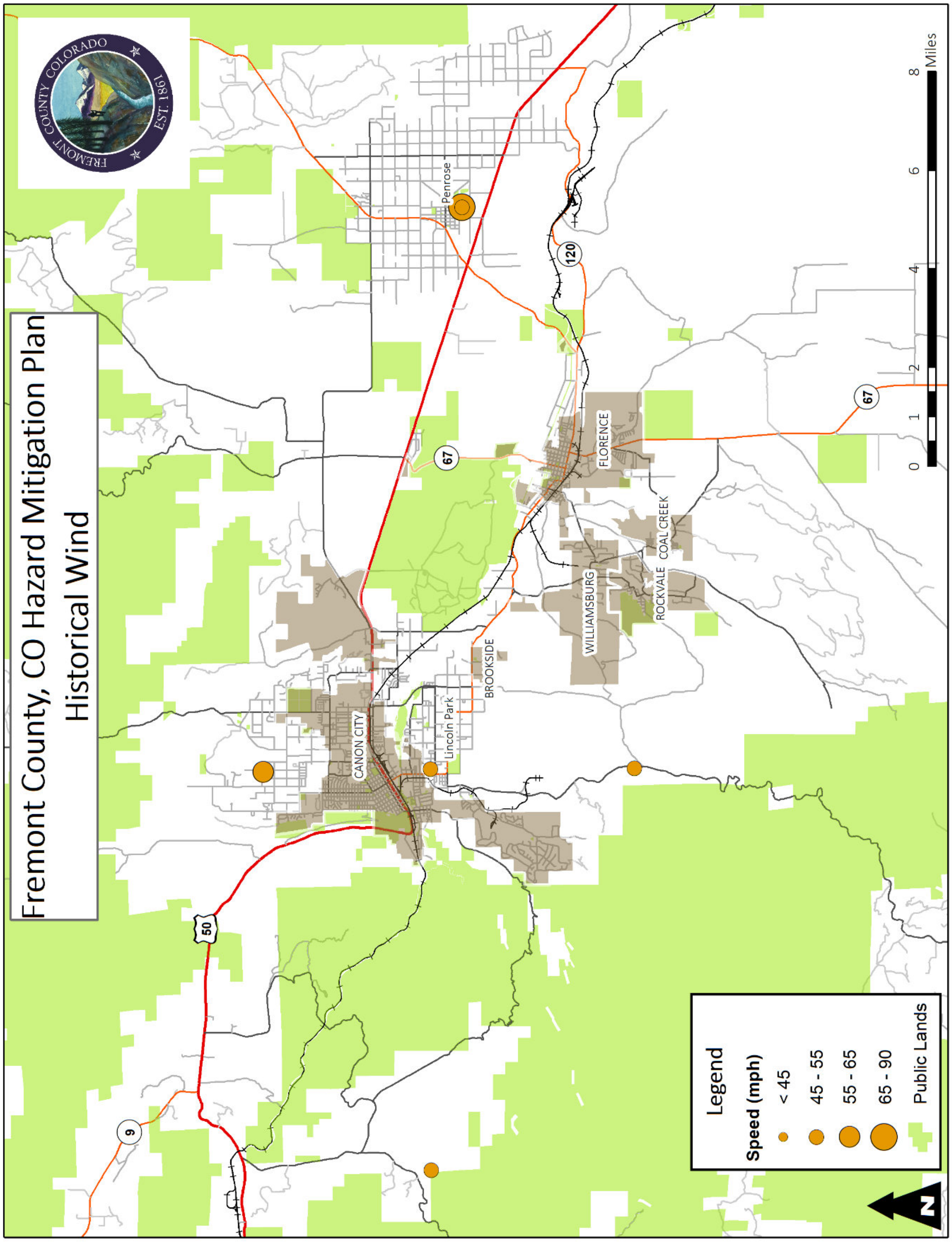


FIGURE 70: HIGH WIND – MUNICIPAL SCALE



Lightning

Data from the National Lightning Detection Network ranks Colorado 26th in the nation (excluding Alaska and Hawaii) with respect to the number of cloud-to-ground lightning flashes, with an average number of more than 500,000 cloud-to-ground lightning strikes per year. Fremont County has an average of 1 to 5 lightning flashes per square kilometer per year, with higher lightning frequency in the northeastern part of the county.

According to the Storm Events Database, there have been 6 notable lightning events in Fremont County between 1996 and 2020:

- July 1, 2019 – One confirmed lightning injury occurred in downtown Cañon City. An 11-year-old female was struck inside her home near a sink and had to be transported to a local hospital with non-life threatening injuries.
- July 3, 2008 – Lightning sparked a fire that destroyed two cabins and a vehicle in Howard. The estimated property damage was $150,000.
- July 26, 2006 – A house in Cañon City was struck by lightning, but smoke and water damage was mainly confined to the attic area and a small portion of the house. The estimated property damage was $20,000.
- June 28, 2002 – A double-wide mobile home in Penrose was struck by lightning and caught fire. Two occupants fled the mobile home, which was totally destroyed. The estimated property damage was $30,000.
- August 13, 2000 – A house in Cañon City was struck by lightning, damaging some walls and destroying the electrical wiring. The estimated property damage was $5,000.
- June 7, 1997 – A lightning bolt caused the loss of power and phone service to a correctional facility. Electricity and phone service were restored later that night.

There is a history of significant events over the last five decades. Table 35 shows the incidents by decade that resulted in reported damages to property or crops, according to SHELDUS.

TABLE 35. HISTORICAL LIGHTNING EVENTS (1960-2019)

Date Range	Number of Events	Injuries	Deaths	Property Damage*	Crop Damage*
1960-1969	3	0	0	$ 38,959	$ 94,329
1970-1979	1	0	0	$ 3,720	$ 37
1980-1989	2	0	1	$ 109,621	$ 0
1990-1999	0	0	0	$ 0	$ 0
2000-2009	4	0	0	$ 249,021	$ 0

*Adjusted to 2018 US Dollars

LOCATION

Severe weather events have the potential to happen anywhere in the planning area. The entire extent of Fremont County is exposed to some degree of lightning hazard, though exposed points of high elevation have significantly higher frequency of occurrence. Higher elevations could experience the most significant wind speeds, but these areas are generally not developed or populated.

FREQUENCY

Thunderstorms, including both hail and high wind events, happen every year in Fremont County. Based on reported data, there is a 25% chance of a damaging lightning strike occurring in a given year.

SEVERITY

Hail

Hail can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from resulting damages. Hail has been known to cause injury to humans and occasionally has been fatal. Research has shown that damage occurs after hail reaches around 1" in diameter and larger. Hail of this size will trigger a severe thunderstorm warning from NWS.

The hailstorm that hit Pueblo on July 29, 2009 remains one of Colorado's 10 most costly hailstorms, producing over $280 million in damages (2020 dollars).[10]

High Wind

High winds, often accompanying severe thunderstorms, can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from business closures and power loss. Wind storms in Fremont County are rarely life threatening but do disrupt daily activities and cause damage to buildings and structures. Winter winds can also cause damage, close highways (blowing snow), and induce avalanches. Winds can also cause trees to fall, particularly those killed by pine beetles or wildfire, creating a hazard to property or individuals outdoors.

Lightning

Lightning is one of the more dangerous weather hazards in the United States and in Colorado. Each year, lightning is responsible for deaths, injuries, and millions of dollars in property damage, including damage to buildings, communications systems, power lines, and electrical systems. Lightning can cause forest and brush fires, as well as deaths and injuries to livestock and other animals. According to the

[10] Rocky Mountain Insurance Information Association

National Lightning Safety Institute, lightning causes more than 26,000 fires in the United States each year. The institute estimates property damage, increased operating costs, production delays, and lost revenue from lightning and secondary effects to be in excess of $6 billion per year. Impacts can be direct or indirect. People or objects can be directly struck, or damage can occur indirectly when the current passes through or nearby.

WARNING TIME

Meteorologists can often predict the likelihood of a severe storm. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours of warning time. Weather forecasts for the planning area are limited. People generally rely on weather forecasts for the Pueblo or Colorado Springs areas, as they are the nearest cities with adequate coverage. However, Fremont County has significant altitude, geothermal, and jet stream differences from those areas. At times warning for the onset of severe weather may be limited.

SECONDARY HAZARDS

The most significant secondary hazards associated with severe local storms are floods, debris flow, falling and downed trees, landslides, and downed power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes becomes oversaturated and fails. Fires can occur as a result of lightning strikes. Many locations in the region have minimal vegetative ground cover and the high winds can create a large dust storm, which becomes a hazard for travelers and a disruption for local services. High winds in the winter can turn small amount of snow into a complete whiteout and create drifts in roadways. Debris carried by high winds can also result in injury or damage to property. A wildland fire can be accelerated and rendered unpredictable by high winds.

CLIMATE CHANGE IMPACTS

Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. Historical data shows that the probability for severe weather events increases in a warmer climate. The changing hydrograph caused by climate change could have a significant impact on the intensity, duration, and frequency of storm events. All of these impacts could have significant economic consequences.

EXPOSURE AND VULNERABILITY

Everything in the planning area would be exposed, to some degree, to the impacts of severe weather. Certain areas are more exposed due to geographic location and local weather patterns.

Lifelines

All Lifelines exposed to flooding are also likely exposed to risks associated with thunderstorms and hail. Those on higher ground may also be exposed to wind damage or damage from falling trees. The most common problems associated with these weather events are loss of utilities. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to secondary hazards such as landslides. Lightning events can have destructive effects on power and information systems. Failure of these systems would have cascading effects throughout the county.

Population

It can be assumed that the entire planning area is exposed to some extent to thunderstorm, hail, high wind, and lightning events. Areas of greater exposure are where higher population densities exist. Certain areas are more exposed due to geographic location and local weather patterns. Populations living at higher elevations, with large stands of trees or power lines may be more susceptible to wind damage and black out, while populations in low-lying areas are at risk for possible flooding. It is not uncommon for residents living in more remote areas of the county to be isolated after such events.

Vulnerable populations are the elderly, those with low income, linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for medical support. Isolation of these populations is a significant concern. These populations face isolation and exposure during thunderstorm, wind, and hail events and could suffer more secondary effects of the hazard. Hikers and climbers in the area may also be more vulnerable to severe weather events. Visitors to the area may not be aware of how quickly a thunderstorm can build in the mountains.

Property

Wind pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift and suction forces that act to pull building components and surfaces outward. The effects of winds are magnified in the upper levels of multi-story structures. As positive and negative forces impact the building's protective envelope (doors, windows, and walls), the result can be roof or building component failures and considerable structural damage.

All buildings are considered to be exposed to the thunderstorm, hail, high wind, and lightning hazards, but structures in poor condition or in particularly vulnerable locations (located on hilltops or exposed open areas) may risk the most damage. The frequency and degree of damage will depend on specific locations.

Environment

The environment is highly exposed to thunderstorms, hail, high wind, and lightning. Natural habitats, such as streams and trees, risk major damage and destruction. Prolonged rains can saturate soils and lead to slope failure. Flooding events can produce river channel migration or damage riparian habitat.

Economy

Economic impact from thunderstorm, hail, high wind, and lightning hazards is possible, as damage to property, crops and livestock may result in losses. This can occur in any events for these hazards, however events with large hail have been known to cause the death of livestock and devastate crops. High wind events are also extremely damaging to crops. The losses suffered from a harvest ruined by hail or high wind, or the death of livestock, can affect the local economy.

In addition, disruption of Lifelines and daily operations due to damaged infrastructure and facilities can cause losses. Repairing, rebuilding or replacing critical equipment may be a slow process which could have cascading effects on businesses and the local economy. Any extended delay of returning to normal functioning has the potential to close businesses and impact industry.

FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by severe storms. The vulnerability of community assets to thunderstorms is increasing through time as more people enter the planning area. The ability to withstand impacts lies in consistent enforcement of codes and regulations for new construction.

TORNADO

Fremont County has ranked the risk from tornado to be Low. The previous HMP also ranked this hazard the same.

Low Risk

GENERAL BACKGROUND

A tornado is a narrow, violently rotating column of air that extends from the base of a cumulonimbus cloud to the ground. The visible sign of a tornado is the dust and debris that is caught in the rotating column made up of water droplets. Tornadoes are the most violent of all atmospheric storms. The following are common ingredients for tornado formation:

- Very strong winds in the mid and upper levels of the atmosphere
- Clockwise turning of the wind with height (i.e., from southeast at the surface to west aloft)
- Increasing wind speed in the lowest 10,000 feet of the atmosphere (i.e., 20 mph at the surface and 50 mph at 7,000 feet.)
- Very warm, moist air near the ground with unusually cooler air aloft
- A forcing mechanism such as a cold front or leftover weather boundary from previous shower or thunderstorm activity.

Tornadoes can form from individual cells within severe thunderstorm squall lines. They also can form from an isolated super-cell thunderstorm. Weak tornadoes can sometimes occur from air that is converging and spinning upward, with little more than a rain shower occurring in the vicinity.

Tornadoes are classified based on the damage inflicted once it has passed over a man-made structure, which allows experts to assess and estimate wind intensity. The Fujita Scale (Table 36) was used until 2007, classifying the intensity from the least to most intense, in seven categories (F0-F6). This scale was replaced by the Enhance Fujita Scale (Table 37), which uses six intensity categories (EF0-EF5) to measure tornado strength and associated damages. The scale was revised to reflect better examinations of tornado damage surveys, to align wind speeds more closely with associated storm damage. The new scale takes into account how most structures are designed and is considered a more accurate representation of the surface wind speeds in the most violent tornadoes. Table 36 provides details on how the Enhanced Fujita Scale intensities can be derived from the previous Fujita Scale.

TABLE 36: DERIVED EF SCALE

Fujita Scale		Derived EF Scale	
F Number	**3 Second Gust (mph)**	**EF Number**	**3 Second Gust (mph)**
0	45-78	**0**	65-85
1	79-117	**1**	86-109
2	118-161	**2**	110-137
3	162-209	**3**	138-167
4	210-261	**4**	168-199
5	262-317	**5**	200-234

PAST EVENTS

The National Centers for Environmental Information's (NCEI) Storm Events Database lists one dust devil and five tornadoes in Fremont County between 1996 and 2020. Of the two reported events that occurred since this plan's last update, there were no reports of damages or injuries.

Five tornadoes that caused property damage have been recorded in the county since 1950, although none have been rated as higher than EF 1.

- June 12, 2012, Dust Devil – A powerful dust devil moved through the Cañon City Head Start property, destroying two 40-foot long carports and damaging another. There was minor damage to a storage shed and some buses, with an estimated cost of $3,000.
- June 15, 2004, Tornado – An F0-rated tornado caused an estimated $1,000 in damage to fencing.
- July 13, 1989, Tornado – An F0-rated tornado caused an estimated $10,000 in damages.
- April 21, 1988, Tornado – An F0-rated tornado caused an estimated $17,000 in damages.
- July 22, 1985, Tornado – An F1-rated tornado caused an estimated $3,000 in damages.

Figure 71 and Figure 72 display the locations of historical tornado events across the county. Note that all have occurred within or in close proximity to the municipalities, on the eastern side of the county.

FIGURE 71: HISTORICAL TORNADOES

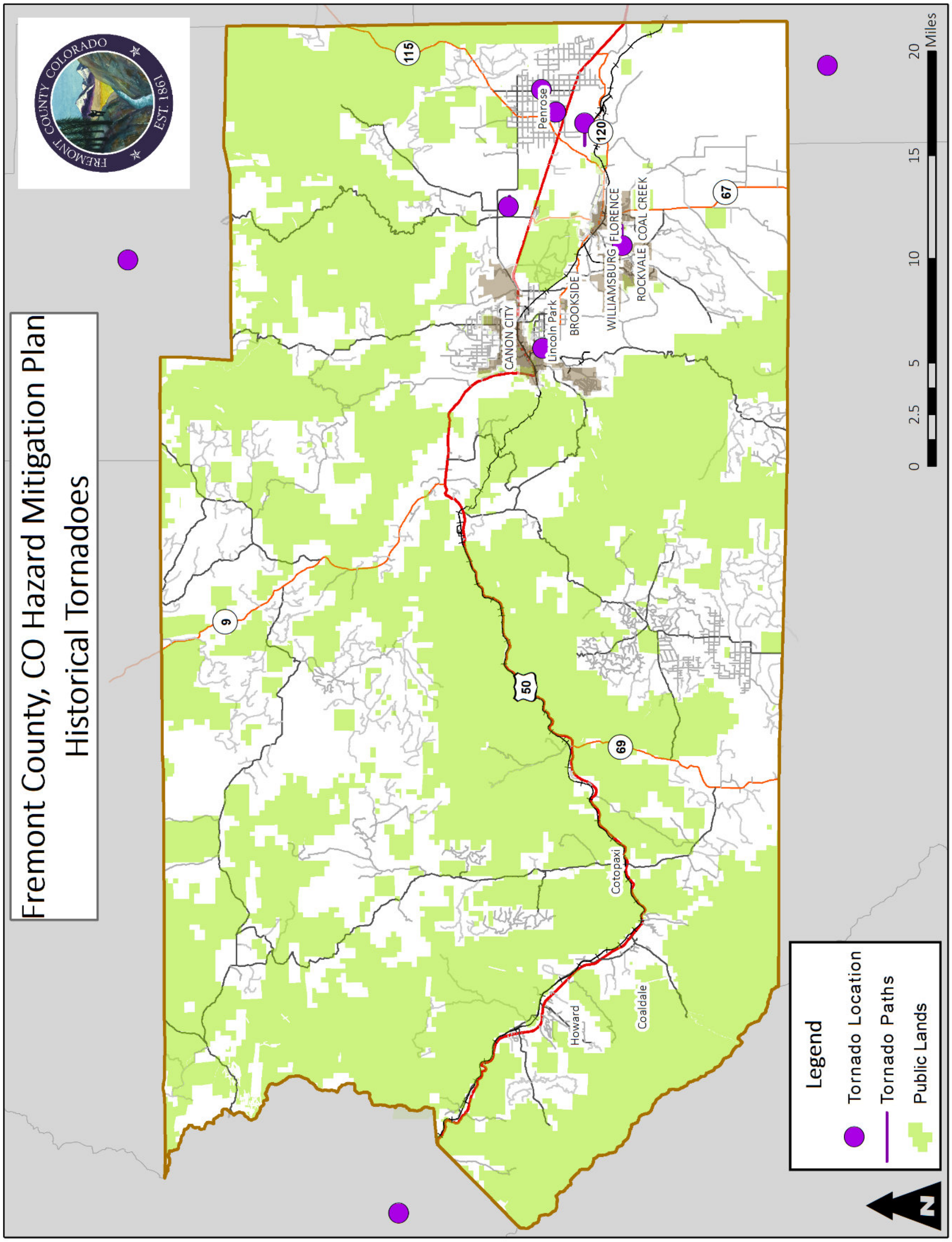
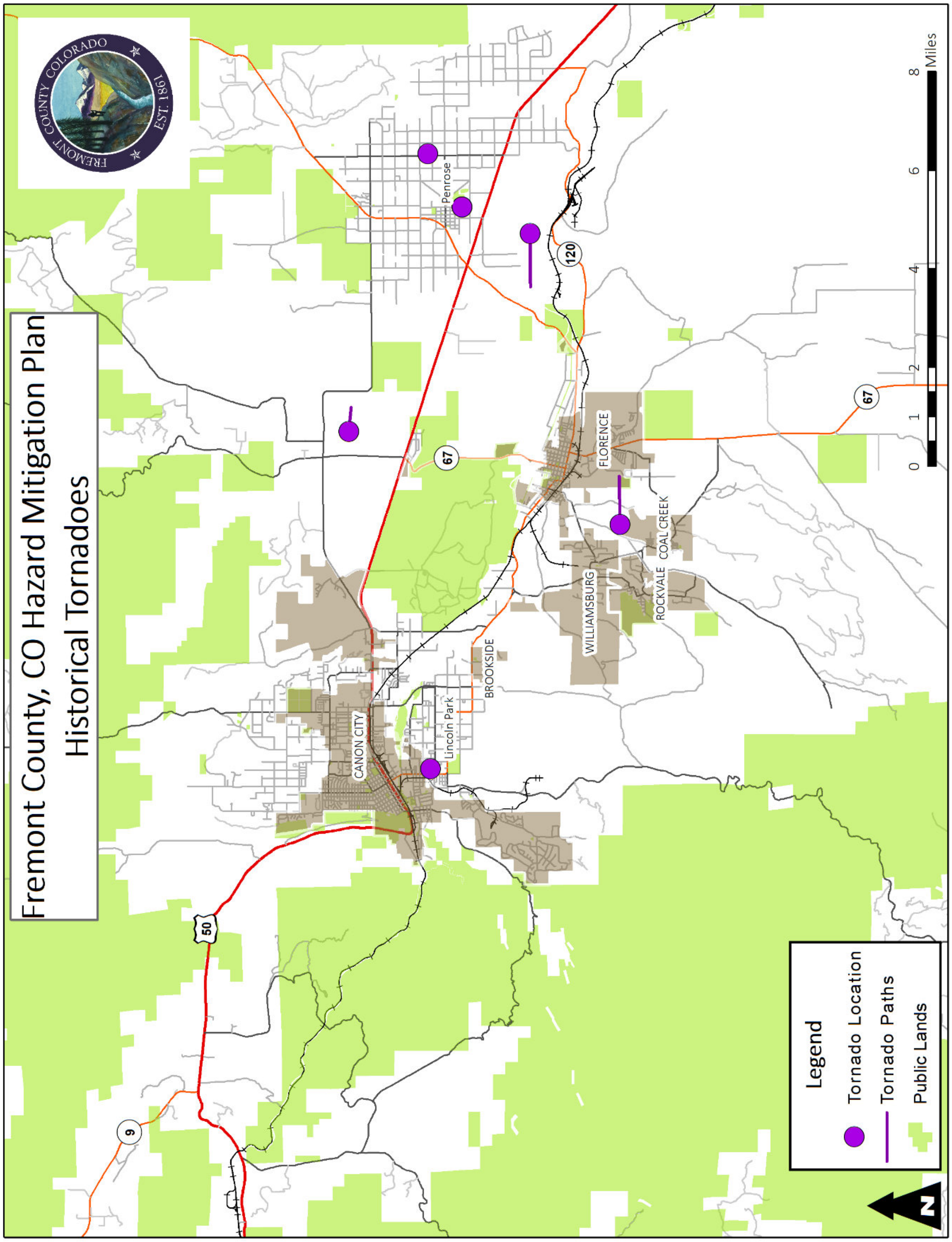


FIGURE 72: HISTORICAL TORNADOES – MUNICIPAL SCALE



LOCATION

Recorded tornadoes in the planning area are typically small and short-lived. They are more likely to occur in the eastern portion of the county.

FREQUENCY

Tornadoes have been reported nine months of the year in Colorado, with peak occurrences between mid-May through mid-August. State-wide, June is the month with the most recorded tornadoes. Tornadoes occur at all times of the day, with more than half occurring between 3 p.m. and 6 p.m., and about 88 percent occurring between 1 p.m. and 9 p.m.

Based on reported data, there is less than a 10% chance of a damaging tornado impacting the county.

SEVERITY

Tornadoes are potentially the most dangerous of local storms. If a major tornado were to strike within the populated areas of Fremont County, damage could be widespread. Businesses could be forced to close for an extended period or permanently, fatalities could be high, many people could be homeless for an extended period, and routine services such as telephone or power could be disrupted. Buildings may be damaged or destroyed.

Historically, tornadoes have not typically been severe or caused damage in the planning area. Table 37 presents the damages associated with the various F Scales.

TABLE 37: EF SCALE

F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage
F0	Gale tornado	40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages signboards.
F1	Moderate tornado	73-112 mph	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.

F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.
F6	Inconceivable tornado	319-379 mph	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies

WARNING TIME

The NOAA's storm prediction center issues tornado watches and warnings for Fremont County:

- Tornado Watch - Tornadoes are possible. Remain alert for approaching storms. Watch the sky and stay tuned to NOAA Weather Radio, commercial radio, or television for information.
- Tornado Warning - A tornado has been sighted or indicated by weather radar. Take shelter immediately.

Once a warning has been issued, residents may have only a matter of seconds or minutes to seek shelter.

SECONDARY HAZARDS

Tornadoes may cause loss of power if utility service is disrupted. Additionally, fires may result from damages to natural gas infrastructure. Hazardous materials may be released if a structure housing such materials is damaged or if such a material is in transport.

CLIMATE CHANGE IMPACTS

Climate change impacts on the frequency and severity of tornadoes are unclear. According to the Center for Climate Change and Energy Solutions, "Researchers are working to better understand how the building blocks for tornadoes – atmospheric instability and wind shear – will respond to global warming. It is likely that a warmer, moister world would allow for more frequent instability. However, it is also likely that a warmer world would lessen chances for wind shear. Recent trends for these quantities in the Midwest during the spring are inconclusive. It is also possible that these changes could shift the timing of tornadoes or regions that are most likely to be hit".

EXPOSURE AND VULNERABILITY

Everything in the planning area could be exposed, to some degree, to the impacts of a tornado. The eastern portions of the county have increased vulnerability as that is where all historical events have occurred.

Lifelines

All Lifeline are likely exposed to tornadoes. The most common problems associated with this hazard are utility losses. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water and sewer systems may not function. Roads may become impassable due to downed trees or other debris.

Tornadoes can cause significant damage to trees and power lines, blocking roads with debris, incapacitating transportation, isolating population, and disrupting ingress and egress. Of particular concern are roads providing access to isolated areas and to the elderly. Any facility that is in the path of a tornado is likely to sustain damage.

Population

It can be assumed that the entire planning area is exposed to some extent to tornadoes. Vulnerable populations are the elderly, those with low income, linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for medical support. Isolation of these populations is a significant concern. These populations face isolation and exposure after tornado events and could suffer more secondary effects of the hazard.

Individuals caught in the path of a tornado who are unable to seek appropriate shelter are especially vulnerable. This may include individuals who are out in the open, in cars, or those who do not have access to basements, cellars, or safe rooms.

Property

All property is vulnerable during tornado events, but properties in poor condition or manufactured housing are at the highest risk.

Environment

Environmental features are exposed to tornado risk, although damages are generally localized to the path of the tornado. If tornadoes impact facilities that store hazardous materials, the surrounding areas may be especially vulnerable.

Economy

Tornadoes may have a devastating impact on the economy. The factors of what sustains damages, such as property, crops or livestock, and the extent of the damage dictates the level of this impact. In the case of less intense tornadoes, which may touch down only briefly, damage might be minimal and limited in losses. However, even a lower intensity tornado that touches down and travels can leave a path of destruction and extensive damages in its wake.

High intensity tornadoes, which can destroy structures in a matter of seconds, can leave a community with significant rebuilding, which may take longer durations. These extended periods of rebuilding are likely to have a negative impact on the strength of the economy, as businesses remain closed and Lifelines services may be disrupted.

FUTURE TRENDS IN DEVELOPMENT

All future development can be affected by tornadoes. The vulnerability of community assets is increasing through time as more people enter the planning area. The ability to mitigate impacts lies in consistent enforcement of codes and regulations for new construction.

Future population change across the county is expected to be 1.7% over the next five years. This is similar to the growth experienced over the last five years (1.9%). A majority of this growth is expected to occur as municipal infill. As these areas are at a larger risk to future tornadoes, future development is expected to increase the risk to this hazard.

WILDFIRE

Fremont County has ranked the risk from wildfire to be High. The previous HMP also ranked this hazard the same.

High Risk

GENERAL BACKGROUND

A wildfire is any uncontrolled fire occurring on undeveloped land that requires fire suppression. Wildfires can be ignited by lightning or by human activity such as smoking, campfires, equipment use, and arson.

Fire hazards present a considerable risk to vegetation and wildlife habitats. Short-term loss caused by a wildfire can include the destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long- term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of community infrastructure, as well as cultural and economic resources. Vulnerability to flooding increases due to the destruction of watersheds. The potential for significant damage to life and property exists in areas designated as wildland urban interface (WUI) areas, where development is adjacent to densely vegetated areas.

Wildfires are of significant concern throughout Colorado. According to the Colorado State Forest Service, vegetation fires occur on an annual basis; most are controlled and contained early with limited damage. For those ignitions that are not readily contained and become wildfires, damage can be extensive. According to the State of Colorado Natural Hazards Mitigation Plan, a century of aggressive fire

suppression combined with cycles of drought and changing land management practices has left many of Colorado's forests, including those in Fremont County, unnaturally dense and ready to burn. Further, the threat of wildfire and potential losses is constantly increasing as population and development grow and the wildland-urban interface expands. Another contributing factor to fuel loads in the forest are standing trees killed by pine bark beetles, which have been affecting the forests of Colorado since 2002, becoming more widespread and a serious concern.

Fire protection in Fremont County is divided between Fire Protection Districts, Volunteer Fire Departments, Sheriff's Wildland Fire Team, Bureau of Land Management, and the USDA Forest Service. Multiple community wildfire protection plans are in place and are further discussed in the Community Wildfire Protection Plans section.

PAST EVENTS

Table 38 shows Fremont County federally reported wildfires that burned 10 acres or more from 1980 through 2019.

TABLE 38: MAJOR WILDFIRE EVENTS

Start Date	Name	Cause	Acres
9/19/1980	Hamilton	Human	60
6/24/1981	Carrol Creek	Natural	10
8/29/1985	Gorge Hill	Natural	95
3/20/1988	Milsap Creek	Human	34
6/19/1990	Copper Gulch	Human	200
5/25/1991	Tanner Peak	Natural	20
7/20/1996	Table	Natural	18.5
5/29/1998	Fremont 2	Human	200
9/17/2000	Copper Mountain	Natural	64.9
10/1/2001	Big Baldy	Natural	25
5/19/2002	Locke Mountain	Natural	16
6/2/2002	Iron Mountain	Human	4,436
6/21/2003	Phantom Canyon	Natural	22
6/26/2007	Goat Park	Natural	10.3
5/12/2008	Ferguson	Human	190
7/29/2008	YMCA Mountain	Natural	16.5
10/16/2008	Table Mountain	Natural	15
11/16/2008	Phantom	Human	15
3/16/2009	Long Ranch	Human	12
7/10/2009	Newlin	Human	142
6/21/2010	Parkdale	Human	600
6/18/2011	High Park	Human	46.5
6/12/2011	Duckett	N/A	4,358
7/19/2011	Crampton	Natural	13

Start Date	Name	Cause	Acres
6/16/2013	Royal Gorge	Human	3,218
6/19/2013	Bull Gulch	Natural	76
6/24/2014	Eight Mile	Natural	528
7/8/2016	Hayden Pass	Natural	16,754
9/8/2019	Decker Fire	Natural	8,910

Figure 73 maps the major wildfires that have impacted areas around and within Fremont County. It is important to take this regional look to understand how similar forests have burned in this part of the state. Figure 74 shows all federally reported wildfires that have burned across the county.

FIGURE 73: MAJOR REGIONAL WILDFIRES

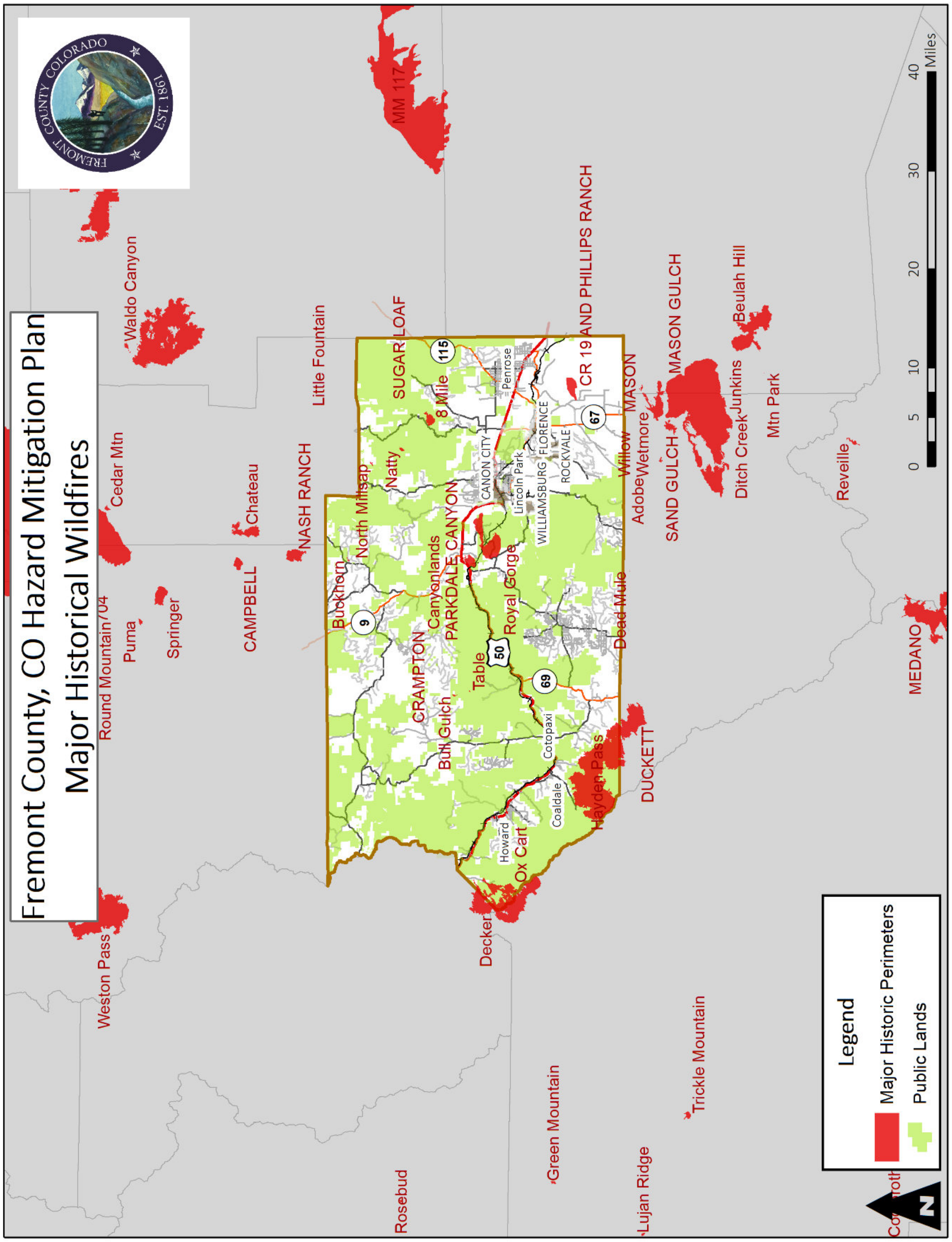
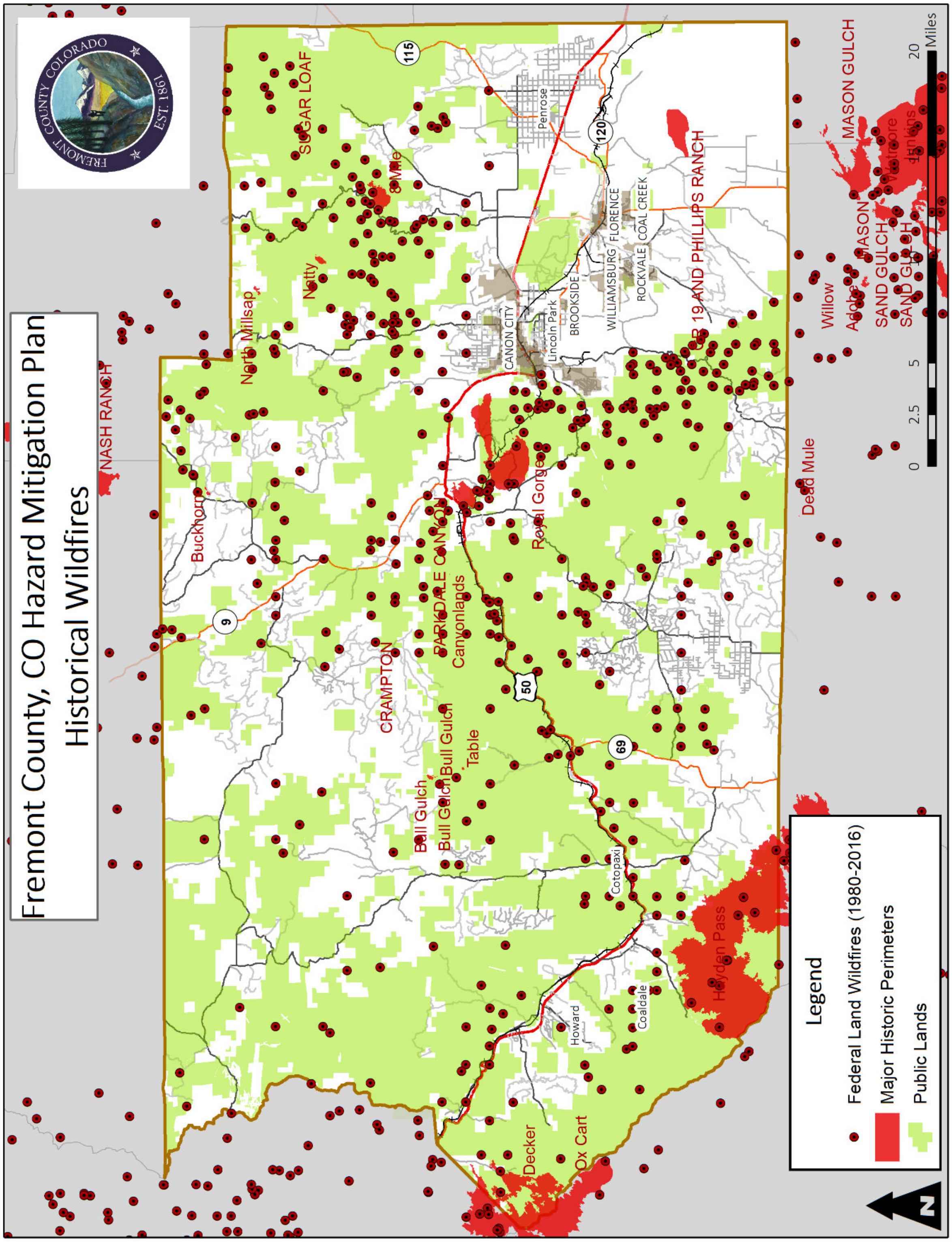


FIGURE 74: HISTORIC WILDFIRES



The following is a description of recent significant fires affecting the county:

- **Iron Mountain Fire (2002):** The Iron Mountain Fire began at 1:30 p.m. on June 2, 2002, on private land, in southern Fremont County and was contained on June 7, 2002. The fire quickly grew out of control due to southwest winds and spread through the Colorado Acres and Deer Mountain subdivisions, which are located about 12 miles west of Cañon City. There were over 270 incident personnel, 6 engines, 5 dozers, 8 hand crews, and various air resources that responded to the fire. The fire was contained 4 days after it started, but not before it burned 4,436 acres of land, and destroyed 200 structures, including 100 homes. There were no reported injuries or fatalities, as a result of the fire, but numerous animals and livestock were lost. The final damage estimate was $20 million with only about 37 percent covered by insurance (Fremont County Office of Emergency Management, 2003).
- **Royal Gorge Fire (2013):** The Royal Gorge Fire started on June 11, 2013 and was 100 percent contained on June 16, 2013. At the peak of the fire, approximately 600 people were evacuated from their homes and almost 900 prisoners were transferred out of the fire threat area. A total of 3,218 acres were burned by the fire. Of this, 16 percent is owned by the Bureau of Land Management, 17 percent is owned privately, and 67 percent is owned by the City of Cañon City. The fire destroyed the Royal Gorge Bridge and Park, resulting in major impacts to the local economy (see Figure 17-2). According to the Governor's Request for Presidential Major Disaster Declaration, all structures at the park, including the historic bridge, were damaged: 48 of the 52 park structures were completely destroyed. The fire directly resulted in the loss of employment for 150 seasonal employees of the park as well as loss of revenue for the City of Cañon City (Office of the Governor of the State of Colorado, 2013).
- **Hayden Pass Fire (2016):** A lightning strike caused the Hayden Pass wildfire on July 8, 2016, and the wildfire continued to smolder until August 10, 2013. The wildfire was mainly on USFS wilderness land, high up in the northern Sangre de Cristo Mountains. The wildfire consumed over 16,000 acres, and for a time it threatened properties to the east and north, including Coaldale. Approximately 400 properties were under mandatory evacuation for several days. The wildfire only destroyed one unoccupied structure. The estimated cost to fight the wildfire was $10.4 million.

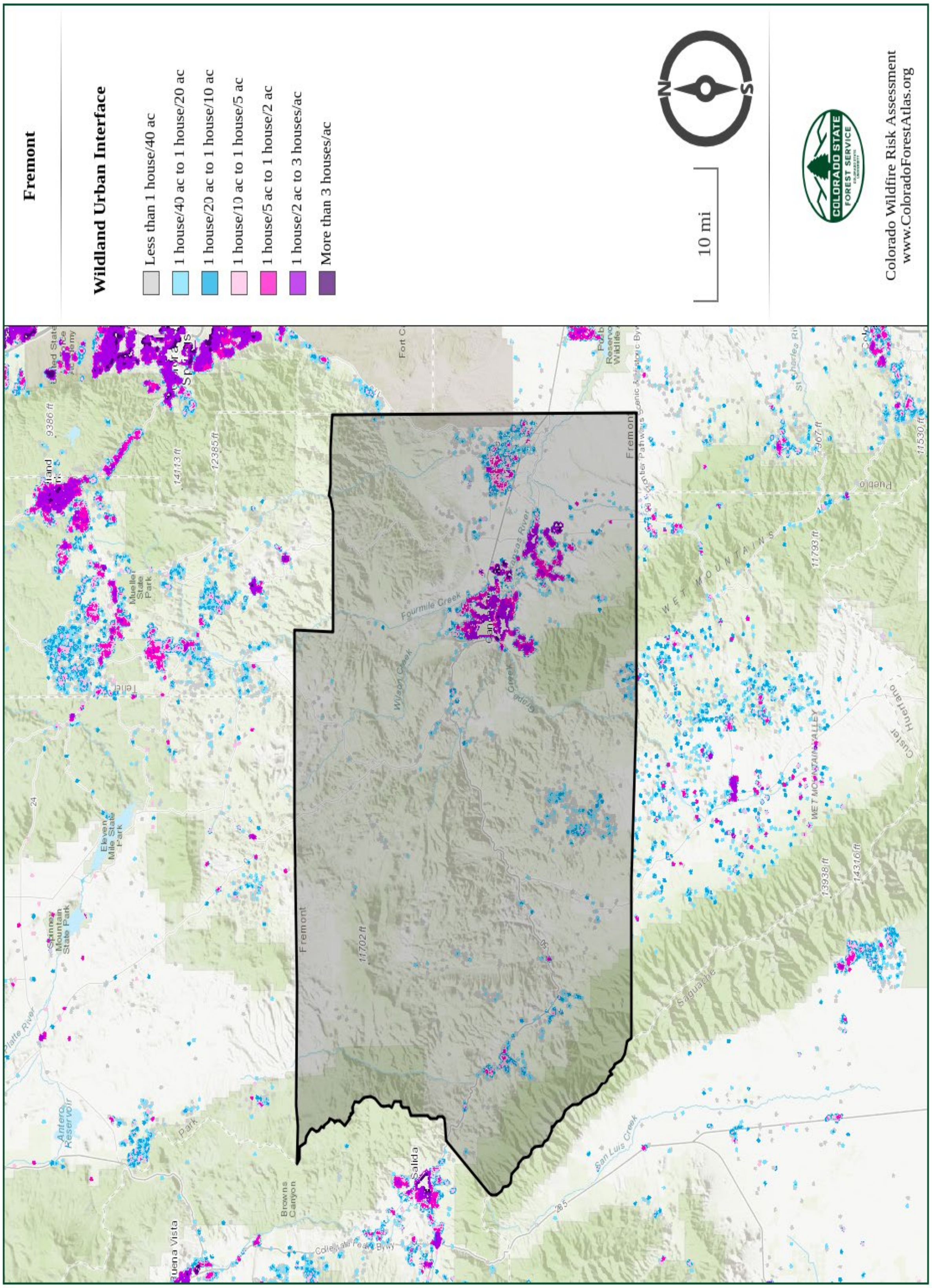
FIGURE 75: VIEW OF THE ROYAL GORGE BRIDGE AREA AFTER THE 2013 ROYAL GORGE FIRE

LOCATION

As part of this Plan's risk assessment, the Colorado State Forest Service (CSFS) produced Fremont County's Wildfire Risk Assessment (WRA) Summary Report. This report provides many additional details pertaining to wildfire risk across the county. It has been included in Appendix B: Wildfire Risk Assessment Summary Report. Some pieces of this report are also included on the following pages. Readers can visit the Colorado Forest Atlas to learn more and access a web viewer of these various risk maps.

Wildfires can occur anywhere across the county, but the highest vulnerability resides in the WUI. Figure 76 provides an overview of Fremont County's WUI. These areas have been identified across the county, with the densest WUI areas surrounding the incorporated municipalities.

FIGURE 76: WILDLAND URBAN INTERFACE



FREQUENCY

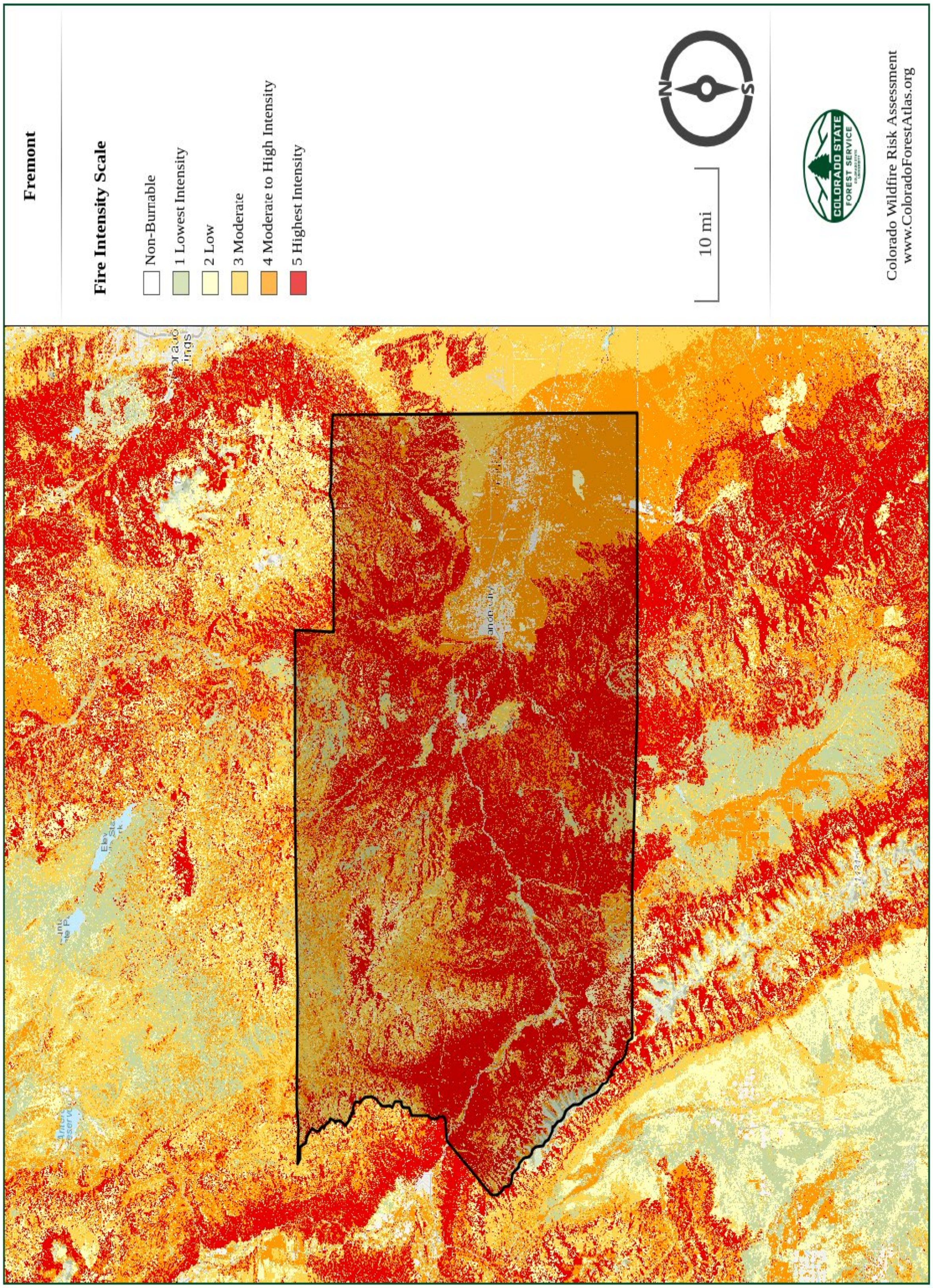
According to the WRA for Fremont County, there is a 100-percent chance that at least one wildfire will occur each year across the county. Many of these fires will be 5 acres and less.

SEVERITY

Based on the widespread impacts, the magnitude/severity of severe wildfires is considered critical. Disaster events can result in: isolated deaths and multiple injuries, major or long-term property damage that threatens structural stability, interruption and destruction of Lifelines, and economic impacts due to loss of tourism.

The WRA's fire intensity scale is a fire behavior output, which is influenced by three environmental factors - fuels, weather, and topography. Weather is by far the most dynamic variable as it changes frequently. Figure 77 presents this information showing Fremont County has a large percentage of the highest fire intensities modeled across the state.

FIGURE 77: FIRE INTENSITY SCALE



WARNING TIME

Wildfires are often caused by humans, either intentionally or accidentally. There is no way to predict when one might break out. Because fireworks often cause brush fires, extra diligence is warranted around the Fourth of July when the use of fireworks is highest. Dry seasons and droughts are factors that greatly increase fire likelihood. Dry lightning may trigger wildfires. Severe weather can be predicted, so special attention can be paid during weather events that may include lightning. Reliable National Weather Service lightning warnings are available on average 24 to 48 hours before a significant electrical storm.

If a fire does break out and spreads rapidly, residents may need to evacuate within hours or minutes. A fire's peak burning period generally is between 1 p.m. and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. Improvements to communication technologies has further contributed to a significant improvement in warning time.

SECONDARY HAZARDS

Wildfires can generate a range of secondary effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses in the reduction of harvestable timber and indirect economic losses in reduced tourism. Wildfires cause the contamination of reservoirs, destroy transmission lines, and contribute to flooding. They have the potential to drive increased animal movement which could increase changes for wildlife-vehicle collisions.

Most damaging, they strip slopes of vegetation, exposing them to greater amounts of runoff. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire. Most wildfires burn hot and for long durations that can bake soils, especially those high in clay content. This increases the imperviousness of the ground which increases the runoff generated by storm events, thus increasing the chance of flooding and debris flow events.

CLIMATE CHANGE IMPACTS

Fire in western ecosystems is affected by climate variability, local topography, and human intervention. Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot, dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods.

Historically, drought patterns in the West are related to large-scale climate patterns in the Pacific and Atlantic oceans. The El Niño–Southern Oscillation in the Pacific varies on a 5- to 7-year cycle, the Pacific Decadal Oscillation varies on a 20- to 30-year cycle, and the Atlantic Multidecadal Oscillation varies on a 65- to 80-year cycle. As these large-scale ocean climate patterns vary in relation to each other, drought conditions in the U.S. shift from region to region.

Climate scenarios project summer temperature increases between 3.6°F and 9°F and precipitation decreases of up to 15 percent. Such conditions would exacerbate summer drought, further promoting high-elevation wildfires which release stores of carbon and further contribute to the buildup of greenhouse gases. Forest response to increased atmospheric carbon dioxide – the so-called "fertilization effect" – could also contribute to more tree growth and thus more fuel for fires, but the effects of carbon dioxide on mature forests are still largely unknown. High carbon dioxide levels should enhance tree recovery after fire and young forest regrowth, as long as sufficient nutrients and soil moisture are available, although the latter is in question for many parts of the western United States because of climate change.

EXPOSURE AND VULNERABILITY

"Wildfire Risk" represents the possibility of loss or harm occurring from a wildfire. It identifies areas with the greatest potential impacts from a wildfire, considering both WUI Risk, Drinking Water Risk, Forest Assets Risk, and Riparian Areas Risk. Figure 78 and Figure 79 present this information for Fremont County. Areas of High and Highest Risk cover a good portion of the county and parts of all municipalities. Highest Risk areas do cover portions of Brookside, Coal Creek, Florence, and Williamsburg.

FIGURE 78: WILDFIRE RISK

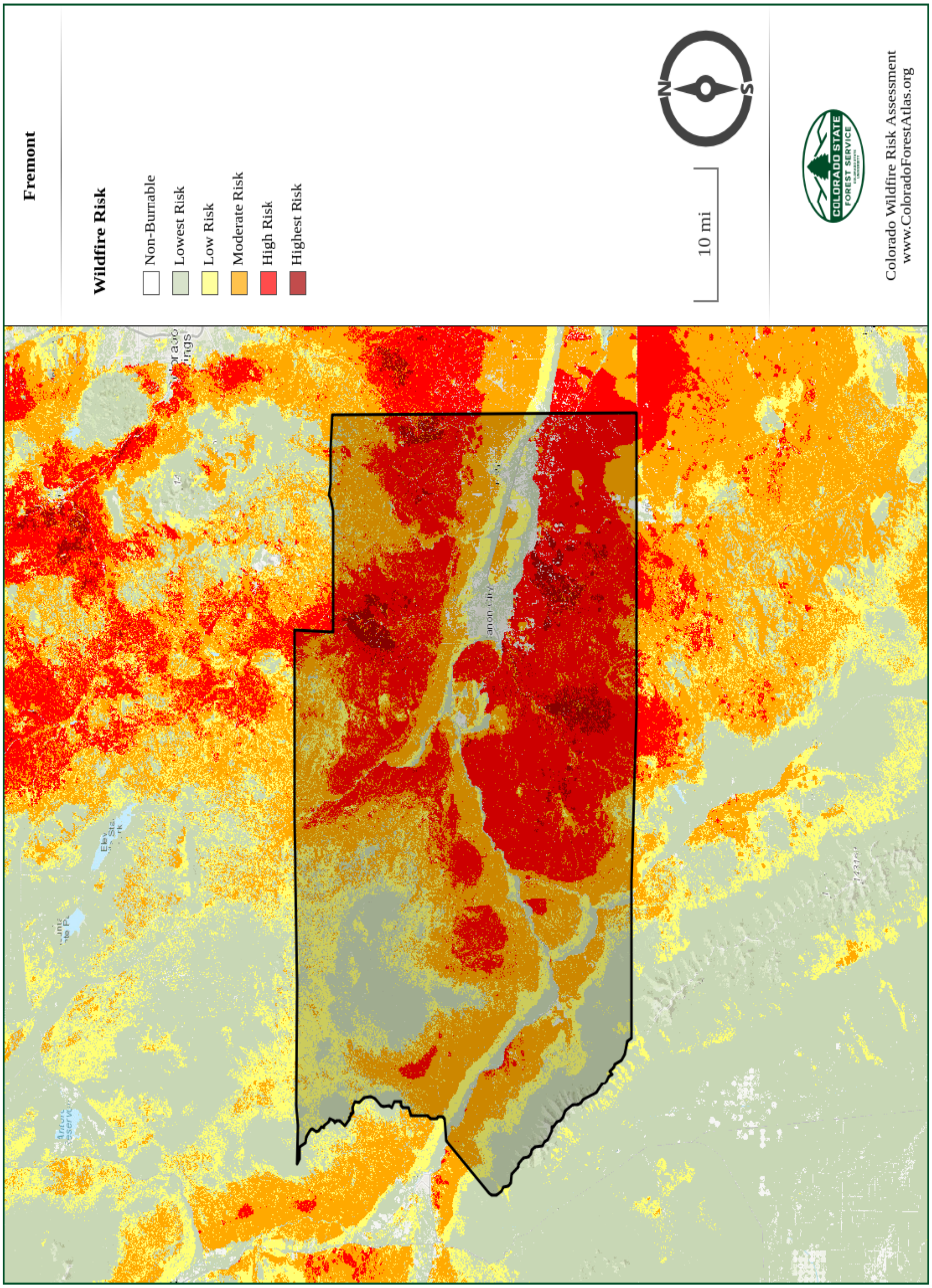
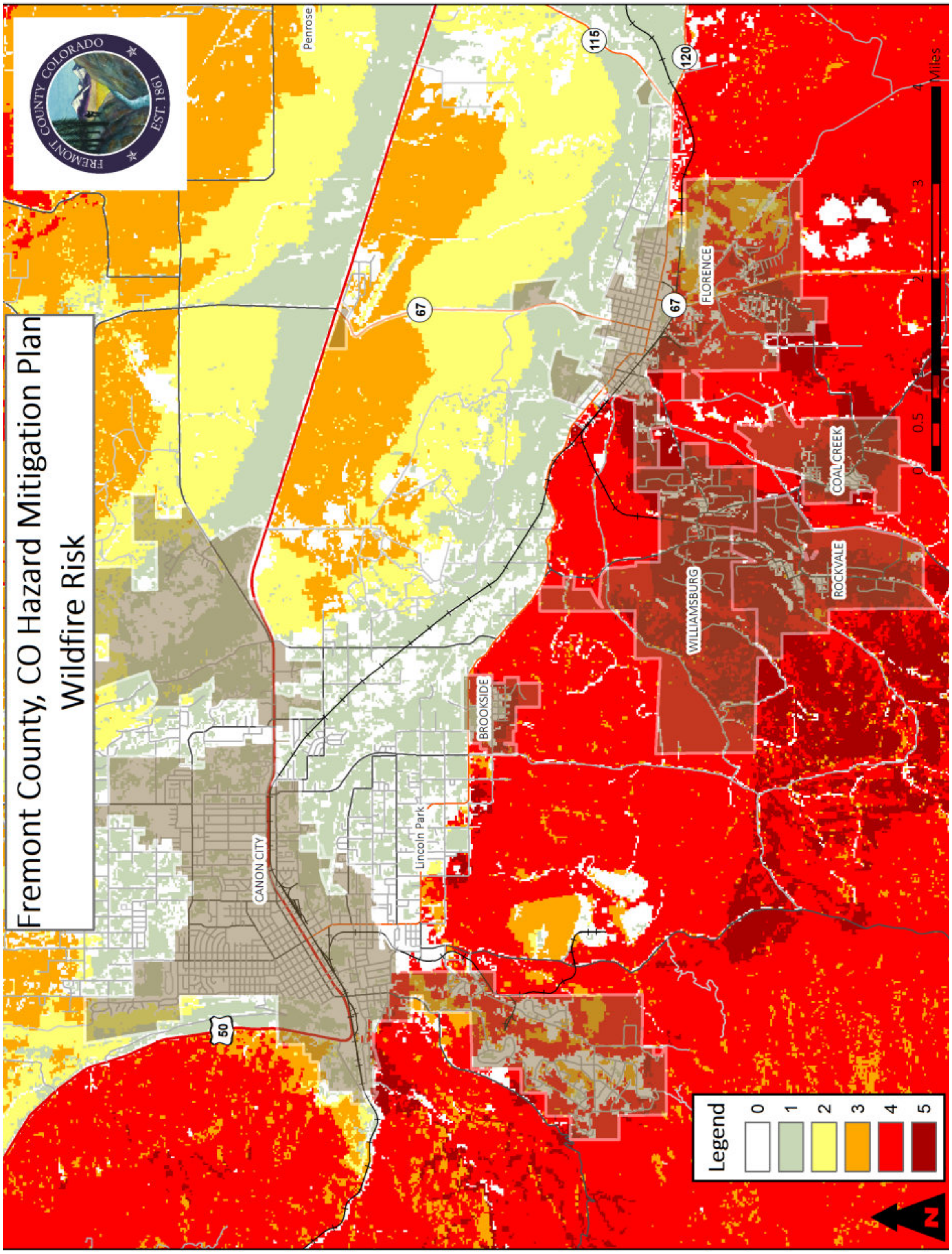


FIGURE 79: WILDFIRE RISK – MUNICIPAL SCALE



The commission that drafted the Fremont County Community Wildfire Protection Plan (CWPP) identified four highest priority fire hazards areas, listed below. Additionally, the more recent localized CWPPs that have been developed since the county's plan identify additional areas of concern.

- **Spruce Basin/Indian Springs** – Spruce Basin and Indian Springs are two subdivisions that are each connected to a County road by a single ingress and egress road. Each access is steep and narrow with large amounts of wildland fuels. Many individual home accesses have driveways that are unsuited for response vehicles. Heavy timber is predominant, with steep, sloping ridges. Many homes are summer residences.
- **Deer Mountain** – Heavy wildland fire fuels, steep hills, narrow roads, and a growing housing area combine to make the Glen Vista Subdivision of Deer Mountain a high risk area. Many roads offer only one ingress and egress. The road system is poorly maintained in places and extremely confusing, with many roads starting and stopping only to start up again somewhere else.
- **Coaldale/Howard Southern Boundaries** – The terrain is similar from Coaldale through Howard and up to the Chaffee County boundary on the southern border with the USFS public lands. Many single ingress and egress roads exist. These normally start at U.S. Highway 50 and proceed into, and end, at the National Forest at a much higher elevation. Fairly narrow roads with substantial wildland fire fuels on either side present a high risk factor. New and existing homes are present, throughout areas of Pinon/Juniper, up to heavily timbered areas along and inside the public lands. Steeply sloping ridges are the norm. Water sources are rare. Some intermittent and annual streams are present in normal years.
- **Christopher Ranch Subdivision** – The Christopher Ranch Subdivision is located in a steeply sloping area that is heavily wooded with a Pinon/Juniper mix. New housing areas are developing rapidly. Access roads are generally good but are bordered by heavy wildland fire fuels. This area is the near the main route north to the gambling and tourist area of Cripple Creek. Water sources are not readily available.

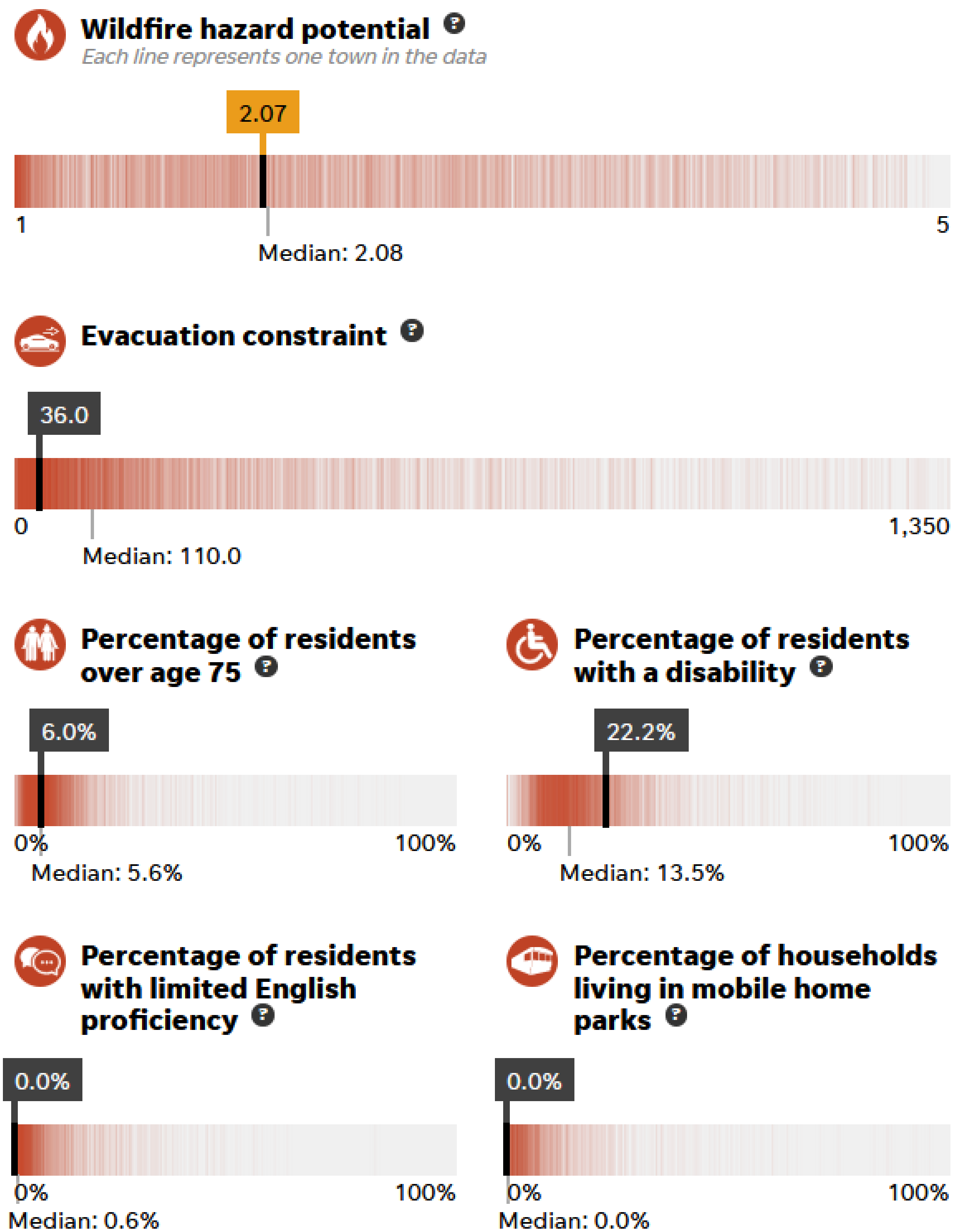
A report titled: *'Ahead of the Fire: Where will the West's next deadly wildfire strike? The risks are everywhere.*[11]*"* was published in The Arizona Republic in the summer of 2019. The study, spurned by the devastating Paradise Fire in California, looked across 5,000 small communities across 11 states to determine wildfire risk. Inputs into this analysis included a wildfire hazard potential dataset, in addition to the following inputs: evacuation routes, resident age, disabilities, and language spoken, emergency

[11] https://www.azcentral.com/in-depth/news/local/arizona-wildfires/2019/07/22/wildfire-risks-more-than-500-spots-have-greater-hazard-than-paradise/1434502001/

alerts, and mobile home inventories. These reports are included in the Appendix A: MUNICIPAL ANNEXES.

A sample community report for the Town of Coal Creek is provided in Figure 80.

FIGURE 80: SAMPLE 'AHEAD OF THE FIRE' SUMMARY REPORT



— By Pamela Ren Larson, Dennis Wagner, Ryan Marx and Mitchell Thorson / USA TODAY NETWORK

Lifelines

In the event of wildfire, there would likely be little damage to the majority of Lifeline infrastructure. Most roads and railroads would be without damage except in the worst scenarios. Power lines are the most at risk to wildfire because most power poles are made of wood and susceptible to burning. In the event of a wildfire, pipelines could provide a source of fuel and lead to a catastrophic explosion. Structural Lifelines of wood frame construction are especially vulnerable during wildfire events.

Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Wildfire typically does not have a major direct impact on bridges, but it can create conditions in which bridges are obstructed. Many bridges in areas of high to moderate fire risk are important because they provide the only ingress and egress to large areas and in some cases to isolated neighborhoods.

As part of this vulnerability assessment, the county's Lifelines were assessed with the wildfire risk areas shown in Figure 78 and Figure 63. Individual assessments of those exposed Lifelines can help to identify potential mitigation actions to consider implementing.

TABLE 39: LIFELINE EXPOSURE

Lifeline	Total Count	Count Exposed High Risk	% High Risk	County Exposed Highest Risk	% Highest Risk
Medical Facilities	3	0	0%	0	0%
Schools	33	9	27%	0	0%
Sewage Facilities	1	0	0%	0	0%
Other Lifelines	174	9	5%	1	1%
Tier II Facilities	45	16	36%	5	11%
Transportation (miles)	563.0	78.3	14%	10.2	2%

Population

Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly, and those with respiratory and cardiovascular diseases. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility.

Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

Property

Property damage from wildfires can be severe and can significantly alter entire communities. All property is vulnerable during wildfire events, but those properties located in the WUI are at the highest risk.

Environment

Fire is a natural and critical ecosystem process in most terrestrial ecosystems, dictating in part the types, structure, and spatial extent of native vegetation. However, wildfires can cause severe environmental impacts:

- Damaged Fisheries – Critical fisheries can suffer from increased water temperatures, sedimentation, and changes in water quality.
- Soil Erosion – The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion can occur, causing landslides and threatening aquatic habitats.
- Spread of Invasive Plant Species – Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control.
- Disease and Insect Infestations – Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.
- Destroyed Endangered Species Habitat – Catastrophic fires can have devastating consequences for endangered species.
- Soil Sterilization – Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost. It can take decades or even centuries for ecosystems to recover from a fire. Some fires burn so hot they can sterilize the soil.

Many ecosystems are adapted to historical patterns of fire occurrence. These patterns, called "fire regimes," include temporal attributes (e.g., frequency and seasonality), spatial attributes (e.g., size and spatial complexity), and magnitude attributes (e.g., intensity and severity), each of which have ranges of natural variability. Ecosystem stability is threatened when any of the attributes for a given fire regime diverge from its range of natural variability.

Economy

Wildfire can impact the economy due to potential damage to property, crops and livestock. There may be direct costs due to losses and indirect costs for the loss of work that comes from harvest and livestock transport. Overhead that may result during repair or reconstruction of properties may also be an indirect cost.

Damage to natural areas and tourist attractions can drastically affect the local economy, as a main driver of income may no longer be a preferred destination for visitors.

If roads are closed or areas are evacuated due to a fire, transport may be limited and businesses may have to close. While this can typically be a short-term impact, prolonged wildfires can have a large impact on the operations of a community and its economy.

FUTURE TRENDS IN DEVELOPMENT

Future population change across the county is expected to be 1.7% over the next five years. This is similar to the growth experienced over the last five years (1.9%). A majority of this growth is expected to occur as municipal infill. As some of these areas are at a higher risk to wildfire and located in the WUI, future development has the potential to greatly increase the risk to this hazard.

While the risk of wildfire on public land is generally understood, much of the adjacent private land is equally at risk. Private lands adjoining public lands are becoming increasingly valued for their scenic beauty, solitude, and access to recreation opportunities. As development in these areas continue to increase, the risk to lives, property, and resources correspondingly increases.

The expansion of the WUI can be managed with strong land use and building codes. In May 1972, a revision to the Colorado Revised Statutes exempted properties divided into parcels of 35 acres or more from the statutory definition of a subdivision. Tracts of 35-acre lots developed since that time have not been subject to state or local subdivision regulations.

The Fremont County Community Wildfire Protection Plan identified several actions that would directly influence future development in the planning area:

- Action Recommendation No. 2 – Provide improved access for responders through road and trail improvements. All new home construction/subdivisions should be required through zoning/planning regulations to provide adequate ingress and egress routes to each area in case of emergency. Road steepness and width should be adequate to provide safe access for emergency vehicles with turn-around capability provided.

- Action Recommendation No. 6 – Use the Land Use Code as a vehicle for maintaining the momentum of wildfire management strategies on private and public land.

WILDLIFE-VEHICLE COLLISIONS

Fremont County has ranked the risk from wildfire to be Moderate.

Moderate Risk

GENERAL BACKGROUND

Wildlife-vehicle collisions (WVCs) are a hazard with increased risk as development encroaches on wildlife habitats. Growth in traffic along roadways has created more opportunities for incidents to occur, especially in areas where wildlife congregate, breed and migrate through. Large animals including elk, deer, moose, bears, bighorn sheep and cows are associated with the most property damage and potential danger. However, smaller animals including raccoons, skunks, beavers, coyotes, bobcats and foxes are a major factor in the overall number of incidents and can also lead to dangerous outcomes.

While WVCs can happen in urban and suburban settings, rural areas with long stretches of roadway may see incidents with more impact due to increased speeds of travel. Collisions can happen any time of day but are typically more common in dawn or dusk hours, as well as dark-unlighted conditions.

PAST EVENTS

Wildlife-vehicle collisions happen year-round. Over the past ten years, CDOT has seen an average of 3,300 reported wildlife hits each year.[12] This number does not include hits that were not reported to law enforcement, and it has varied from about 2,000 to 4,000 each year. There is always an increase during migration season and particularly during the hours between dusk and dawn. These collisions are not only a matter of safety but can be quite costly as well.

Between 2005 and 2016, of the WVCs that occurred in Fremont county, 690 of them resulted in property damage only, while 66 resulted in injury. There were no fatalities during this period.

Table 40 shows the characteristics of incidents from 2014 to 2019, in Fremont County, including the number of injuries and length of the roadway monitored. About half of the collisions occurred in dark-unlighted conditions and the majority of WVCs occurred on US 50A. During this period, there was only one fatality, which occurred on US 50A.

[12] https://www.codot.gov/programs/environmental/wildlife/wildlifeonthemove

TABLE 40. COLLISIONS WITH WILDLIFE (2014-2019)

Roadway	Length (in miles)	Injuries	Daylight	Dawn or Dusk	Dark - Lighted	Dark-Unlighted	Total Collisions
SH 9A	18.2	8	9	6	0	19	34
US 50A	70.75	28	79	38	24	144	285
SH 67A	2.5	1	1	1	0	3	5
SH 69A	11.16	2	8	0	0	3	11
SH 115A	27.0	5	30	11	6	46	93
Total	129.61	44	127	56	30	215	428

* SH – State Highway, US – US Highway

LOCATION

Wildlife-vehicle collisions can happen anywhere in Colorado, including urban areas which may have substantial small animal populations, such as raccoons and skunks. In addition to small animal incidents, larger animal collisions may occur in suburban areas as the wildland urban interface expands. However, most large animal incidents are likely to happen on roadways through more remote wildlife areas, especially areas of migration and breeding.

As seen previously in Table 40 incidents have occurred along all major roadways in Fremont County.

FREQUENCY

As development of areas in the county increases, it is likely that the frequency of WVCs will as well. Collisions are dependent on a variety of factors but are mostly driven by animal behaviors. During periods of migration, as larger numbers of animals move over great distances, collisions are more common. Migration patterns are aligned with seasonal changes, with the greatest movement in the fall and spring, which coincides with the shortening of daylight hours. Traffic on the roads during the dawn and dusk hours are at a greater risk of collisions during these migration periods. The increase in traffic from community growth is another factor that amplifies this risk.

Across Colorado, in 2016, 4.600 deer were killed on highways, according to Colorado Parks and Wildlife data. This number was over a 50% increase from the 3,000 deer killed in 2013. While numbers can fluctuate from year to year, the recent 2020 data shows 4,400 deer killed on highways.[13]

A 2020 State Farm study found there was an estimate 1.5 million deer claims nationwide. Across the state, Colorado drivers had a one in 209 chance of an animal collision between 2019 and 2020. This is

[13] https://www.codot.gov/programs/environmental/wildlife/data/annual-roadkill-reports/roadkill-data-2020.pdf

compared to the one in 116 chance for all U.S. drivers. While deer make up the majority of collisions, this data included all animals.[14]

SEVERITY

Collisions can lead to serious injury, death, and extensive vehicle damage. However, typically the only direct impact is to a small geographic area and only few people at once. In most cases, only one vehicle is impacted, but the resulting obstruction on the roadway can impact a larger area, such as backing up traffic. People may be indirectly affected by road closures or congestion and there may be a risk of other accidents in the area.

WARNING TIME

By the nature of a wildlife-vehicle collision, there is very little to no warning time. As vehicles travel on roadways at any speed, the unpredictability of wildlife takes response time down to milliseconds.

SECONDARY HAZARDS

A secondary hazard of a WVC may be due to fluid leakage post collision. While the leakage is not likely to be in quantities that pose a large risk to people, wildlife, waterways or large areas, any fluids from the vehicle(s) should be handled per standard operating procedure.

CLIMATE CHANGE IMPACTS

Climate change may impact wildlife-vehicle collisions, as temperatures and seasons fluctuate in unexpected ways. Migration patterns and the availability of food and water may be altered by the effects of climate change, leading to animals traveling more often and over greater distances.

EXPOSURE AND VULNERABILITY

All vehicles on the road have the potential to be in a wildlife-vehicle collision. This risk is increased by various factors including what wildlife may be present in the area and the chances of these animals crossing roadways. WVCs can be dangerous to people and damaging to property regardless of speed of the vehicle and the type of animal involved. While large animals, such as elk and deer, may typically cause more damage, the possibility of drivers losing control of the vehicle during any collision creates a risk to life safety and property.

[14] https://newsroom.statefarm.com/animal-collision/

Lifelines

This hazard may impact the Transportation Lifeline. WVCs can block roadways, sometimes for extended periods, and vehicles involved in a collision have the potential to cause damage to roads and bridges.

Population

Fremont County residents are all vulnerable to wildlife-vehicle collisions, as they can happen on any roadway at any time. People who often drive during dawn and dusk hours, such as commuters, likely have more exposure to this hazard.

Property

It is possible that a collision could result in a vehicle damaging roads, bridges or infrastructure, such as electric poles. However, a majority of the time, most property damage only involves personal vehicles and can range greatly in the impact on the vehicle's value. Transportation companies, who operate using large trucks, have the potential to be impacted, either directly from a collision or indirectly due to possible traffic issues resulting from the collision.

Environment

After a collision, environmental damage may occur when vehicles leave the roadways. Damaged vehicles may leak engine fluids onto the ground, though likely not in large enough quantities to cause extensive or long-term environmental damage.

Economy

The local economy may not see any noticeable impact from WVCs, but residents may be burdened by the loss of transportation, temporary or otherwise, the costs of repair or replacement and any medical costs resulting from the collision.

According to the Highway Loss Data Institute, between 2006 and 2018 the claims costs for animal strikes steadily increased, likely due to the increase in vehicle prices. In 2018, the average claim was for $3,875, compared to $2,424 in 2006.[15] This is significant to most families in the U.S. and the scope of this hazard is evident when looking at national data.

[15] https://www.iihs.org/media/ef6738c2-07dd-422a-b0da-47599762ed27/NAdp_Q/HLDI%20Research/Bulletins/hldi_bulletin_36.04.pdf

Based on available national data, the Federal Highway Administration estimates the total annual cost associated with wildlife-vehicle collisions, specifically for deer, is $8.3 billion.[16] This includes vehicle and medical costs, as well as the overhead for towing and law enforcement. This number also figures in the monetary value of the animal, as public agencies may incur financial losses due to the death of the animal.

FUTURE TRENDS IN DEVELOPMENT

In a 2018 report from the state on development and WVCs, Fremont county has a projected housing change of 28% from 2010 to 2030. This is considered a high growth rating and is a factor in the likelihood of increased collisions. A consequence of this development will be increased vehicular traffic, presenting more opportunities for exposure of animal populations. As development expands into areas that animal populations are used to living in, the potential to cut off migration corridors, as well as access to food and water, is an issue. Animals may be unaware of the increased human risk and may not avoid roadways or developed areas.

[16] https://www.fhwa.dot.gov/publications/research/safety/08034/exec.cfm

Appendix A: MUNICIPAL ANNEXES

The following municipal annexes provide additional, specific information that is unique to each adopting jurisdiction included in this HMP.

Communities are encouraged to leverage available web map viewers to access the most recent hazard data as they reference this Plan. This will ensure municipalities are consulting the best available data which they can view at multiple scales, allowing hazard risk to be reviewed across the entire community, within specific neighborhoods, or for site specific assessments. Additional details and links are provided in the HAZARD DATA VIEWERS section of this Plan.

BROOKSIDE

Risk Ranking

Brookside's overall qualitative risk rankings for the hazards profiled in this plan are presented in Table 41. The top hazards of concern include: drought / extreme temperatures, severe winter weather, and thunderstorm (including hail, high wind, and lightning).

TABLE 41. BROOKSIDE HAZARD RISK RATINGS

	Dam Failure	Debris Flow	Drought / Extreme Heat	Earthquake	Flood	Landslide / Rockfall	Pandemic	Severe Winter Weather	Subsidence / Erosion	Thunderstorm (hail, high wind, lighting)	Tornado	Wildfire	Wildlife-Vehicle Collisions
Brookside	L	L	H	M	L	L	L	H	L	H	M	M	L

Vulnerability Assessment

In addition to the content provided in the main Risk Assessment chapter of this plan, following are a few figures specific to Brookside. Figure 84 displays the current FEMA 100-year floodplains present in and around the town. The Hazus flood loss estimates are then shown in Figure 85. Finally, Figure 86 presents the wildfire risk summary report from the *'Ahead of the Fire'* report detailed in the Wildfire section of this HMP.

FIGURE 81: FEMA FLOODPLAINS - BROOKSIDE

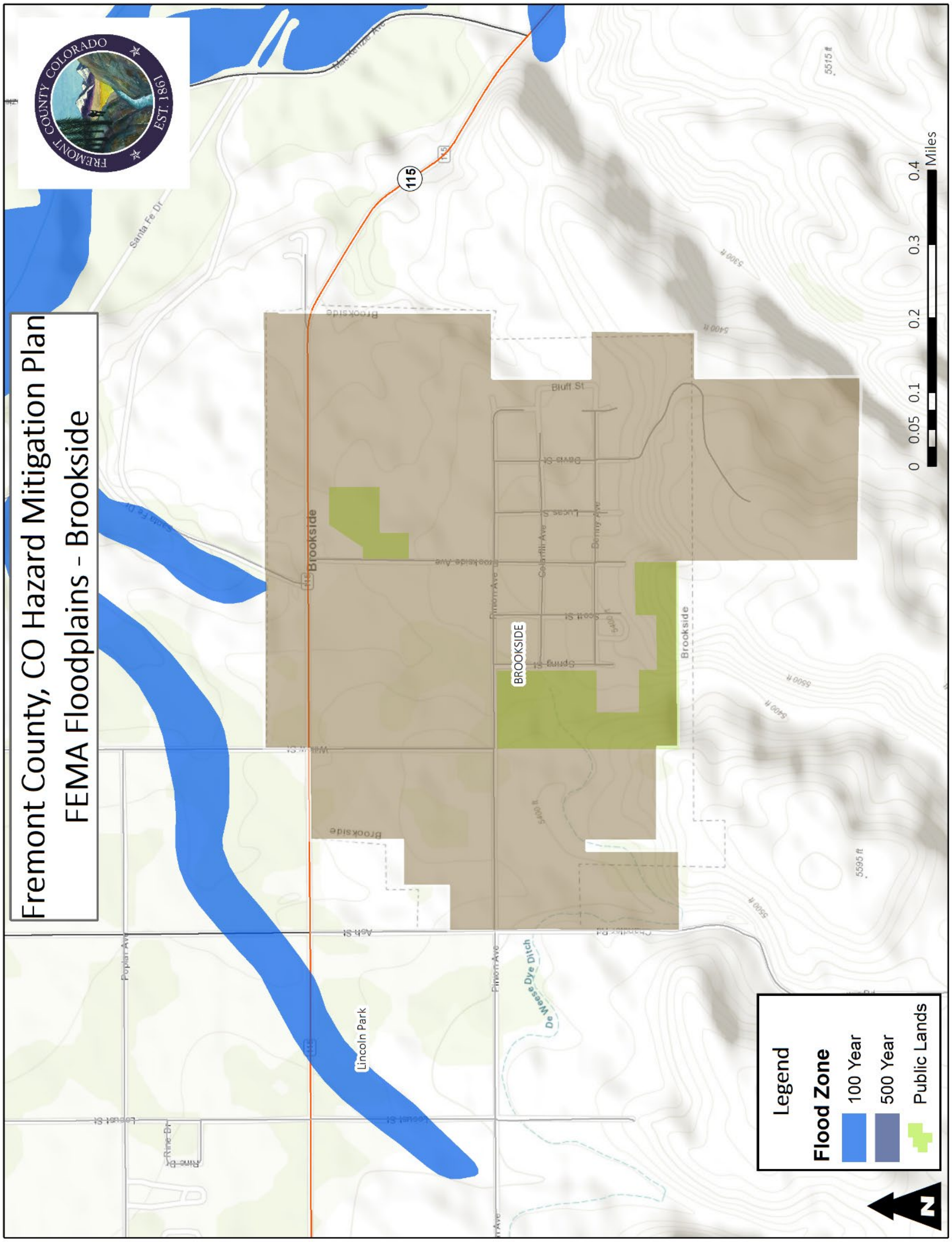


FIGURE 82: HAZUS FLOOD ESTIMATED LOSSES - BROOKSIDE

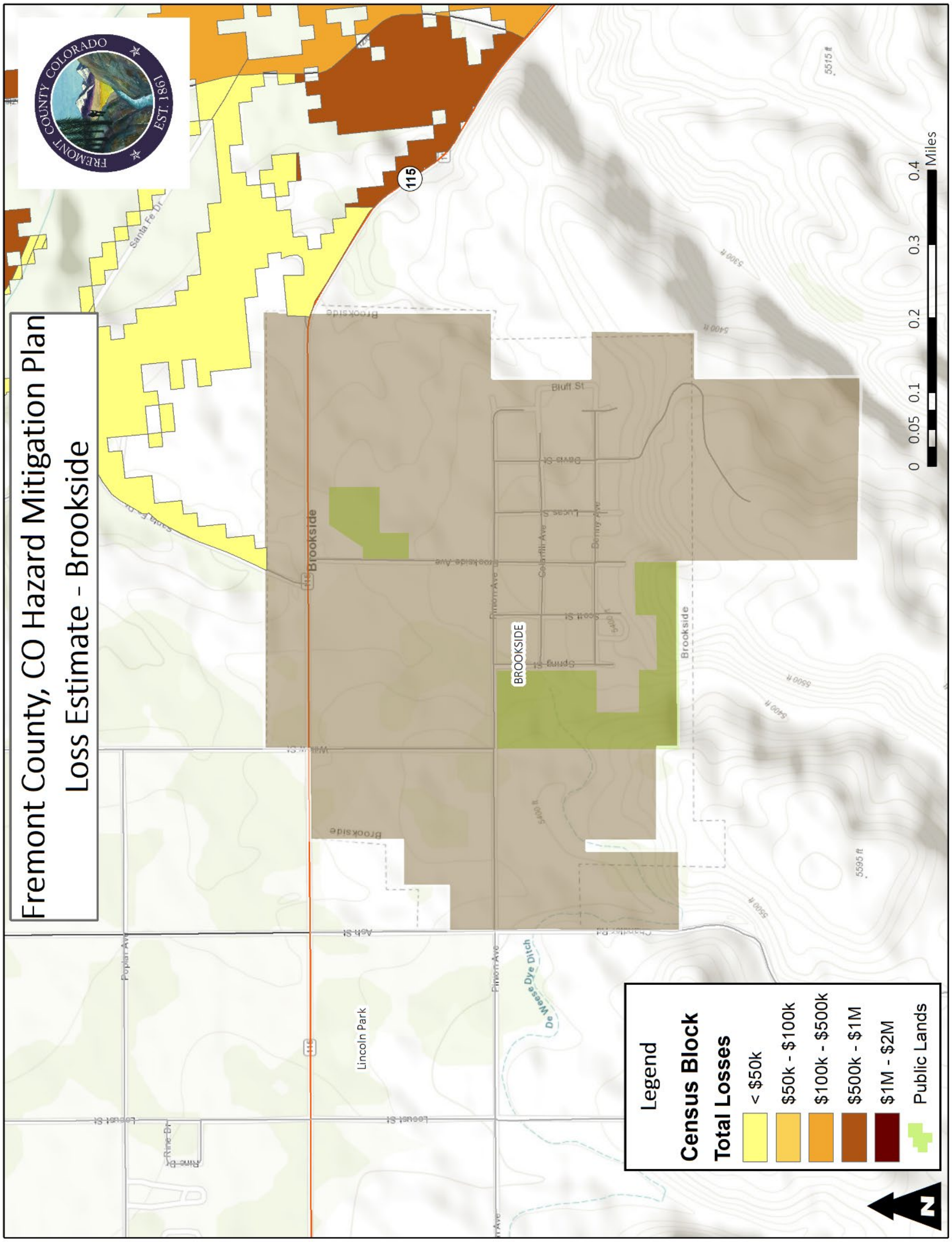
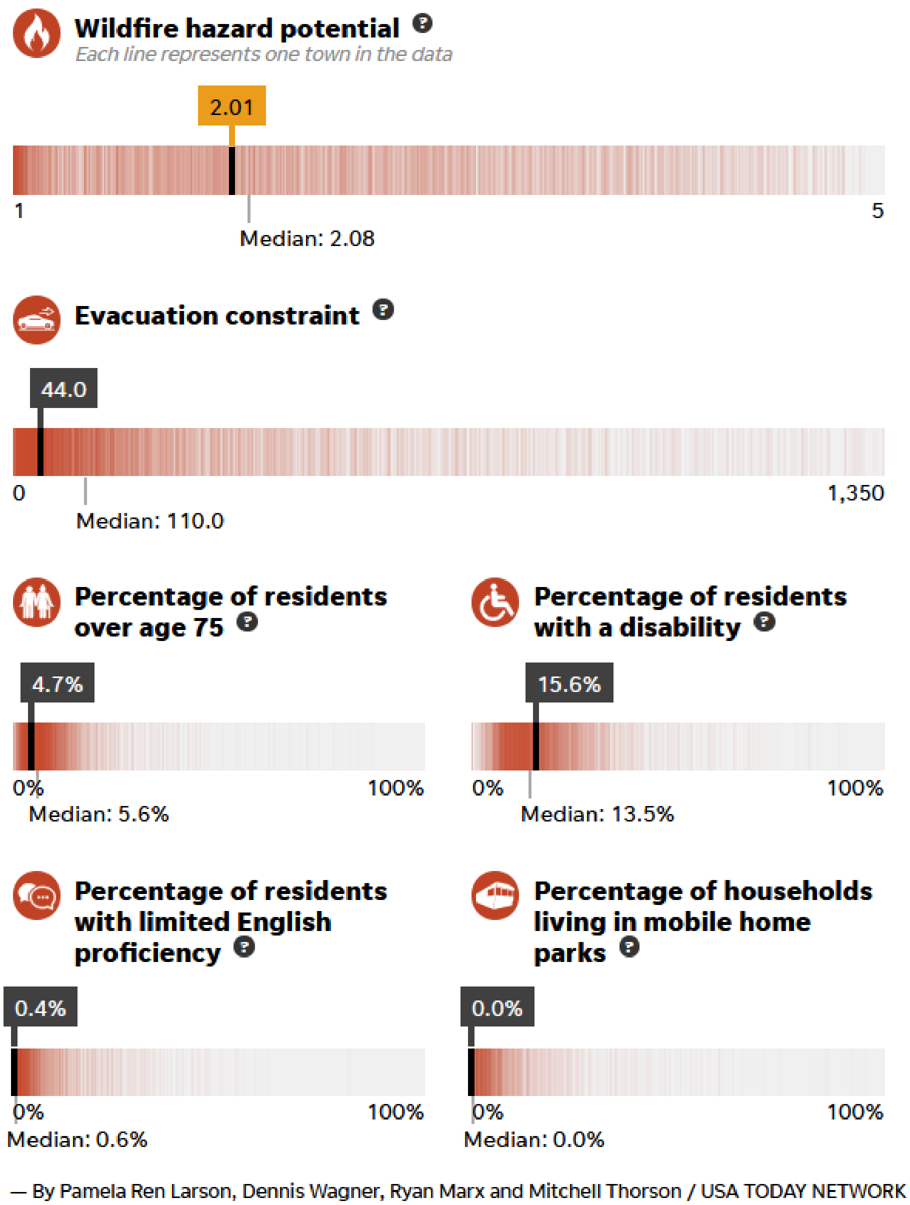


FIGURE 83: WILDFIRE RISK SUMMARY - BROOKSIDE



Mitigation Capabilities

Planning and regulatory capabilities are powerful tools for implementing hazard mitigation. The town currently utilizes a portion of the capabilities shown in Table 42. It is important for the town to regularly review each of these tools, to identify opportunities for further risk reduction efforts.

Table 42. Planning & Regulatory Capabilities

Mitigation Capability	Utilized?	Comments
Comprehensive, Master, or General Plan	Yes	
Capital Improvement Program or Plan (CIP)	Yes	GMS Engineering created Road Improvements Plan
Floodplain Management Plan	No	FEMA has no established flood plains in the Town
Stormwater Program / Plan	No	
Community Wildfire Protection Plan (CWPP)	No	Town is member of Cañon City Fire Protection District
Erosion / Sediment Control Program	No	
Economic Development Plan	No	
Other: Required Permits	Yes	Vulnerability Assessment & Emergency Response Plan
Building Codes (Year)	Y (2006)	
BCEGS Rating	n/a	
Site Plan Review Requirements	Yes	
Other:	No	
Zoning Ordinance (Land Use)	Yes	
Subdivision Ordinance	Yes	
National Flood Insurance Program (NFIP) Participant	No	FEMA has no established flood plains in the Town
Flood Insurance Study / Flood Insurance Rate Map / DFIRM	No	FEMA has no established flood plains in the Town
Floodplain Ordinance	No	
Elevation Certificates for Floodplain Development	No	FEMA has no established flood plains in the Town
Community Rating System (CRS) Participant	No	

Mitigation Capability	Utilized?	Comments
Open Space / Conservation Program	Yes	20- acre native park with walking trails
Growth Management Ordinance	Yes	zoning restrictions control growth
Stormwater Ordinance	No	
Other Hazard Ordinance (steep slope, wildfire, snow loads, etc.)	Yes	steep slope
Other:	No	

Available resources including staff, municipal groups, and technology are all vital for a community to be able to implement hazard mitigation. Brookside has a town staff of one and is fortunate to have some of these capabilities identified in Table 43.

Table 43. Administrative & Technical Capabilities

Mitigation Capability	Utilized?	Comments
Planning Commission	Yes	Town Trustees serve as Planning Commission
Mitigation Planning Committee	No	Town Clerk attends County Mitigation Planning
Maintenance Programs (tree trimming, clearing drainage, etc.)	No	no program, but work is done
Emergency Manager	No	Town has staff of one: Town Clerk/Fremont County EM
Building Official	Yes	
Floodplain Administrator	No	FEMA has no established flood plains in the Town
Community Planner	No	Town has staff of one: Town Clerk
Transportation Planner	No	Town has staff of one: Town Clerk
Civil Engineer	No	Town contracts out for engineering work
GIS Capability	No	Town has staff of one: Town Clerk/Fremont County GIS

Mitigation Capability	Utilized?	Comments
Resiliency Planner	No	Town has staff of one: Town Clerk
Other:	No	
Warning Systems / Services (flood)	Yes	Frecom911 (Everbridge)
Warning Systems / Services (other / multi hazard)	Yes	Frecom911 (Everbridge)
Grant Writing / Management	Yes	Town clerk
Other:	No	

The ability of a community to implement a comprehensive mitigation strategy is largely dependent on available funding. These related municipal capabilities are outlined in Table 44 and show that the town utilizes a number of these financial tools that can support mitigation activities.

Table 44. Financial Capabilities

Mitigation Capability	Utilized?	Comments
Levy for Specific Purposes with Voter Approval	Yes	road mill levy
Utilities Fees	Yes	Water Distribution System Enterprise
System Development / Impact Development Fee	Yes	Water Enterprise/Fire District/Land Development
General Obligation Bonds to Incur Debt	No	
Special Tax Bonds to Incur Debt	No	
Open Space / Conservation Fund	Yes	Conservation Trust Fund distributions
Stormwater Utility Fees	No	

Mitigation Capability	Utilized?	Comments
Capital Improvement Project Funding	Yes	road mill levy
Community Development Block Grants (CDBG)	No	
Withhold Spending in Hazard-Prone Areas	No	
Other:	Yes	grants: DOLA and others

Education and outreach are important capabilities that allow a community to continue the conversation with their public regarding hazard risk and opportunities to mitigate. Table 45shows that the town does leverage some of these capabilities in some fashion, though not through formal programs.

Table 45. Education & Outreach Capabilities

Mitigation Capability	Utilized?	Comments
Public Hazard Education / Outreach Program	No Program	Town Clerk sends out information emails when necessary
Local Citizen Groups That Communicate Hazard Risks	Not Organized	We do hear from and listen to citizens regularly
Firewise	No	
StormReady	No	
Other:	Yes	Town Clerk sends out information emails as received

CAÑON CITY

Risk Ranking

Cañon City's overall qualitative risk rankings for the hazards profiled in this plan are presented in Table 46. The top hazards of concern include: dam failure, drought / extreme temperatures, flood, thunderstorm (including hail, high wind, and lightning), and wildfire. Dam failure and flood were previously considered to be of moderate concern in the previous plan.

TABLE 46. CAÑON CITY HAZARD RISK RATINGS

	Dam Failure	Debris Flow	Drought / Extreme Heat	Earthquake	Flood	Landslide / Rockfall	Pandemic	Severe Winter Weather	Subsidence / Erosion	Thunderstorm (hail, high wind, lighting)	Tornado	Wildfire	Wildlife-Vehicle Collisions
Cañon City	H	M	H	L	H	L	M	M	L	H	L	H	L

Vulnerability Assessment

In addition to the content provided in the main Risk Assessment chapter of this plan, following are a few figures specific to Cañon City. Figure 84 displays the current FEMA 100-year floodplains present in and around the city. The Hazus flood loss estimates are then shown in Figure 85. Finally, Figure 86 presents the wildfire risk summary report from the *'Ahead of the Fire'* report detailed in the Wildfire section of this HMP.

FIGURE 84: FEMA FLOODPLAINS - CAÑON CITY

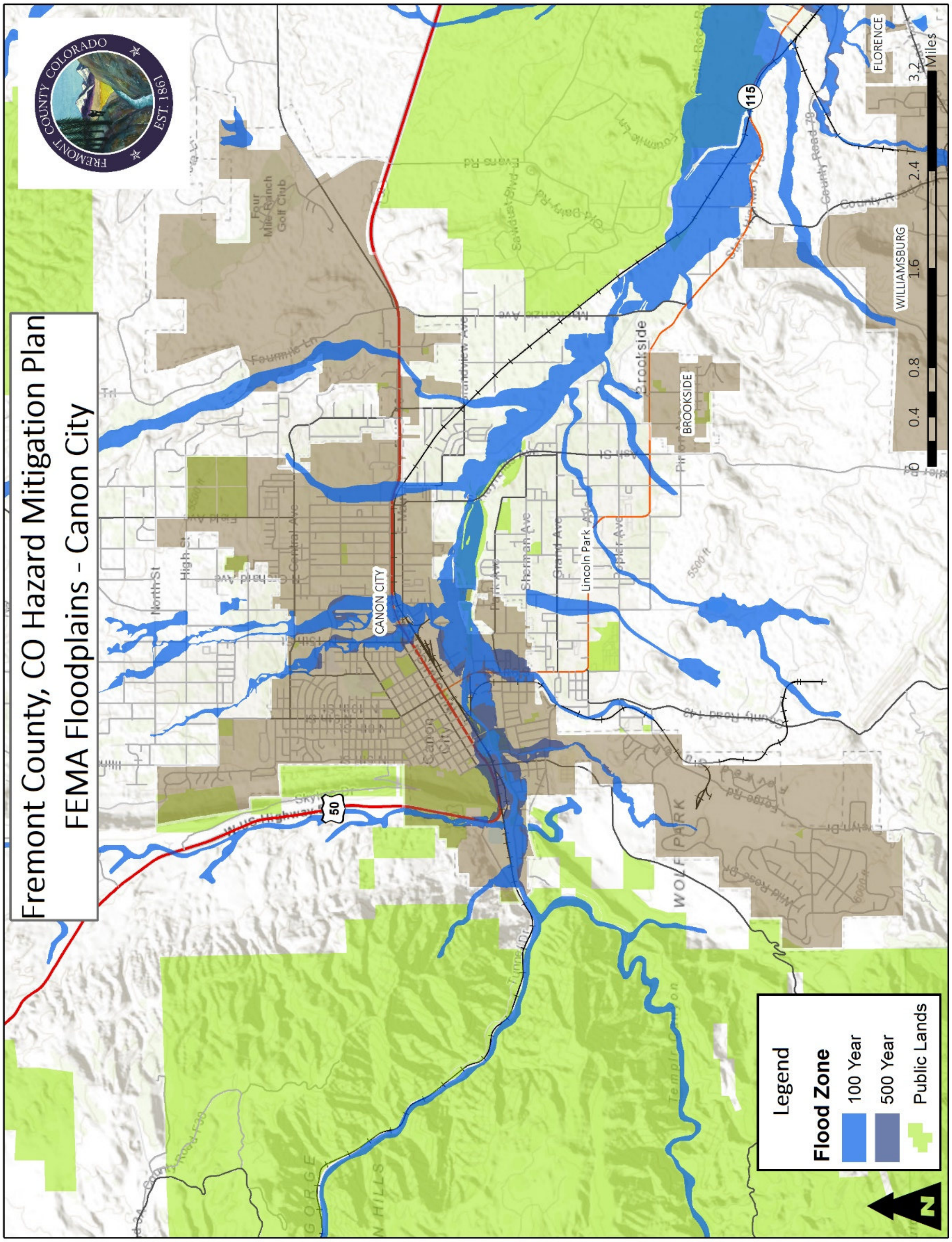


FIGURE 85: HAZUS FLOOD ESTIMATED LOSSES - CAÑON CITY

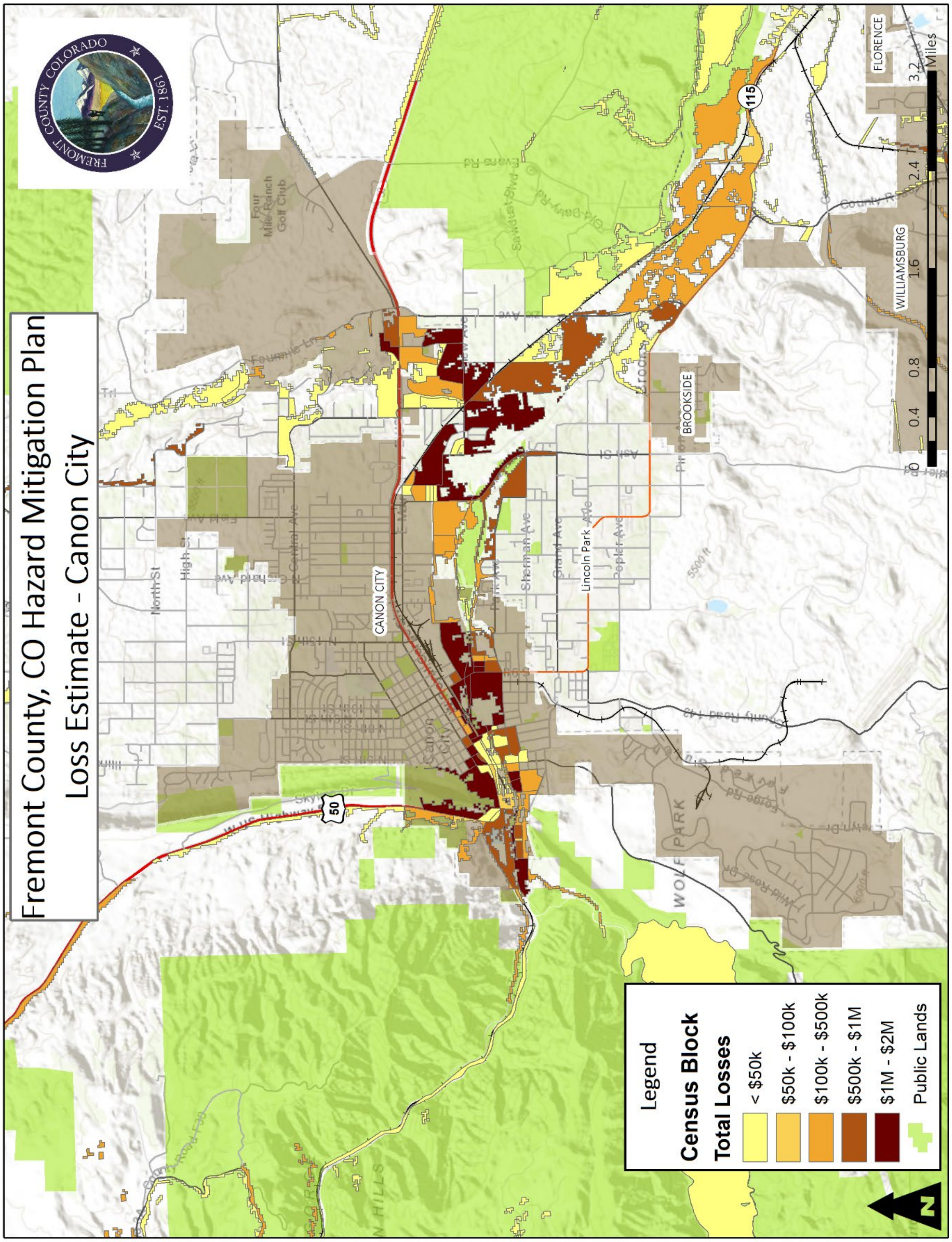
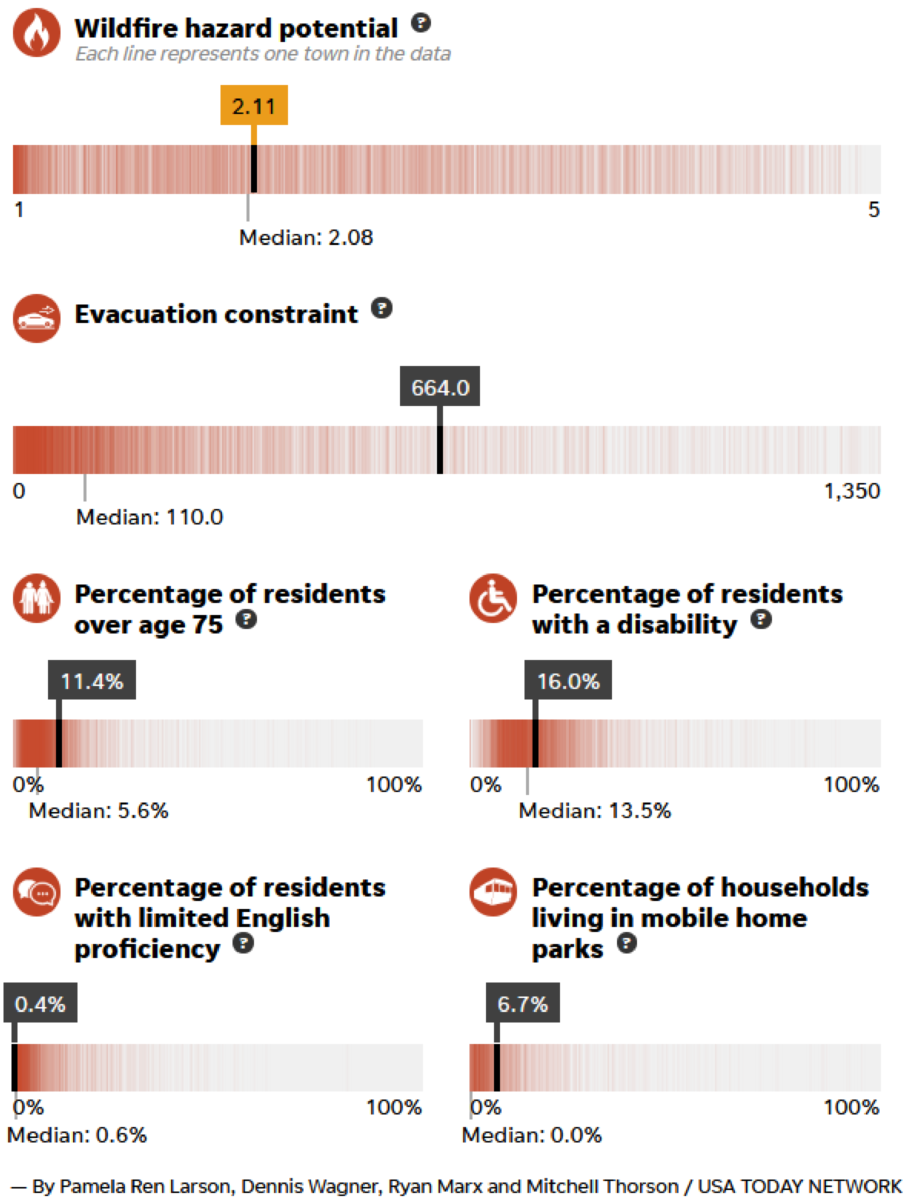


FIGURE 86: WILDFIRE RISK SUMMARY - CAÑON CITY



Mitigation Capabilities

Planning and regulatory capabilities are powerful tools for implementing hazard mitigation. The city currently utilizes or has implemented most of these capabilities shown in Table 47. It is important for the city to regularly review each of these tools, to identify opportunities for further risk reduction efforts.

Table 47. Planning & Regulatory Capabilities

Mitigation Capability	Utilized?	Comments
Comprehensive, Master, or General Plan	Yes	
Capital Improvement Program or Plan (CIP)	Yes	
Floodplain Management Plan	Yes	
Stormwater Program / Plan	Yes	
Community Wildfire Protection Plan (CWPP)	Yes	
Erosion / Sediment Control Program	Yes	
Economic Development Plan	Yes	
Other: Required Permits	No	
Building Codes (Year)	2006	Updating to 2018. Proposed to implement in 2021
BCEGS Rating	4	For both 1&2 family residential and commercial/industrial
Site Plan Review Requirements	Yes	
Other:	Yes	
Zoning Ordinance (Land Use)	Yes	
Subdivision Ordinance	Yes	
National Flood Insurance Program (NFIP) Participant	Yes	
Flood Insurance Study / Flood Insurance Rate Map / DFIRM	Yes	
Floodplain Ordinance	Yes	
Elevation Certificates for Floodplain Development	Yes	
Community Rating System (CRS) Participant	Yes	

Mitigation Capability	Utilized?	Comments
Open Space / Conservation Program	Yes	
Growth Management Ordinance	No	
Stormwater Ordinance	Yes	
Other Hazard Ordinance (steep slope, wildfire, snow loads, etc.)	No	
Other:	No	

Available resources including staff, municipal groups, and technology are all vital for a community to be able to implement hazard mitigation. Cañon City is fortunate to have most of these capabilities identified in Table 48.

Table 48. Administrative & Technical Capabilities

Mitigation Capability	Utilized?	Comments
Planning Commission	Yes	
Mitigation Planning Committee	No	
Maintenance Programs (tree trimming, clearing drainage, etc.)	Yes	
Emergency Manager	No	
Building Official	Yes	
Floodplain Administrator	Yes	
Community Planner	Yes	
Transportation Planner	Yes	
Civil Engineer	Yes	
GIS Capability	Yes	
Resiliency Planner	No	
Other:	No	

Mitigation Capability	Utilized?	Comments
Warning Systems / Services (flood)	No	
Warning Systems / Services (other / multi hazard)	No	
Grant Writing / Management	Yes	
Other:	No	

The ability of a community to implement a comprehensive mitigation strategy is largely dependent on available funding. These related municipal capabilities are outlined in Table 49 and show that the city utilizes many of these financial tools that can support mitigation activities.

Table 49. Financial Capabilities

Mitigation Capability	Utilized?	Comments
Levy for Specific Purposes with Voter Approval	Yes	Roads
Utilities Fees	Yes	
System Development / Impact Development Fee	Yes	
General Obligation Bonds to Incur Debt	Yes	
Special Tax Bonds to Incur Debt	No	
Open Space / Conservation Fund	No	
Stormwater Utility Fees	Yes	
Capital Improvement Project Funding	Yes	

Mitigation Capability	Utilized?	Comments
Community Development Block Grants (CDBG)	Yes	
Withhold Spending in Hazard-Prone Areas	No	
Other:	Yes	

Education and outreach are important capabilities that allow a community to continue the conversation with their public regarding hazard risk and opportunities to mitigate. Table 50 shows that the city currently does not have most of these capabilities in place at this time.

Table 50. Education & Outreach Capabilities

Mitigation Capability	Utilized?	Comments
Public Hazard Education / Outreach Program	No	
Local Citizen Groups That Communicate Hazard Risks	No	
Firewise	No	
StormReady	No	
Other:	Yes	Information dissemination via social media using information provided by other agencies

COAL CREEK

Risk Ranking

Coal Creek's overall qualitative risk rankings for the hazards profiled in this plan are presented in Table 51. The top hazards of concern include: drought / extreme temperatures, flood, severe winter weather, thunderstorm (including hail, high wind, and lightning), and wildfire.

TABLE 51. COAL CREEK HAZARD RISK RATINGS

	Dam Failure	Debris Flow	Drought / Extreme Heat	Earthquake	Flood	Landslide / Rockfall	Pandemic	Severe Winter Weather	Subsidence / Erosion	Thunderstorm (hail, high wind, lighting)	Tornado	Wildfire	Wildlife-Vehicle Collisions
Coal Creek	L	L	H	L	H	M	L	H	L	H	L	H	L

Vulnerability Assessment

In addition to the content provided in the main Risk Assessment chapter of this plan, following are a few figures specific to Coal Creek. Figure 84 displays the current FEMA 100-year floodplains present in and around the town. The Hazus flood loss estimates are then shown in Figure 85. Finally, Figure 86 presents the wildfire risk summary report from the *'Ahead of the Fire'* report detailed in the Wildfire section of this HMP.

FIGURE 87: FEMA FLOODPLAINS – COAL CREEK

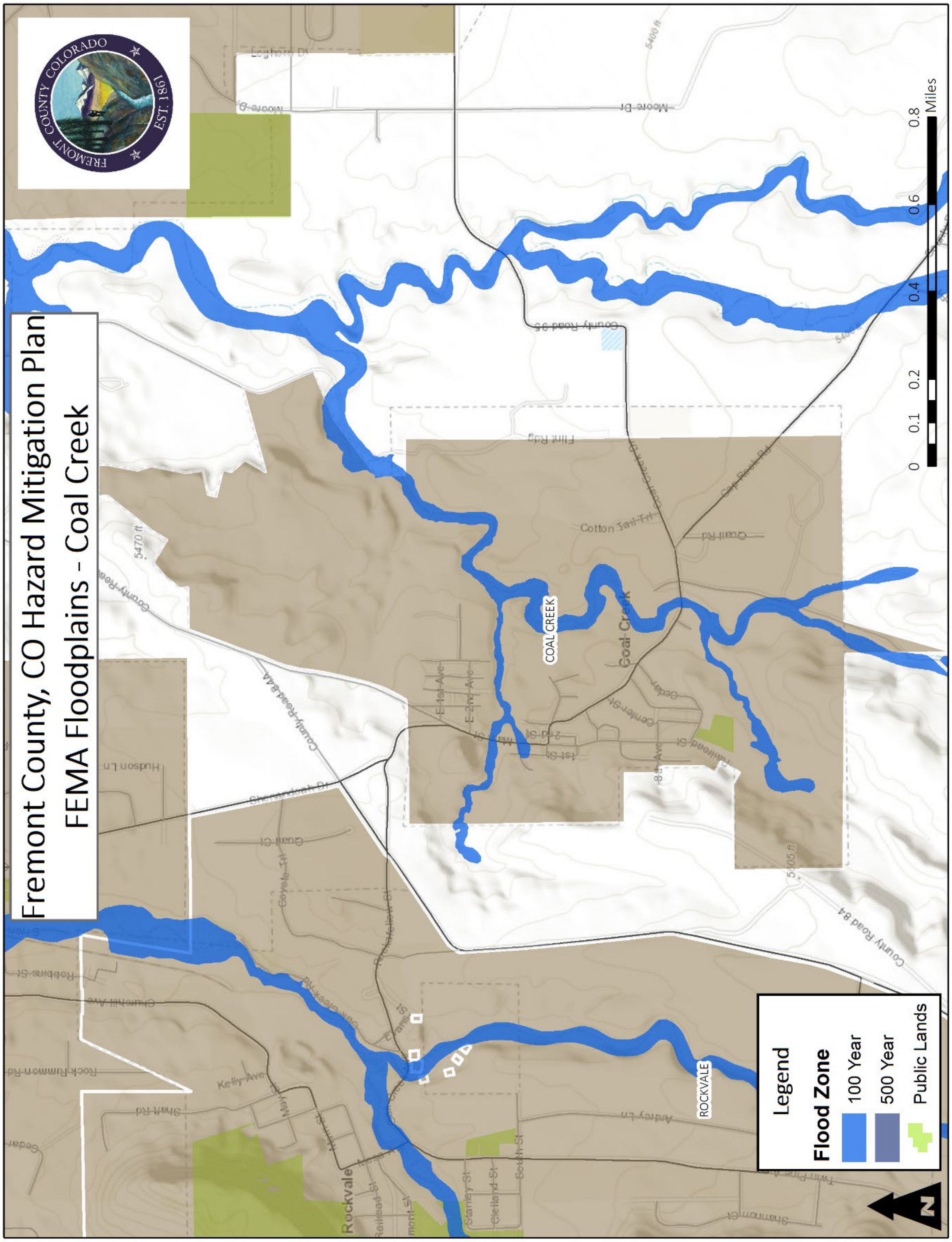


FIGURE 88: HAZUS FLOOD ESTIMATED LOSSES – COAL CREEK

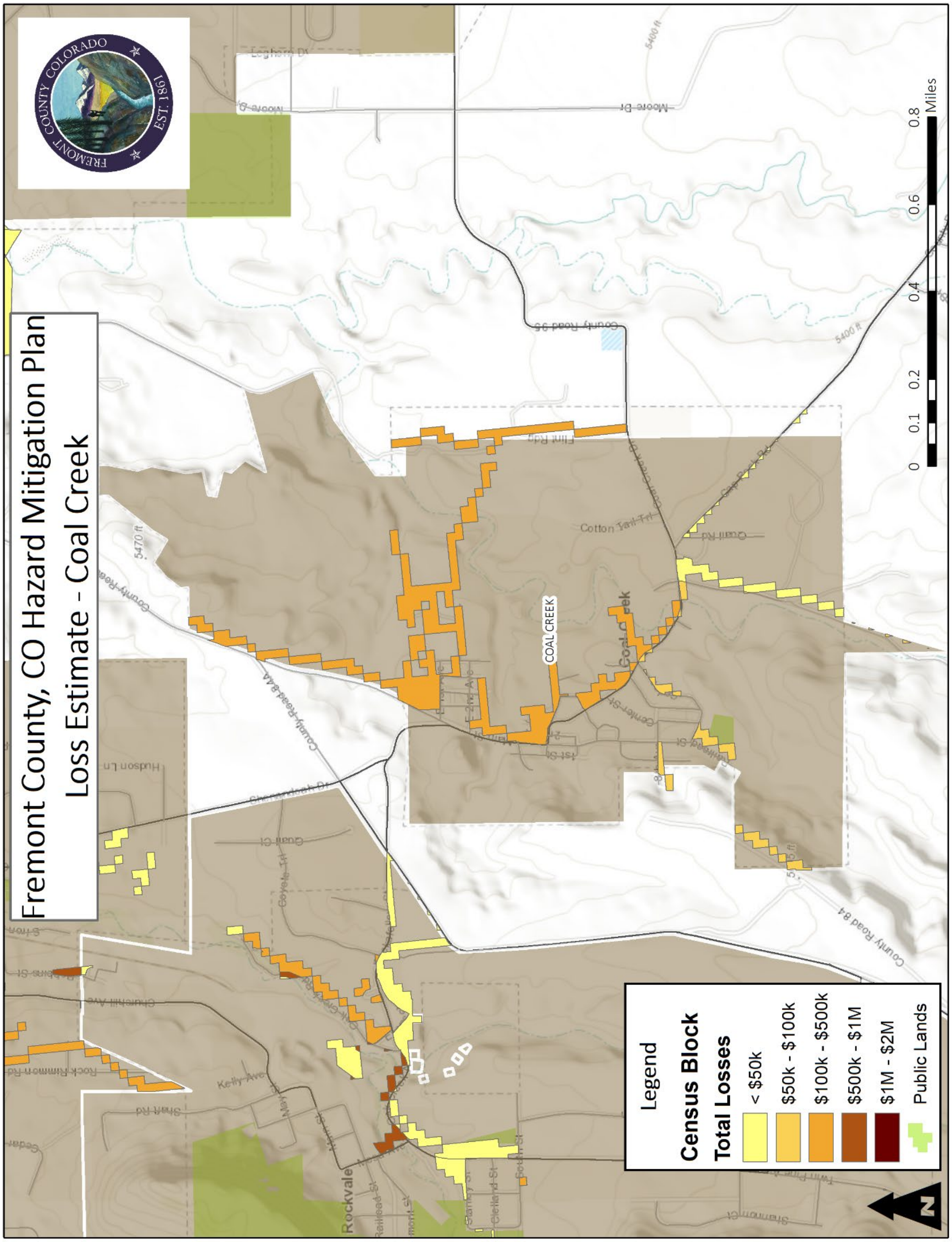
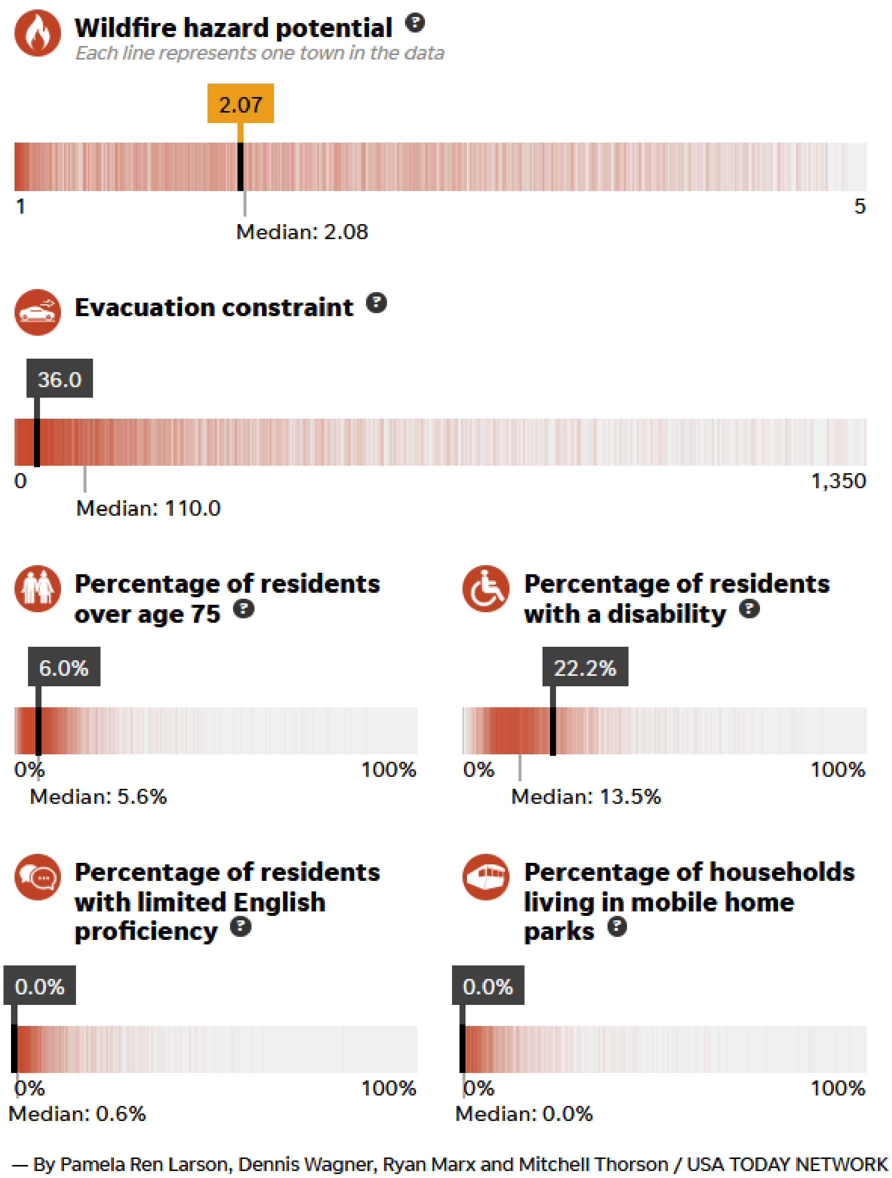


FIGURE 89: WILDFIRE RISK SUMMARY – COAL CREEK



Mitigation Capabilities

Planning and regulatory capabilities are powerful tools for implementing hazard mitigation. The town currently has implemented some of these capabilities shown in Table 52. It is important for the town to regularly review each of these tools, to identify opportunities for further risk reduction efforts.

Table 52. Planning & Regulatory Capabilities

Mitigation Capability	Utilized?	Comments
Comprehensive, Master, or General Plan	Yes	
Capital Improvement Program or Plan (CIP)	No	
Floodplain Management Plan	No	
Stormwater Program / Plan	No	
Community Wildfire Protection Plan (CWPP)	No	
Erosion / Sediment Control Program	No	
Economic Development Plan	No	
Other: Required Permits	No	
Building Codes (Year)	Yes (2006)	Preparing to update to 2016
BCEGS Rating	n/a	
Site Plan Review Requirements	Yes	
Other:	No	
Zoning Ordinance (Land Use)	Yes	
Subdivision Ordinance	Yes	
National Flood Insurance Program (NFIP) Participant	Yes	
Flood Insurance Study / Flood Insurance Rate Map / DFIRM	Yes	
Floodplain Ordinance	Yes	
Elevation Certificates for Floodplain Development	No	
Community Rating System (CRS) Participant	No	
Open Space / Conservation Program	No	

Mitigation Capability	Utilized?	Comments
Growth Management Ordinance	No	
Stormwater Ordinance	No	
Other Hazard Ordinance (steep slope, wildfire, snow loads, etc.)	No	
Other:	No	

Available resources including staff, municipal groups, and technology are all vital for a community to be able to implement hazard mitigation. Coal Creek currently leverages some of these capabilities identified in Table 53.

Table 53. Administrative & Technical Capabilities

Mitigation Capability	Utilized?	Comments
Planning Commission	Yes	
Mitigation Planning Committee	No	
Maintenance Programs (tree trimming, clearing drainage, etc.)	Yes	
Emergency Manager	No	
Building Official	Yes	
Floodplain Administrator	Yes	
Community Planner	No	
Transportation Planner	No	
Civil Engineer	No	
GIS Capability	No	We can leverage Fremont County GIS
Resiliency Planner	No	
Other:	No	
Warning Systems / Services (flood)	Yes	Frecom911 - County as well as through our water billing system.

Mitigation Capability	Utilized?	Comments
Warning Systems / Services (other / multi hazard)	Yes	Frecom911 - County as well as through our water billing system.
Grant Writing / Management	No	
Other:	No	

The ability of a community to implement a comprehensive mitigation strategy is largely dependent on available funding. These related municipal capabilities are outlined in Table 54 and show that the town currently does not utilize these financial tools that can support mitigation activities.

Table 54. Financial Capabilities

Mitigation Capability	Utilized?	Comments
Levy for Specific Purposes with Voter Approval	No	
Utilities Fees	No	
System Development / Impact Development Fee	No	
General Obligation Bonds to Incur Debt	No	
Special Tax Bonds to Incur Debt	No	
Open Space / Conservation Fund	No	
Stormwater Utility Fees	No	
Capital Improvement Project Funding	No	

Mitigation Capability	Utilized?	Comments
Community Development Block Grants (CDBG)	No	
Withhold Spending in Hazard-Prone Areas	No	
Other:	No	

Education and outreach are important capabilities that allow a community to continue the conversation with their public regarding hazard risk and opportunities to mitigate. Table 55 shows that the town currently does not leverage these capabilities.

Table 55. Education & Outreach Capabilities

Mitigation Capability	Utilized?	Comments
Public Hazard Education / Outreach Program	No	
Local Citizen Groups That Communicate Hazard Risks	No	
Firewise	No	
StormReady	No	
Other:	No	

FLORENCE

Risk Ranking

Florence's overall qualitative risk rankings for the hazards profiled in this plan are presented in Table 56. The top hazards of concern include: flood, severe winter weather, and wildfire. These are the same top hazards identified in the previous plan.

TABLE 56. FLORENCE HAZARD RISK RATINGS

	Dam Failure	Debris Flow	Drought / Extreme Heat	Earthquake	Flood	Landslide / Rockfall	Pandemic	Severe Winter Weather	Subsidence / Erosion	Thunderstorm (hail, high wind, lighting)	Tornado	Wildfire	Wildlife-Vehicle Collisions
Florence	L	M	M	L	H	M	M	H	L	M	L	H	L

Vulnerability Assessment

In addition to the content provided in the main Risk Assessment chapter of this plan, following are a few figures specific to Florence. Figure 84 displays the current FEMA 100-year floodplains present in and around the City. The Hazus flood loss estimates are then shown in Figure 85. Finally, Figure 86 presents the wildfire risk summary report from the *'Ahead of the Fire'* report detailed in the Wildfire section of this HMP.

FIGURE 90: FEMA FLOODPLAINS - FLORENCE

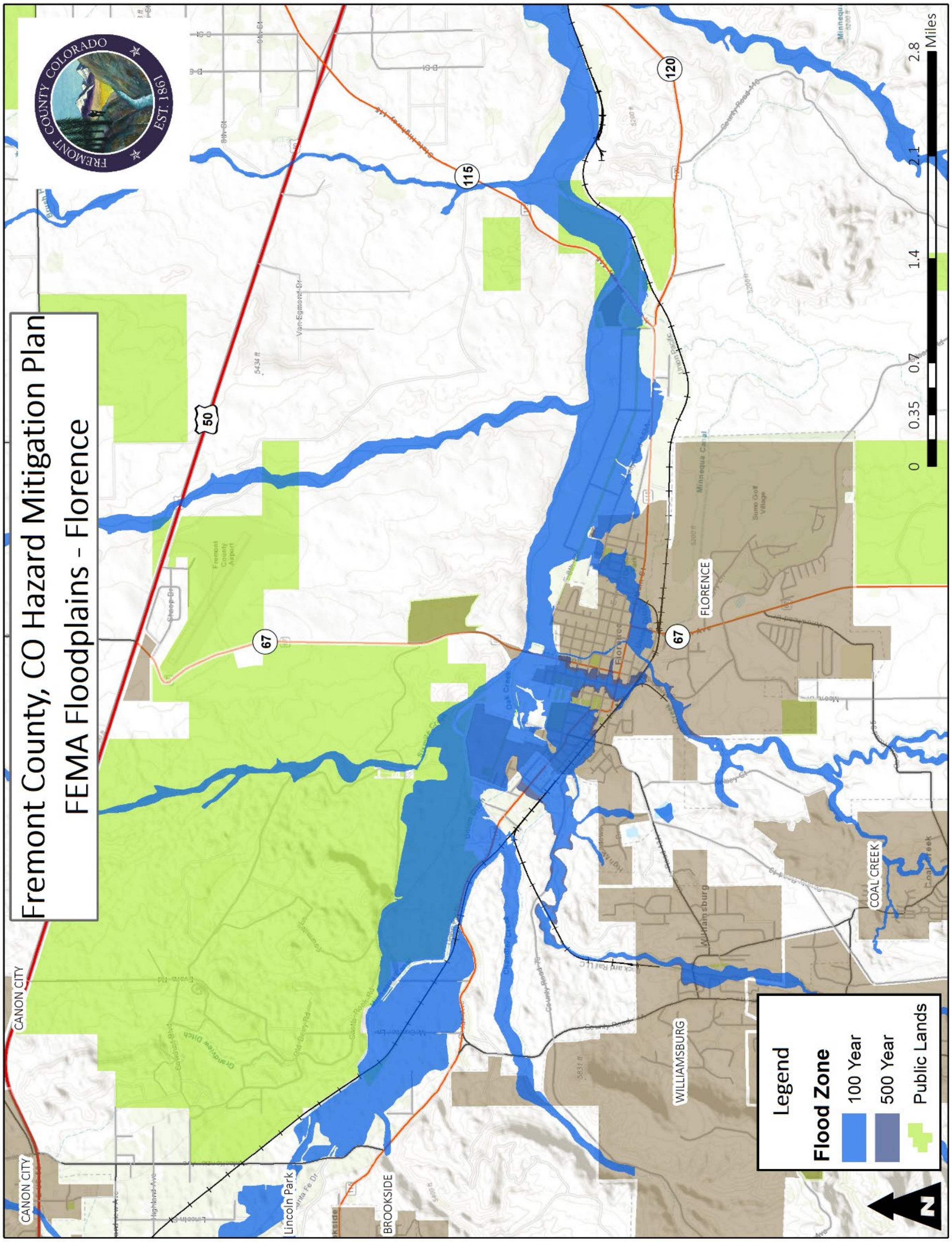


FIGURE 91: HAZUS FLOOD ESTIMATED LOSSES - FLORENCE

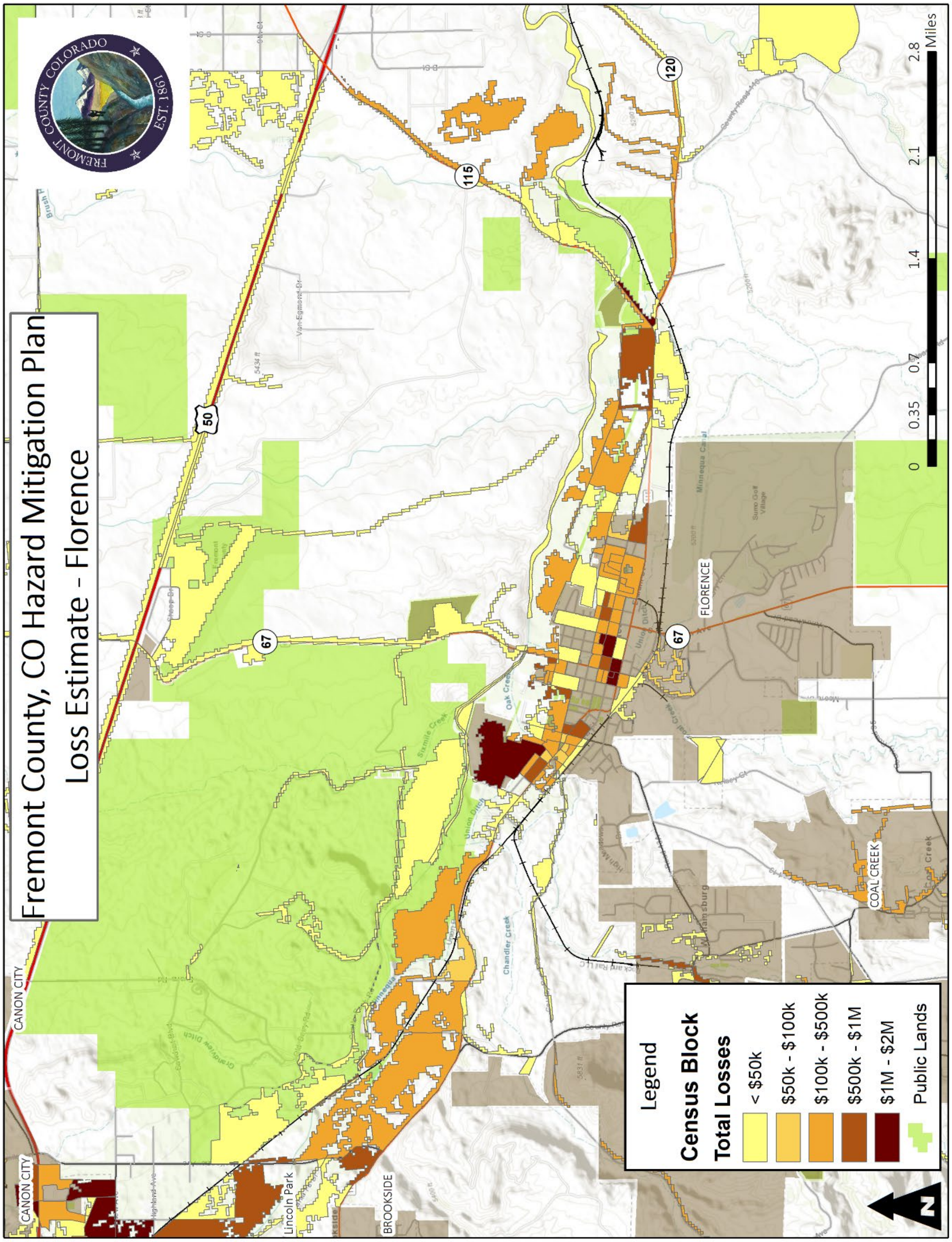
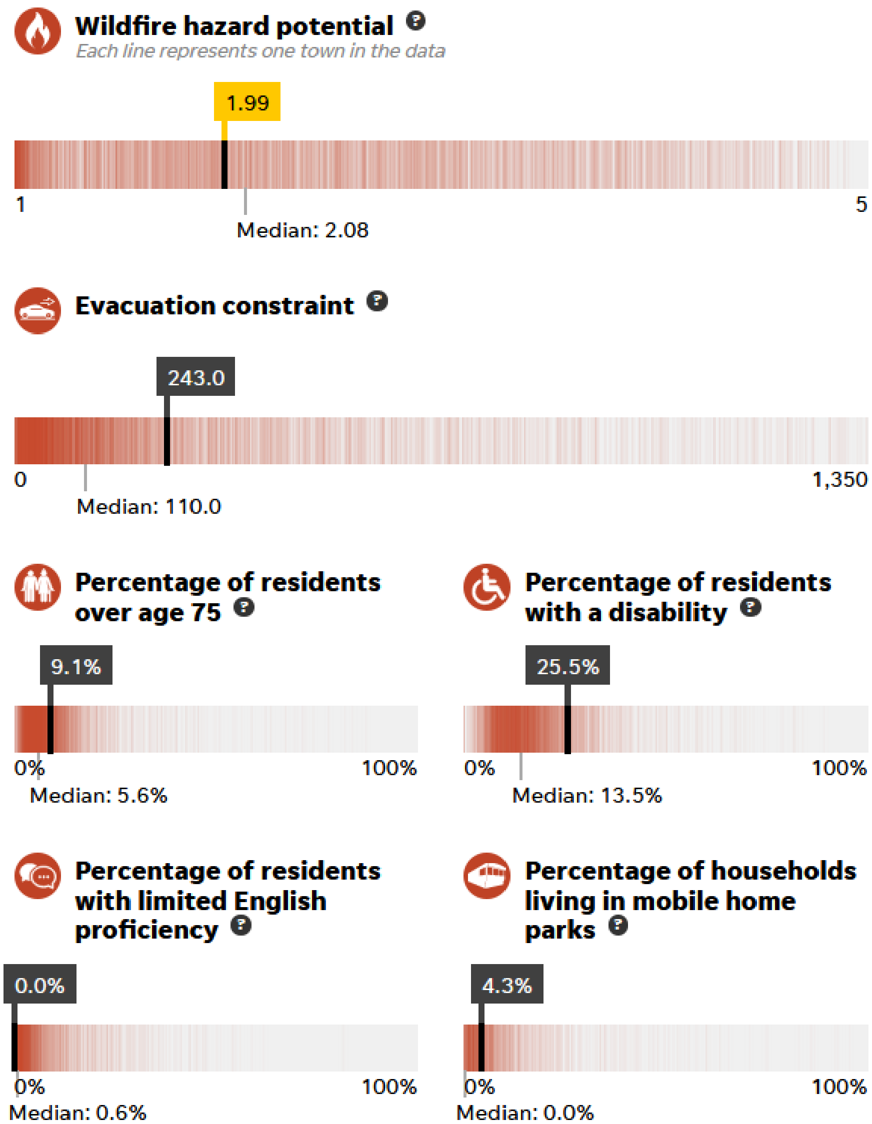


FIGURE 92: WILDFIRE RISK SUMMARY - FLORENCE



— By Pamela Ren Larson, Dennis Wagner, Ryan Marx and Mitchell Thorson / USA TODAY NETWORK

Mitigation Capabilities

Planning and regulatory capabilities are powerful tools for implementing hazard mitigation. The city currently utilizes or has implemented most of these capabilities shown in Table 57. It is important for the city to regularly review each of these tools, to identify opportunities for further risk reduction efforts.

Table 57. Planning & Regulatory Capabilities

Mitigation Capability	Utilized?	Comments
Comprehensive, Master, or General Plan	Yes	Plan approved 2017
Capital Improvement Program or Plan (CIP)	No	
Floodplain Management Plan	No	
Stormwater Program / Plan	No	Exempt from MS4
Community Wildfire Protection Plan (CWPP)	No	
Erosion / Sediment Control Program	No	
Economic Development Plan	Yes	In master plan
Other: Required Permits	No	
Building Codes (Year)	2006 IBC	
BCEGS Rating	n/a	
Site Plan Review Requirements	Yes	
Other:	No	
Zoning Ordinance (Land Use)	Yes	
Subdivision Ordinance	Yes	
National Flood Insurance Program (NFIP) Participant	Yes	
Flood Insurance Study / Flood Insurance Rate Map / DFIRM	Yes	
Floodplain Ordinance	Yes	Resolution
Elevation Certificates for Floodplain Development	Yes	
Community Rating System (CRS) Participant	No	
Open Space / Conservation Program	No	

Mitigation Capability	Utilized?	Comments
Growth Management Ordinance	No	
Stormwater Ordinance	No	
Other Hazard Ordinance (steep slope, wildfire, snow loads, etc.)	No	
Other:	No	

Available resources including staff, municipal groups, and technology are all vital for a community to be able to implement hazard mitigation. Florence is fortunate to have most of these capabilities identified in Table 58.

Table 58. Administrative & Technical Capabilities

Mitigation Capability	Utilized?	Comments
Planning Commission	Yes	
Mitigation Planning Committee	No	
Maintenance Programs (tree trimming, clearing drainage, etc.)	Yes	City public works
Emergency Manager	No	
Building Official	Yes	
Floodplain Administrator	Yes	
Community Planner	Yes	
Transportation Planner	Yes	
Civil Engineer	Yes	Contractor
GIS Capability	Yes	
Resiliency Planner	No	
Other:	No	
Warning Systems / Services (flood)	No	

Mitigation Capability	Utilized?	Comments
Warning Systems / Services (other / multi hazard)	No	
Grant Writing / Management	Yes	
Other:	No	

The ability of a community to implement a comprehensive mitigation strategy is largely dependent on available funding. These related municipal capabilities are outlined in Table 59 and show that the city utilizes a number of these financial tools that can support mitigation activities.

Table 59. Financial Capabilities

Mitigation Capability	Utilized?	Comments
Levy for Specific Purposes with Voter Approval	No	
Utilities Fees	Yes	Water dept
System Development / Impact Development Fee	No	
General Obligation Bonds to Incur Debt	Yes	Water
Special Tax Bonds to Incur Debt	No	
Open Space / Conservation Fund	Yes	From state
Stormwater Utility Fees	No	
Capital Improvement Project Funding	Yes	In general fund

Mitigation Capability	Utilized?	Comments
Community Development Block Grants (CDBG)	No	
Withhold Spending in Hazard-Prone Areas	No	
Other:	No	

Education and outreach are important capabilities that allow a community to continue the conversation with their public regarding hazard risk and opportunities to mitigate. Table 60 shows that the city currently does not leverage these capabilities.

Table 60. Education & Outreach Capabilities

Mitigation Capability	Utilized?	Comments
Public Hazard Education / Outreach Program	No	
Local Citizen Groups That Communicate Hazard Risks	No	
Firewise	No	
StormReady	No	
Other:	No	

ROCKVALE

Risk Ranking

Rockvale's overall qualitative risk rankings for the hazards profiled in this plan are presented in Table 61. The top hazards of concern include: dam failure, debris flow, flood, and wildfire.

Table 61. Rockvale Hazard Risk Ratings

	Dam Failure	Debris Flow	Drought / Extreme Heat	Earthquake	Flood	Landslide / Rockfall	Pandemic	Severe Winter Weather	Subsidence / Erosion	Thunderstorm (hail, high wind, lighting)	Tornado	Wildfire	Wildlife-Vehicle Collisions
Rockvale	H	H	M	L	H	L	M	M	L	M	L	H	L

Vulnerability Assessment

In addition to the content provided in the main Risk Assessment chapter of this plan, following are a few figures specific to Rockvale. Figure 84 displays the current FEMA 100-year floodplains present in and around the Town. The Hazus flood loss estimates are then shown in Figure 85. Finally, Figure 86 presents the wildfire risk summary report from the *'Ahead of the Fire'* report detailed in the Wildfire section of this HMP.

FIGURE 93: FEMA FLOODPLAINS - ROCKVALE

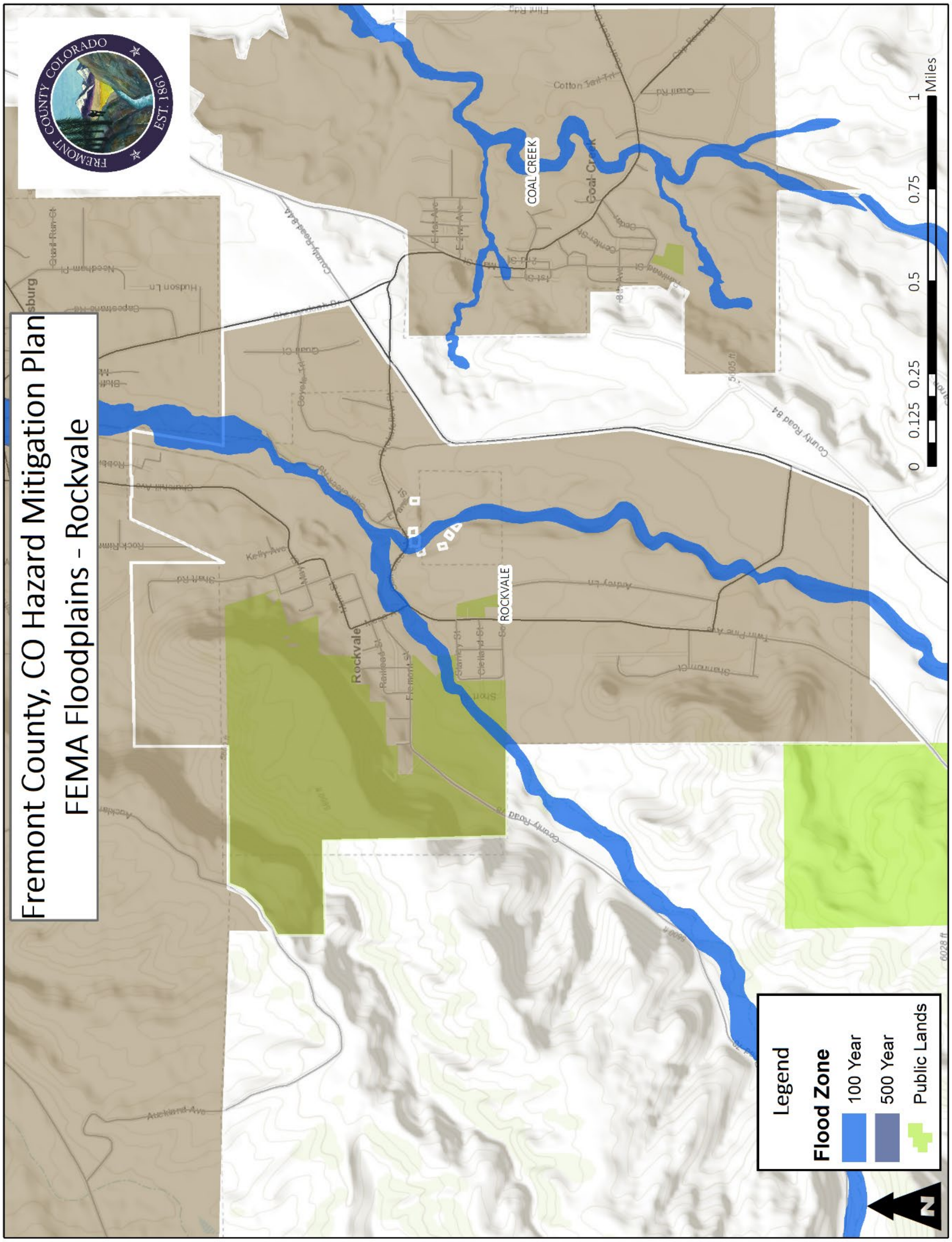


FIGURE 94: HAZUS FLOOD ESTIMATED LOSSES - ROCKVALE

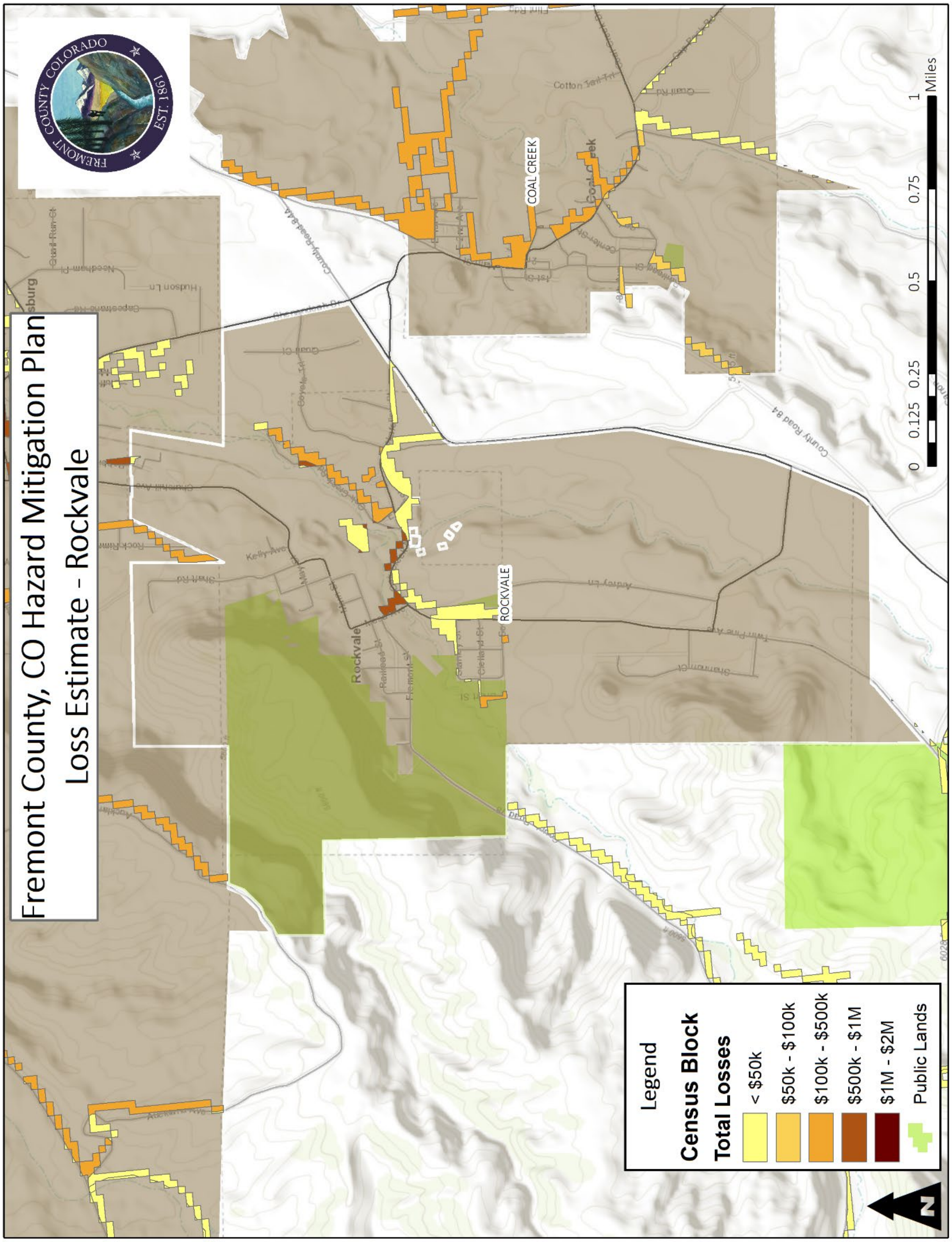
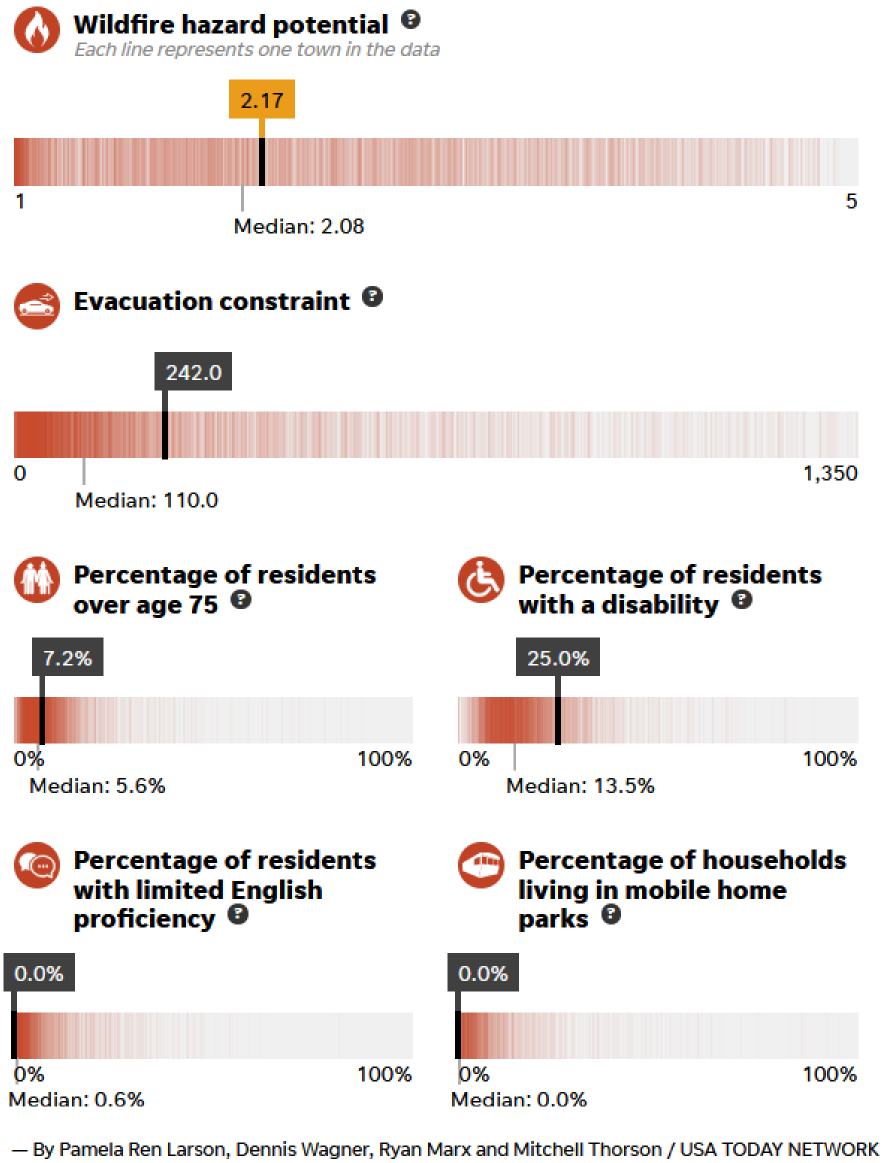


FIGURE 95: WILDFIRE RISK SUMMARY - ROCKVALE



Mitigation Capabilities

Planning and regulatory capabilities are powerful tools for implementing hazard mitigation. The town currently utilizes or has implemented some of these capabilities shown in Table 62. It is important for the town to regularly review each of these tools, to identify opportunities for further risk reduction efforts.

Table 62. Planning & Regulatory Capabilities

Mitigation Capability	Utilized?	Comments
Comprehensive, Master, or General Plan	No	
Capital Improvement Program or Plan (CIP)	No	
Floodplain Management Plan	No	
Stormwater Program / Plan	No	
Community Wildfire Protection Plan (CWPP)	No	
Erosion / Sediment Control Program	No	
Economic Development Plan	No	
Other: Required Permits	No	
Building Codes (Year)	Y (2016)	
BCEGS Rating	n/a	
Site Plan Review Requirements	No	
Other:	No	
Zoning Ordinance (Land Use)	Yes	
Subdivision Ordinance	No	
National Flood Insurance Program (NFIP) Participant	Yes	
Flood Insurance Study / Flood Insurance Rate Map / DFIRM	Yes	
Floodplain Ordinance	Yes	
Elevation Certificates for Floodplain Development	No	
Community Rating System (CRS) Participant	No	
Open Space / Conservation Program	No	

Mitigation Capability	Utilized?	Comments
Growth Management Ordinance	No	
Stormwater Ordinance	No	
Other Hazard Ordinance (steep slope, wildfire, snow loads, etc.)	No	
Other:	No	

Available resources including staff, municipal groups, and technology are all vital for a community to be able to implement hazard mitigation. Rockvale currently does not leverage any of these capabilities identified in Table 63.

Table 63. Administrative & Technical Capabilities

Mitigation Capability	Utilized?	Comments
Planning Commission	No	
Mitigation Planning Committee	No	
Maintenance Programs (tree trimming, clearing drainage, etc.)	No	
Emergency Manager	No	
Building Official	No	
Floodplain Administrator	Yes	
Community Planner	No	
Transportation Planner	No	
Civil Engineer	No	
GIS Capability	No	
Resiliency Planner	No	
Other:	No	
Warning Systems / Services (flood)	No	

Mitigation Capability	Utilized?	Comments
Warning Systems / Services (other / multi hazard)	No	
Grant Writing / Management	No	
Other:	No	

The ability of a community to implement a comprehensive mitigation strategy is largely dependent on available funding. These related municipal capabilities are outlined in Table 64 and show that the town currently does not utilize these financial tools that can support mitigation activities.

Table 64. Financial Capabilities

Mitigation Capability	Utilized?	Comments
Levy for Specific Purposes with Voter Approval	No	
Utilities Fees	No	
System Development / Impact Development Fee	No	
General Obligation Bonds to Incur Debt	No	
Special Tax Bonds to Incur Debt	No	
Open Space / Conservation Fund	No	
Stormwater Utility Fees	No	
Capital Improvement Project Funding	No	

Mitigation Capability	Utilized?	Comments
Community Development Block Grants (CDBG)	No	
Withhold Spending in Hazard-Prone Areas	No	
Other:	No	

Education and outreach are important capabilities that allow a community to continue the conversation with their public regarding hazard risk and opportunities to mitigate. Table 65 shows that the town does not currently leverage these capabilities.

Table 65. Education & Outreach Capabilities

Mitigation Capability	Utilized?	Comments
Public Hazard Education / Outreach Program	No	
Local Citizen Groups That Communicate Hazard Risks	No	
Firewise	No	
StormReady	No	
Other:	No	

WILLIAMSBURG

Risk Ranking

Williamsburg's overall qualitative risk rankings for the hazards profiled in this plan are presented in Table 66. The top hazard of concern is drought / extreme heat.

TABLE 66. WILLIAMSBURG HAZARD RISK RATINGS

	Dam Failure	Debris Flow	Drought / Extreme Heat	Earthquake	Flood	Landslide / Rockfall	Pandemic	Severe Winter Weather	Subsidence / Erosion	Thunderstorm (hail, high wind, lighting)	Tornado	Wildfire	Wildlife-Vehicle Collisions
Williamsburg	L	M	H	L	M	L	L	M	M	L	L	L	L

Vulnerability Assessment

In addition to the content provided in the main Risk Assessment chapter of this plan, following are a few figures specific to Williamsburg. Figure 84 displays the current FEMA 100-year floodplains present in and around the town. The Hazus flood loss estimates are then shown in Figure 85. Finally, Figure 86 presents the wildfire risk summary report from the *'Ahead of the Fire'* report detailed in the Wildfire section of this HMP.

FIGURE 96: FEMA FLOODPLAINS - WILLIAMSBURG

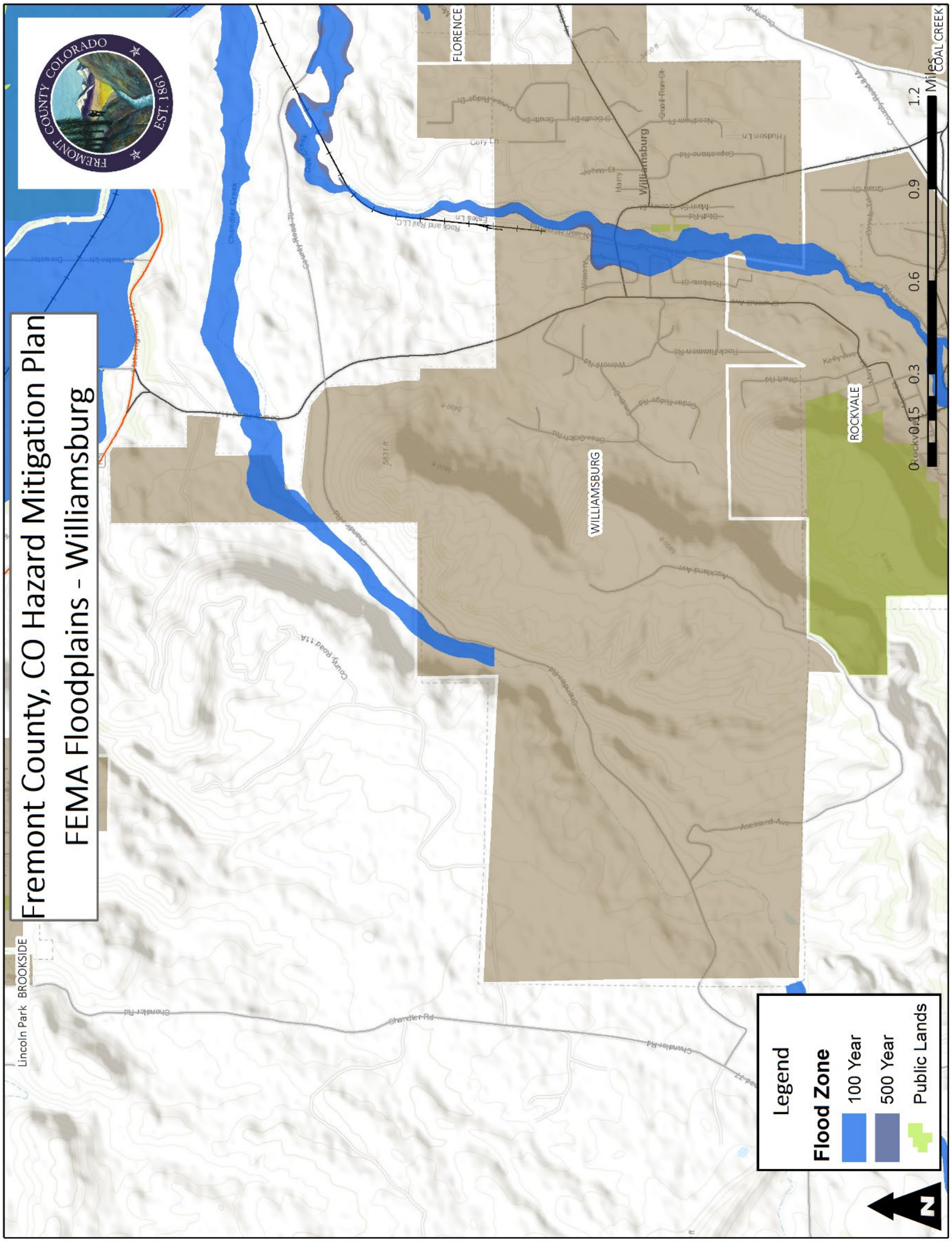


FIGURE 97: HAZUS FLOOD ESTIMATED LOSSES - WILLIAMSBURG

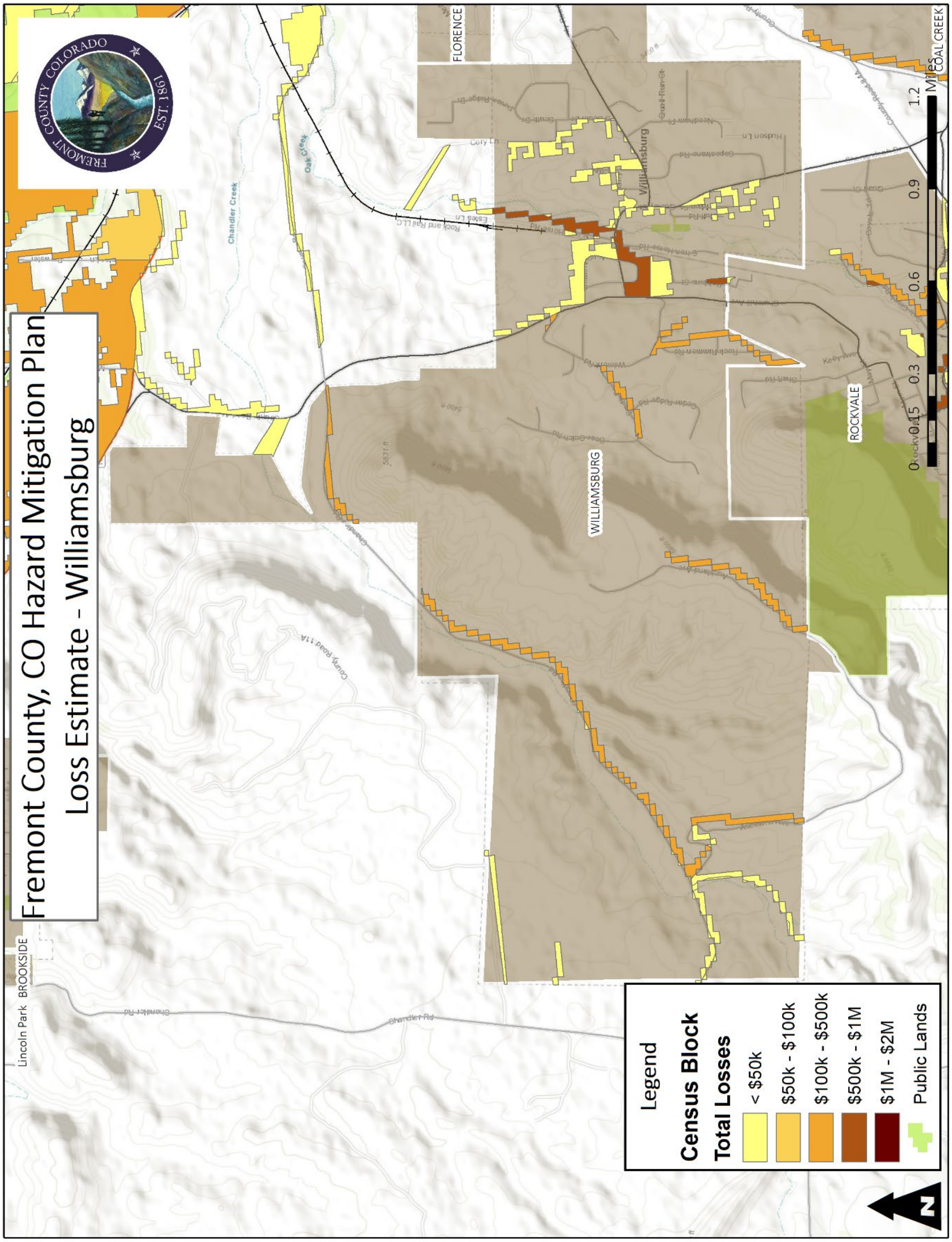
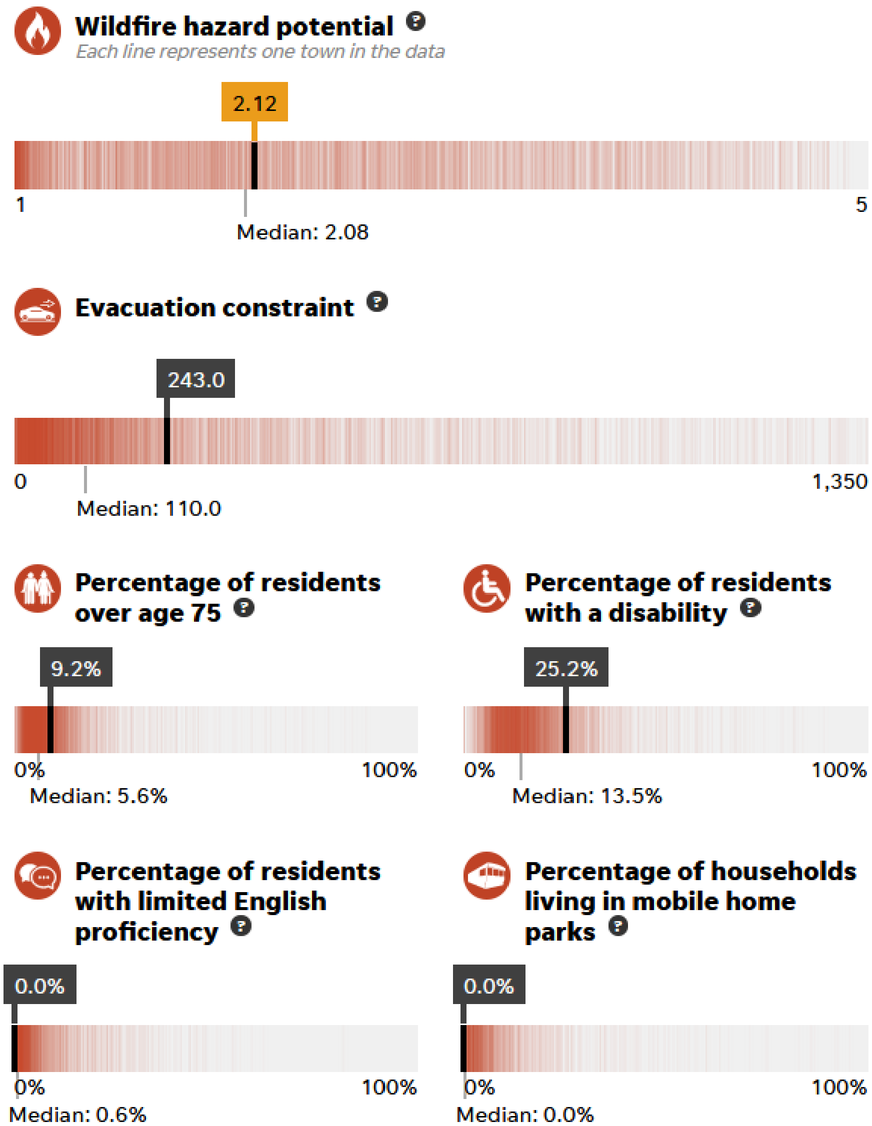


FIGURE 98: WILDFIRE RISK SUMMARY - WILLIAMSBURG



— By Pamela Ren Larson, Dennis Wagner, Ryan Marx and Mitchell Thorson / USA TODAY NETWORK

Mitigation Capabilities

Planning and regulatory capabilities are powerful tools for implementing hazard mitigation. The town currently utilizes or has implemented many of these capabilities shown in Table 67. It is important for the town to regularly review each of these tools, to identify opportunities for further risk reduction efforts.

Table 67. Planning & Regulatory Capabilities

Mitigation Capability	Utilized?	Comments
Comprehensive, Master, or General Plan	Yes	
Capital Improvement Program or Plan (CIP)	No	
Floodplain Management Plan	Yes	
Stormwater Program / Plan	Yes	
Community Wildfire Protection Plan (CWPP)	No	
Erosion / Sediment Control Program	No	
Economic Development Plan	No	
Other: Required Permits	No	
Building Codes (Year)	IRC 2018	
BCEGS Rating	n/a	
Site Plan Review Requirements	Yes	
Other:	No	
Zoning Ordinance (Land Use)	Yes	
Subdivision Ordinance	Yes	
National Flood Insurance Program (NFIP) Participant	Yes	
Flood Insurance Study / Flood Insurance Rate Map / DFIRM	Yes	
Floodplain Ordinance	Yes	
Elevation Certificates for Floodplain Development	No	
Community Rating System (CRS) Participant	No	
Open Space / Conservation Program	Yes	

Mitigation Capability	Utilized?	Comments
Growth Management Ordinance	No	
Stormwater Ordinance	No	
Other Hazard Ordinance (steep slope, wildfire, snow loads, etc.)	No	
Other:	No	

Available resources including staff, municipal groups, and technology are all vital for a community to be able to implement hazard mitigation. Williamsburg is fortunate to have a number of these capabilities identified in Table 68.

Table 68. Administrative & Technical Capabilities

Mitigation Capability	Utilized?	Comments
Planning Commission	Yes	
Mitigation Planning Committee	No	
Maintenance Programs (tree trimming, clearing drainage, etc.)	Yes	
Emergency Manager	Yes	
Building Official	Yes	
Floodplain Administrator	Yes	
Community Planner	No	
Transportation Planner	No	
Civil Engineer	No	
GIS Capability	Yes	
Resiliency Planner	No	
Other:	No	
Warning Systems / Services (flood)	Yes	Reverse call system

Mitigation Capability	Utilized?	Comments
Warning Systems / Services (other / multi hazard)	Yes	Reverse call system / siren
Grant Writing / Management	No	
Other:	No	

The ability of a community to implement a comprehensive mitigation strategy is largely dependent on available funding. These related municipal capabilities are outlined in Table 69 and show that the town utilizes some of these financial tools that can support mitigation activities.

Table 69. Financial Capabilities

Mitigation Capability	Utilized?	Comments
Levy for Specific Purposes with Voter Approval	No	
Utilities Fees	No	
System Development / Impact Development Fee	Yes	
General Obligation Bonds to Incur Debt	Yes	
Special Tax Bonds to Incur Debt	No	
Open Space / Conservation Fund	Yes	
Stormwater Utility Fees	No	
Capital Improvement Project Funding	Yes	

Mitigation Capability	Utilized?	Comments
Community Development Block Grants (CDBG)	No	
Withhold Spending in Hazard-Prone Areas	No	
Other:	No	

Education and outreach are important capabilities that allow a community to continue the conversation with their public regarding hazard risk and opportunities to mitigate. Table 70 shows that the town does not currently leverage these capabilities.

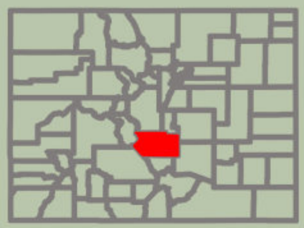
Table 70. Education & Outreach Capabilities

Mitigation Capability	Utilized?	Comments
Public Hazard Education / Outreach Program	No	
Local Citizen Groups That Communicate Hazard Risks	No	
Firewise	No	
StormReady	No	
Other:	No	

Appendix B: Wildfire Risk Assessment Summary Report

2017
Colorado Wildfire Risk Assessment Summary Report

Fremont



COLORADO STATE FOREST SERVICE
COLORADO STATE UNIVERSITY

Report was generated using

www.ColoradoForestAtlas.org

Report version: 1.1.0

Report generated: 2020-09-25

Table of Contents

Disclaimer

Introduction

Colorado Wildfire Risk Assessment Report

Welcome to the Colorado Wildfire Risk Assessment Summary Reporting Tool.

This tool allows users of the Risk Reduction Planner application of the Colorado Forest Atlas web portal to define a specific project area and generate information for this area. A detailed risk summary report can be generated using a set of predefined map products developed by the Colorado Wildfire Risk Assessment project which have been summarized explicitly for the user defined project area. The report is generated in PDF format.

The report has been designed so that information from the report can be copied and pasted into other specific plans, reports, or documents depending on user needs. Examples include, but are not limited to, Community Wildfire Protection Plans, Local Fire Plans, Fuels Mitigation Plans, Hazard Mitigation Plans, Homeowner Risk Assessments, and Forest Management or Stewardship Plans. Example templates for some of these reports are available for download on the Colorado Forest Atlas web portal.

The Colorado WRA provides a consistent, comparable set of scientific results to be used as a foundation for wildfire mitigation and prevention planning in Colorado.

Results of the assessment can be used to help prioritize areas in the state where mitigation treatments, community interaction and education, or tactical analyses might be necessary to reduce risk from wildfires.

The Colorado WRA products included in this report are designed to provide the information needed to support the following key priorities:

- Identify areas that are most prone to wildfire
- Plan and prioritize hazardous fuel treatment programs
- Allow agencies to work together to better define priorities and improve emergency response, particularly across jurisdictional boundaries
- Increase communication with local residents and the public to address community priorities and needs

Products

Each product in this report is accompanied by a general description, table, chart and/or map. A list of available Colorado WRA products in this report is provided in the following table.

COWRA Product	Description
Wildfire Risk	The overall composite risk occurring from a wildfire derived by combining Burn Probability and Values at Risk Rating
Burn Probability	Annual probability of any location burning due to wildfire
Fire Intensity Scale	Quantifies the potential fire intensity by orders of magnitude
Wildland Urban Interface	Housing density depicting where humans and their structures meet or intermix with wildland fuel
Wildland Urban Interface Risk	Annual probability of any location burning due to wildfire
Values at Risk Rating	A composite rating of values and assets that would be adversely impacted by a wildfire by combining the four main risk outputs
Suppression Difficulty Rating	Reflects the difficulty or relative cost to suppress a fire given the terrain and vegetation conditions that may impact machine operability
Drinking Water Risk Index	A measure of the risk to Drinking Water Risk Index Areas (DWIA) based on the potential negative impacts from wildfire
Forest Assets Risk Index	A measure of the risk to forested areas based on the potential negative impacts from wildfire
Riparian Assets Risk Index	A measure of the risk to riparian areas based on the potential negative impacts from wildfire
Characteristic Flame Length	A measure of the expected flame length of a potential fire

COWRA Product	Description
Characteristic Rate of Spread	A measure of the expected rate of spread of a potential fire
Fire Type Extreme Weather	Represents the potential fire type under the extreme percentile weather category
Surface Fuels	A measure of the expected rate of spread of a potential fire
Characteristic Rate of Spread	Characterization of surface fuel models that contain the parameters for calculating fire behavior outputs
Vegetation	General vegetation and landcover types
Forest Assets	Identifies forested land categorized by susceptibility or response to fire
Riparian Assets	Forested riparian areas characterized by functions of water quantity and quality, and ecology
Drinking Water Importance Areas	A measure of quality and quantity of public surface drinking water categorized by watershed

Wildland Urban Interface

Description

Colorado is one of the fastest growing states in the Nation, with much of this growth occurring outside urban boundaries. This increase in population across the state will impact counties and communities that are located within the Wildland Urban Interface (WUI). The WUI is described as the area where structures and other human improvements meet and intermingle with undeveloped wildland or vegetative fuels. Population growth within the WUI substantially increases the risk from wildfire.

For the **Fremont** project area, it is estimated that **34,347** people or **72.4 %** percent of the total project area population (47,446) live within the WUI.

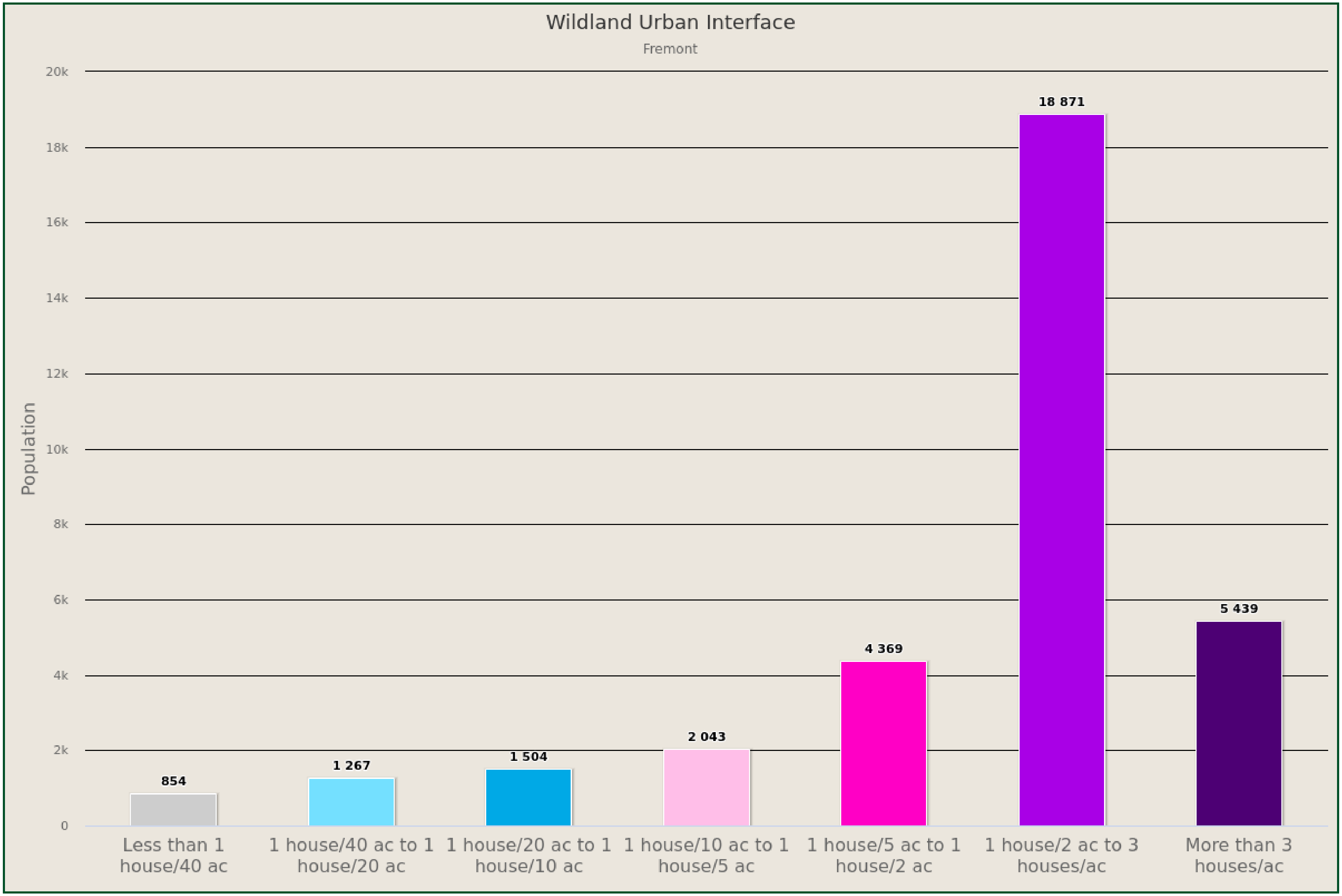
The Wildland Urban Interface (WUI) layer reflects housing density depicting where humans and their structures meet or intermix with wildland fuels. In the past, conventional wildland-urban interface datasets, such as USFS SILVIS, have been used to reflect these concerns. However, USFS SILVIS and other existing data sources did not provide the level of detail needed by the Colorado State Forest Service and local fire protection agencies.

The new WUI dataset is derived using advanced modeling techniques based on the Where People Live dataset and 2016 LandScan USA population count data available from the Department of Homeland Security, HSIP dataset. WUI is simply a subset of the Where People Live dataset. The primary difference is populated areas surrounded by sufficient non-burnable areas (i.e. interior urban areas) are removed from the Where People Live dataset, as these areas are not expected to be directly impacted by a wildfire. This accommodates WUI areas based on encroachment into urban areas where wildland fire is likely to spread.

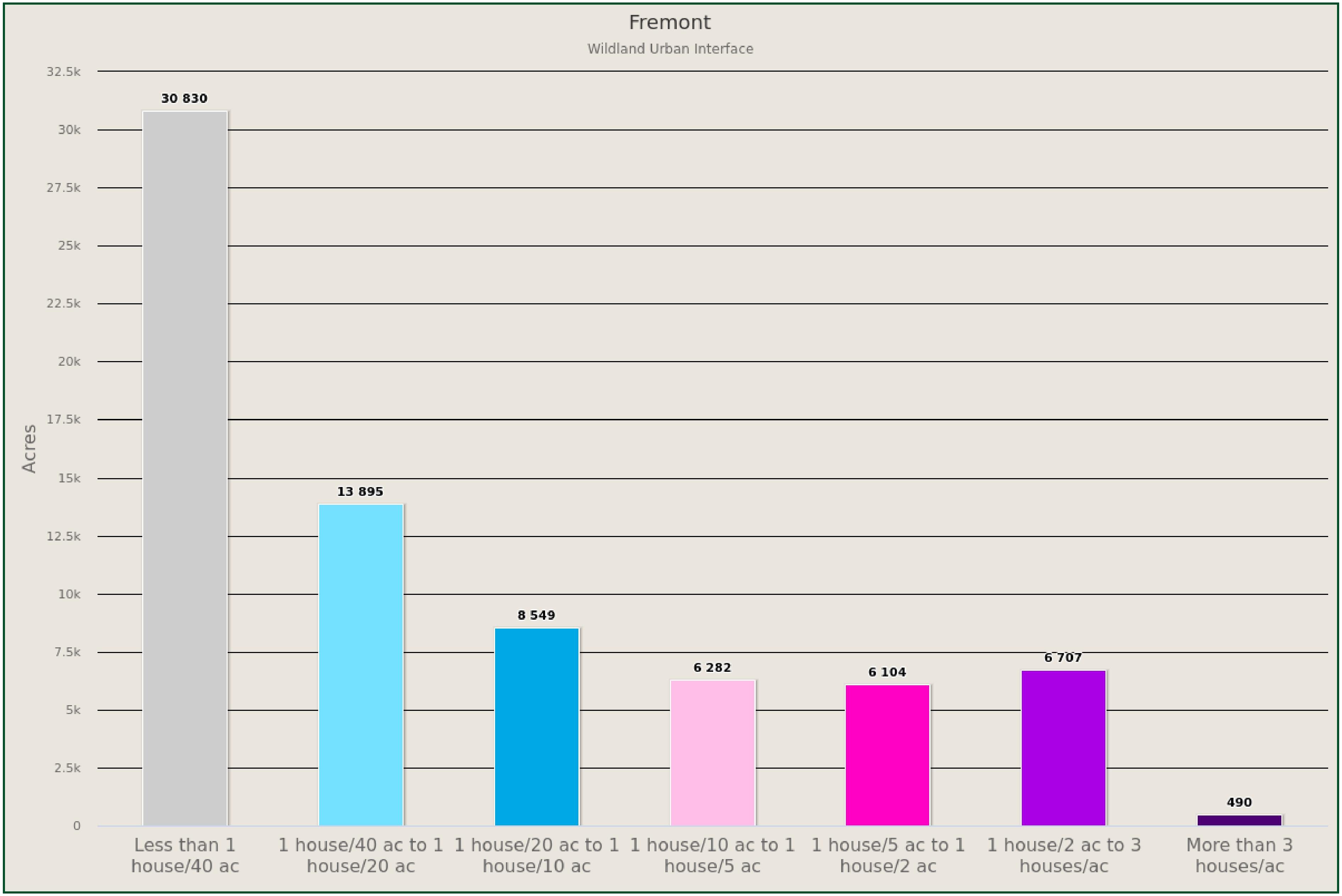
A more detailed description of the risk assessment algorithms is provided in the Colorado Wildfire Risk Assessment (Colorado WRA) Final Report, which can be downloaded from www.ColoradoForestAtlas.org.

Data are modeled at a 30-meter cell resolution (30 m2 or 900 m area per map cell), which is consistent with other Colorado WRA layers. The WUI classes are based on the number of houses per acre. Class breaks are based on densities understood and commonly used for fire protection planning.

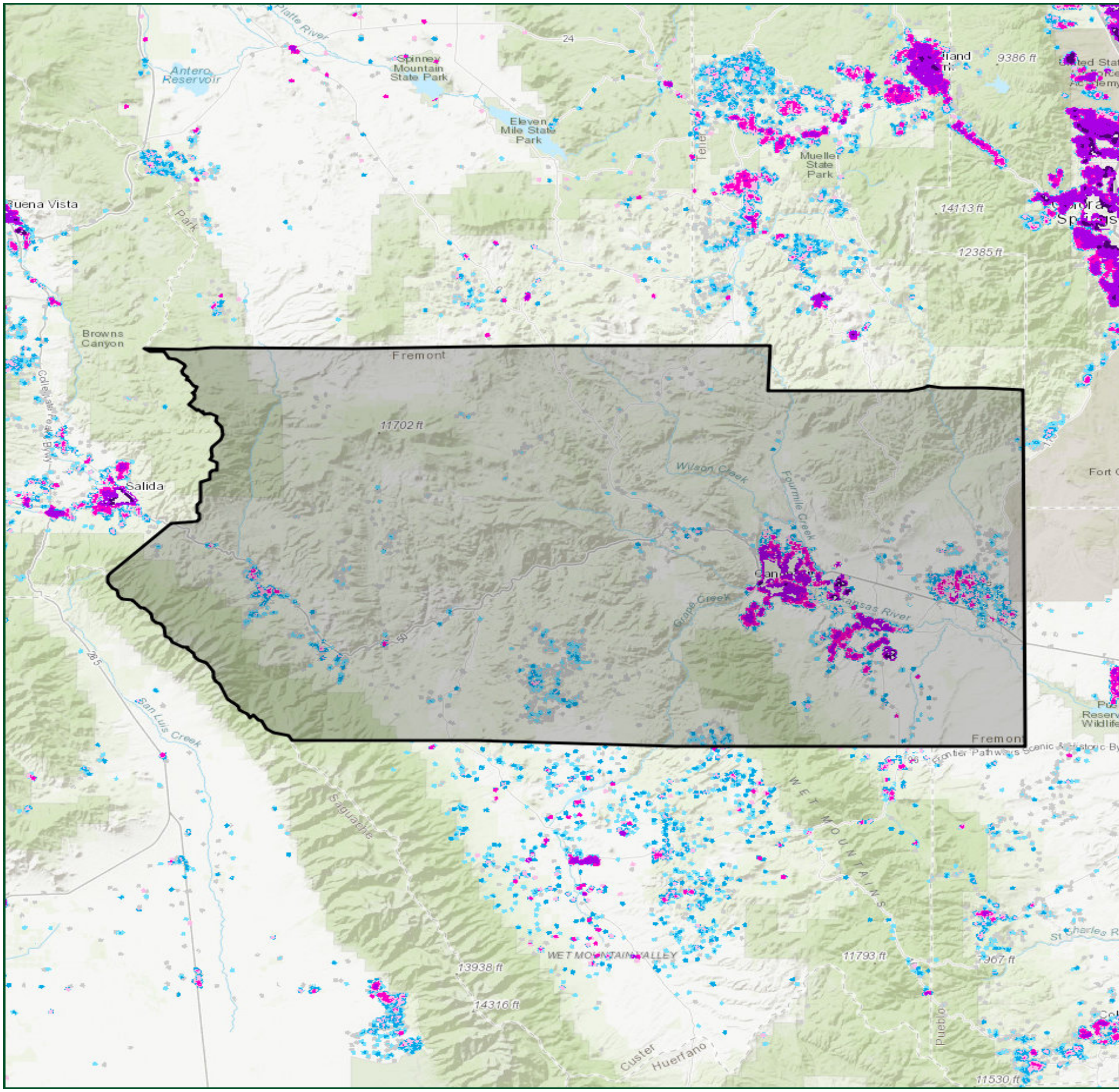
Housing Density	WUI Population	Percent of WUI Population	WUI Acres	Percent of WUI Acres
Less than 1 house/40 ac	854	2.5 %	30,830	42.3 %
1 house/40 ac to 1 house/20 ac	1,267	3.7 %	13,895	19.1 %
1 house/20 ac to 1 house/10 ac	1,504	4.4 %	8,549	11.7 %
1 house/10 ac to 1 house/5 ac	2,043	5.9 %	6,282	8.6 %
1 house/5 ac to 1 house/2 ac	4,369	12.8 %	6,104	8.4 %
1 house/2 ac to 3 houses/ac	18,871	56.8 %	6,707	9.2 %
More than 3 houses/ac	5,439	16.5 %	490	0.7 %
Total	**34,347**	**100.0 %**	**72,856**	**100.0 %**



Wildland Urban Interface
Fremont
Population
20k
18k
16k
14k
12k
10k
8k
6k
4k
2k
0
854
1 267
1 504
2 043
4 369
18 871
5 439
Less than 1 house/40 ac
1 house/40 ac to 1 house/20 ac
1 house/20 ac to 1 house/10 ac
1 house/10 ac to 1 house/5 ac
1 house/5 ac to 1 house/2 ac
1 house/2 ac to 3 houses/ac
More than 3 houses/ac



Fremont
Wildland Urban Interface
Acres
32.5k
30k
27.5k
25k
22.5k
20k
17.5k
15k
12.5k
10k
7.5k
5k
2.5k
0
30 830
13 895
8 549
6 282
6 104
6 707
490
Less than 1 house/40 ac
1 house/40 ac to 1 house/20 ac
1 house/20 ac to 1 house/10 ac
1 house/10 ac to 1 house/5 ac
1 house/5 ac to 1 house/2 ac
1 house/2 ac to 3 houses/ac
More than 3 houses/ac



Fremont

Wildland Urban Interface

- Less than 1 house/40 ac
- 1 house/40 ac to 1 house/20 ac
- 1 house/20 ac to 1 house/10 ac
- 1 house/10 ac to 1 house/5 ac
- 1 house/5 ac to 1 house/2 ac
- 1 house/2 ac to 3 houses/ac
- More than 3 houses/ac

10 mi

N S

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Wildland Urban Interface (WUI) Risk Index

Description

The Wildland-Urban Interface (WUI) Risk Index layer is a rating of the potential impact of a wildfire on people and their homes. The key input, WUI, reflects housing density (houses per acre) consistent with Federal Register National standards. The location of people living in the wildland-urban interface and rural areas is essential for defining potential wildfire impacts to people and homes.

The WUI Risk Index is derived using a response function modeling approach. Response functions are a method of assigning a net change in the value to a resource or asset based on susceptibility to fire at different intensity levels, such as flame length.

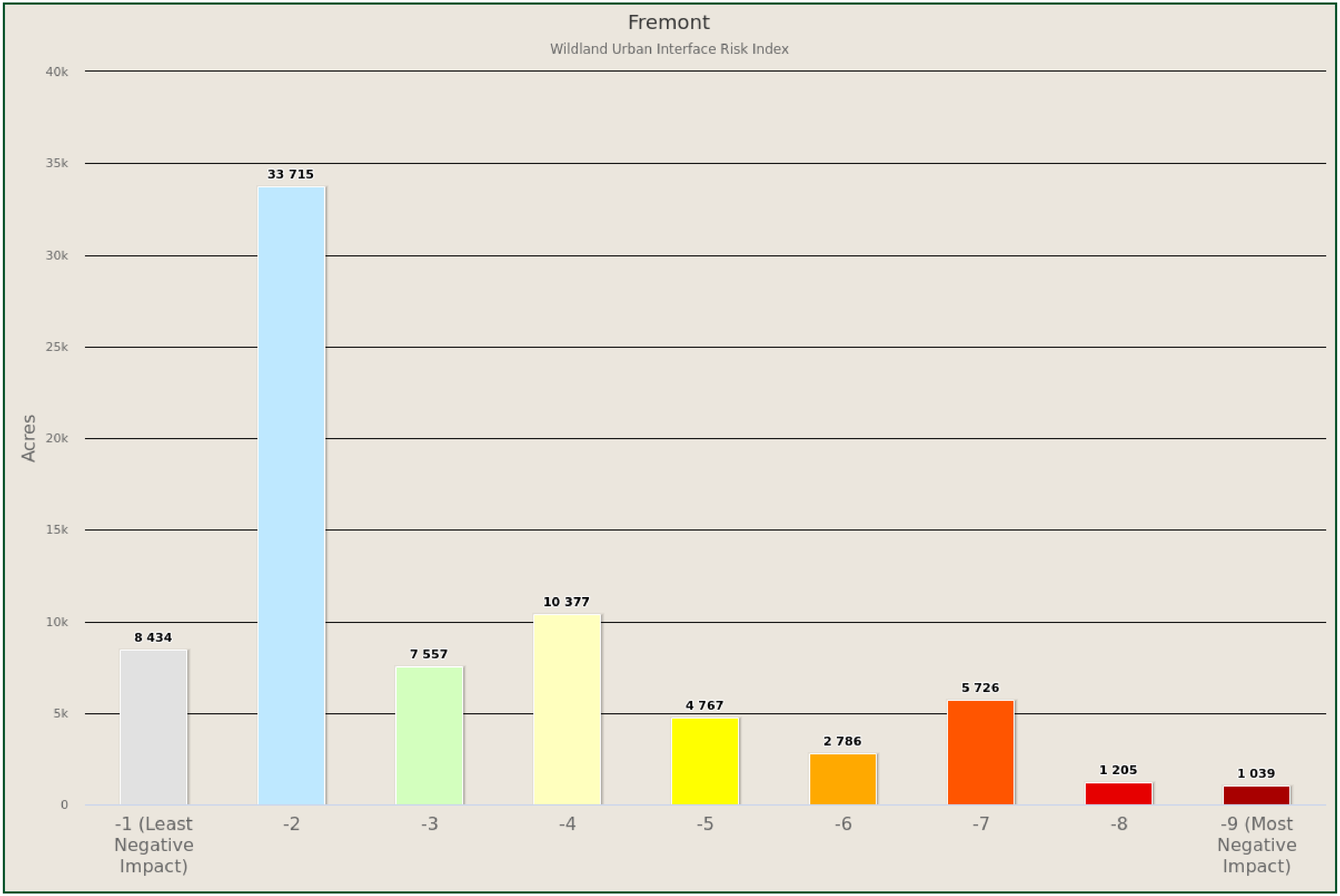
To calculate the WUI Risk Index, the WUI housing density data were combined with flame length data and response functions were defined to represent potential impacts. The response functions were defined by a team of experts led by Colorado State Forest

Service mitigation planning staff. By combining flame length with the WUI housing density data, it is possible to determine where the greatest potential impact to homes and people is likely to occur.

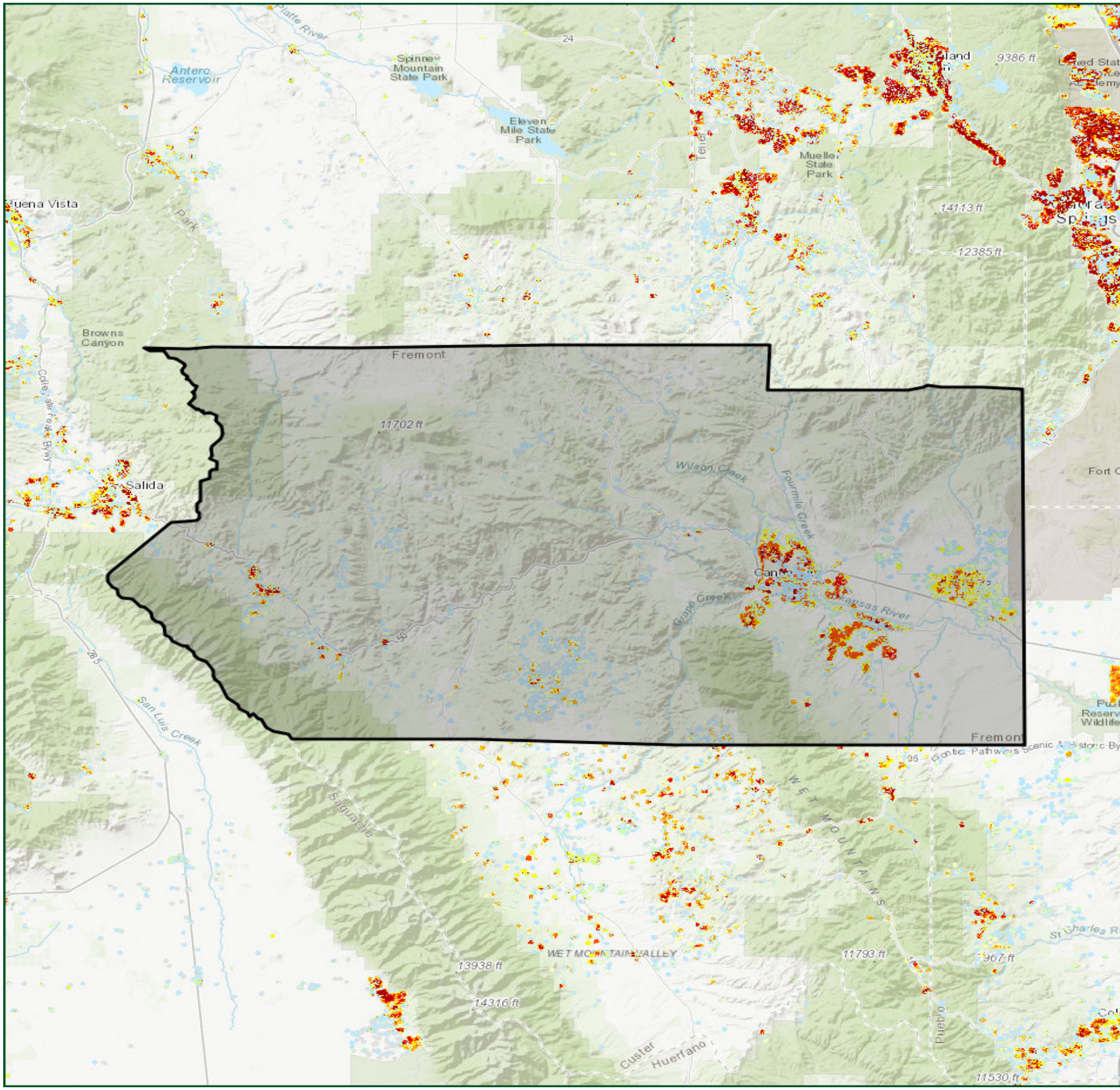
The range of values is from -1 to -9, with -1 representing the least negative impact and -9 representing the most negative impact. For example, areas with high housing density and high flame lengths are rated -9, while areas with low housing density and low flame lengths are rated -1.

The WUI Risk Index has been calculated consistently for all areas in Colorado, which allows for comparison and ordination of areas across the entire state. Data are modeled at a 30-meter cell resolution, which is consistent with other Colorado WRA layers.

WUI Risk Class	Acres	Percent
-1 (Least Negative Impact)	8,434	11.2 %
-2	33,715	44.6 %
-3	7,557	10.0 %
-4	10,377	13.7 %
-5	4,767	6.3 %
-6	2,786	3.7 %
-7	5,726	7.6 %
-8	1,205	1.6 %
-9 (Most Negative Impact)	1,039	1.4 %
Total	75,608	100 %



Fremont
Wildland Urban Interface Risk Index
Acres
40k
35k
30k
25k
20k
15k
10k
5k
0
8 434
33 715
7 557
10 377
4 767
2 786
5 726
1 205
1 039
-1 (Least Negative Impact)
-2
-3
-4
-5
-6
-7
-8
-9 (Most Negative Impact)



Fremont

Wildland Urban Interface Risk

- -1 (Least Negative Impact)
- -2
- -3
- -4
- -5
- -6
- -7
- -8
- -9 (Most Negative Impact)

10 mi

N
S

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Firewise USA®

Description

Firewise USA® is a national recognition program that provides resources to inform communities how to adapt to living with wildfire and encourages neighbors to take action together to reduce their wildfire risk. Colorado communities that take the following five steps can be recognized as Firewise:

1. Form a Firewise board or committee
2. Obtain a wildfire risk assessment from the CSFS or local fire department, and create an action plan
3. Hold a Firewise event once per year
4. Invest a minimum of $24.14 per dwelling unit in local Firewise actions annually
5. Create a National Fire Prevention Association (NFPA) profile and follow the application directions located at https://portal.firewise.org/user/login

NFPA

FIREWISE USA®

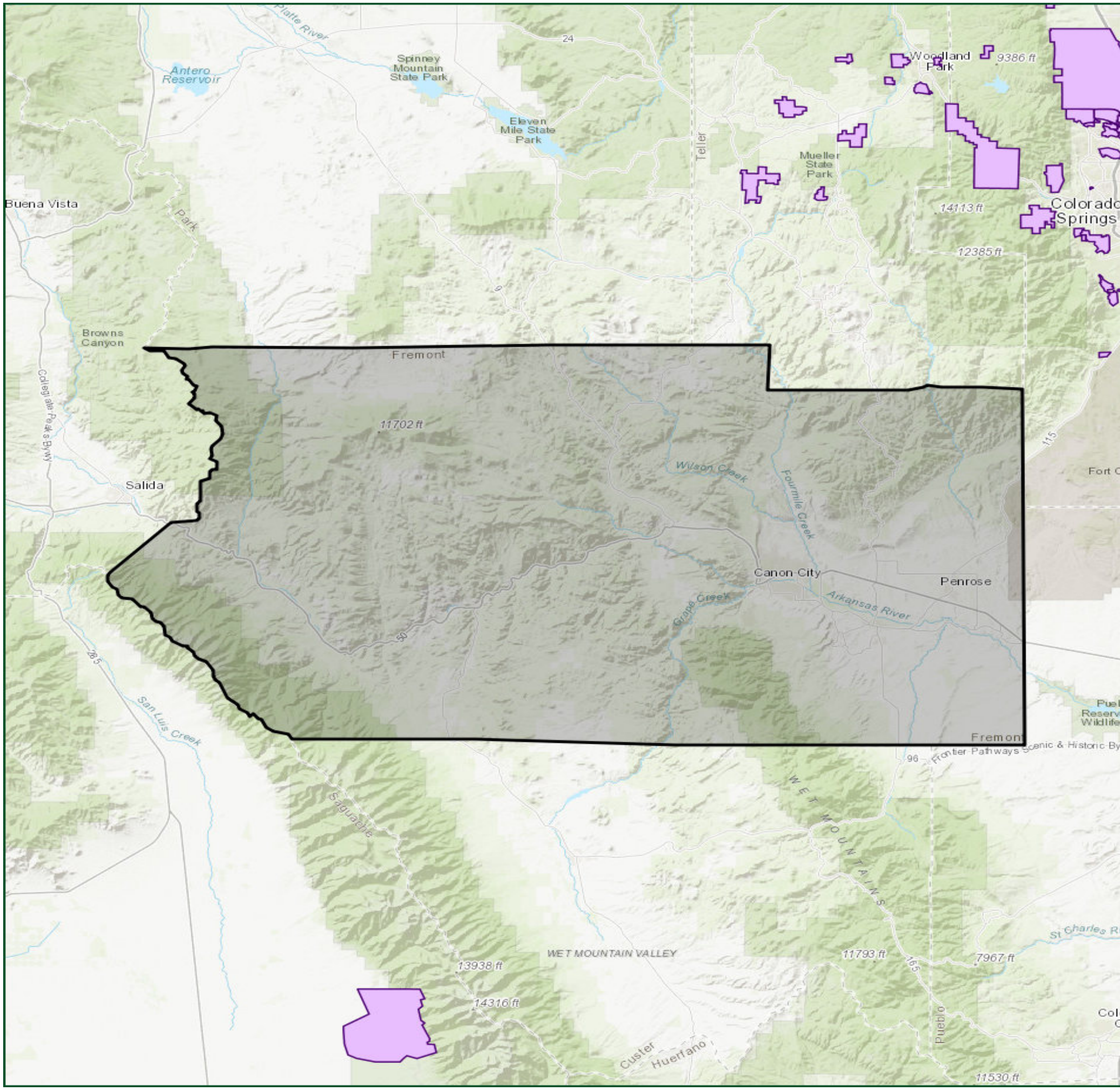
Residents reducing wildfire risks

The Firewise USA® dataset defines the boundaries of the recognized communities. Mapping Firewise USA® boundaries will generally be completed by CSFS staff.

Note: These are estimated boundaries using a variety of methods with varying degrees of accuracy. These are not legal boundaries and should not be construed as such. The boundaries may overlap with CWPP areas and are subject to change over time as the communities develop, change, and continue to implement wildfire mitigation efforts.

To learn more about the Firewise USA® recognition program or to fill out an application, visit https://www.nfpa.org/Public-Education/By-topic/Wildfire/Firewise-USA - OR - https://csfs.colostate.edu/wildfire-mitigation/colorado-firewise-communities/

The designated area does not contain data for this section.



Fremont

Fire Wise Communities

Fire Wise Communities 2018

10 mi

N

S

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Community Wildfire Protection Plans (CWPPs)

Description

A Community Wildfire Protection Plan (CWPP) is a document developed and agreed upon by a community to identify how the community will reduce its wildfire risk. CWPPs identify areas where fuels reduction is needed to reduce wildfire threats to communities and critical infrastructure, address protection of homes and other structures, and plan for wildfire response capability. The Colorado State Forest Service (CSFS) supports the development and implementation of CWPPs and provides resources, educational materials and information to those interested in developing CWPPs.

The CWPP dataset represents the boundaries of those areas that have developed a CWPP. Note that CWPPs can be developed by different groups at varying scales, such as county, Fire Protection District (FPD), community/subdivision, HOA, etc., and as such, can overlap. In addition, the CWPPs can be from different dates. Often a county CWPP is completed first with subsequently more detailed CWPPs done for local communities within that county or FPD. CO-WRAP provides a tool that allows the user to select the CWPP area and retrieve the CWPP document for review (PDF).

Community input is the foundation of a Community Wildfire Protection Plan that identfies community needs and garners community support.

At a minimum, a CWPP should include:

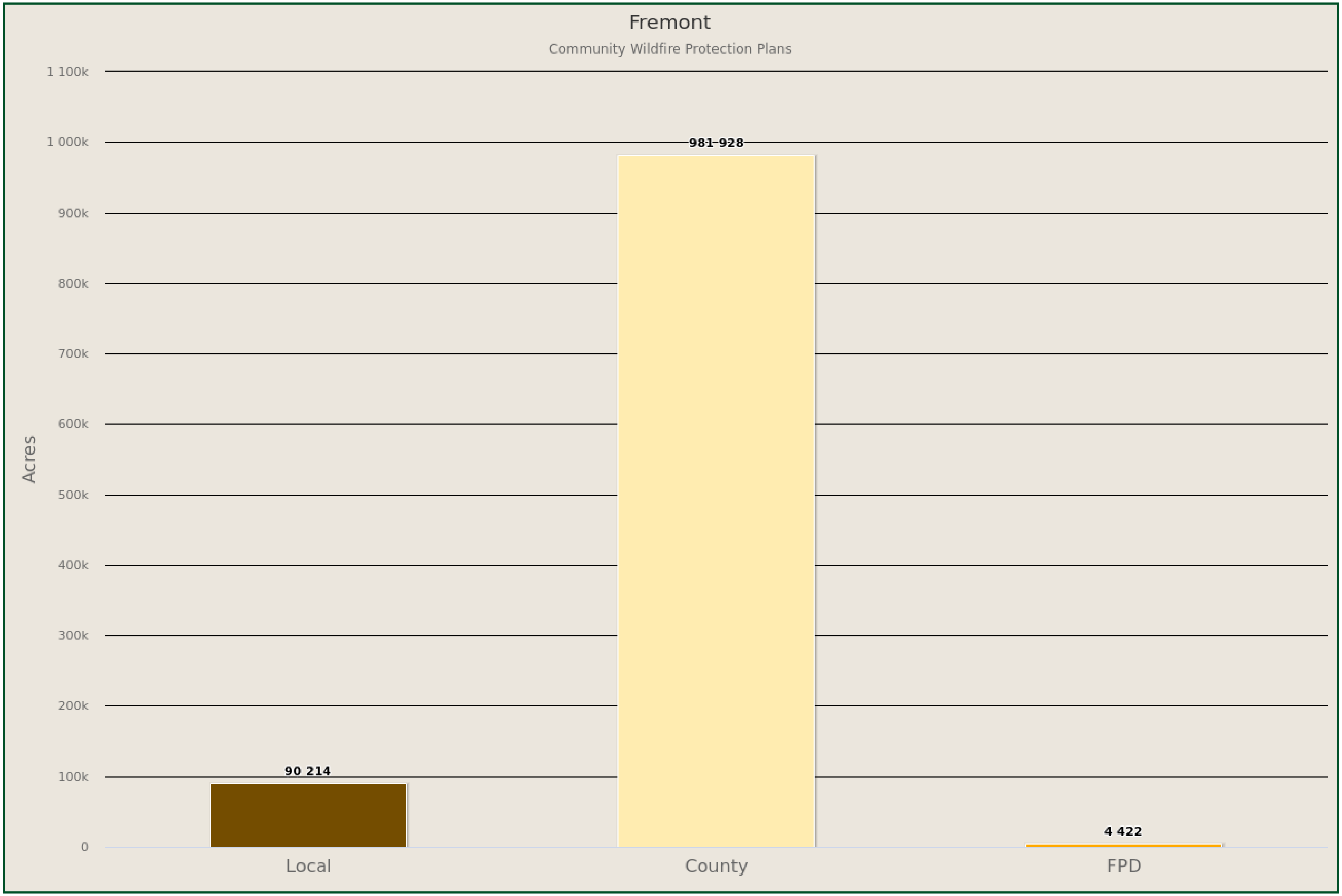
- The wildland-urban interface (WUI) boundary, defined on a map, where people, structures and other community values are most likely to be negatively impacted by wildfire
- The CSFS, local fire authority and local government involvement and any additional stakeholders
- A narrative that identifies the community’s values and fuel hazards
- The community’s plan for when a wildfire occurs
- An implementation plan that identifies areas of high priority for fuels treatments

CWPPs are not shelf documents and should be reviewed, tracked and updated. A plan stays alive when it is periodically updated to address the accomplishments of the community. Community review of progress in meeting plan objectives and determining areas of new concern where actions must be taken to reduce wildfire risk helps the community stay current with changing environment and wildfire mitigation priorities.

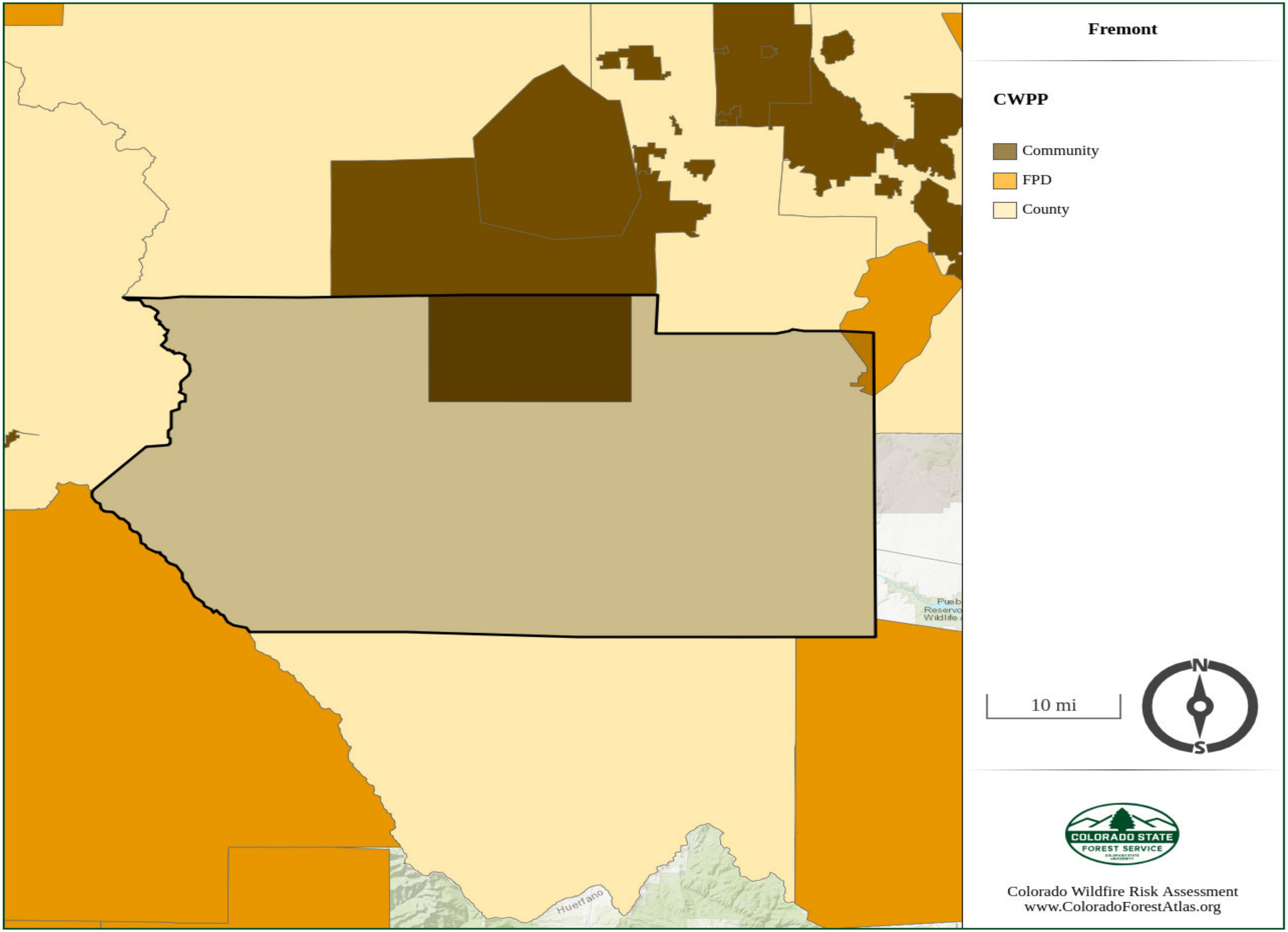
If your community is in an area at risk from wildfire, now is a good time to start working with neighbors on a CWPP and preparing forfuture wildfires. Contact your local CSFS district to learn how to start this process and create a CWPP for your community: http://csfs.colostate.edu/pages/your-local-forester.html

For the Fremont test project area, there are 10 CWPPs areas that are totally or partially in the defined project area.

Community CWPP Name	CWPP Type	CSFS District	Acres inside project area	Total Acres
Four Mile-Currant Creek	Local	Woodland Park	90,214	275,451
El Paso County	County	Woodland Park	1	1,361,915
Teller County	County	Woodland Park	16	357,471
Chaffee County	County	Salida	16	649,122
Fremont County	County	Canon City	981,882	980,970
Park County	County	Woodland Park	5	1,413,950
Custer County	County	Canon City	8	473,187
SW Hwy 115 FPD	FPD	Woodland Park	4,413	42,502
Southwest Pueblo County	FPD	Canon City	9	264,925
Northern Saguache County FPD CWPP	FPD	Alamosa	0	1,048,408
Total Acres			**1,076,564**	**6,867,903**



Fremont
Community Wildfire Protection Plans
Acres
1 100k
1 000k
900k
800k
700k
600k
500k
400k
300k
200k
100k
0
981 928
90 214
4 422
Local
County
FPD



Fremont
CWPP
Community
FPD
County
10 mi
N
S
Huerfano
Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Wildfire Risk

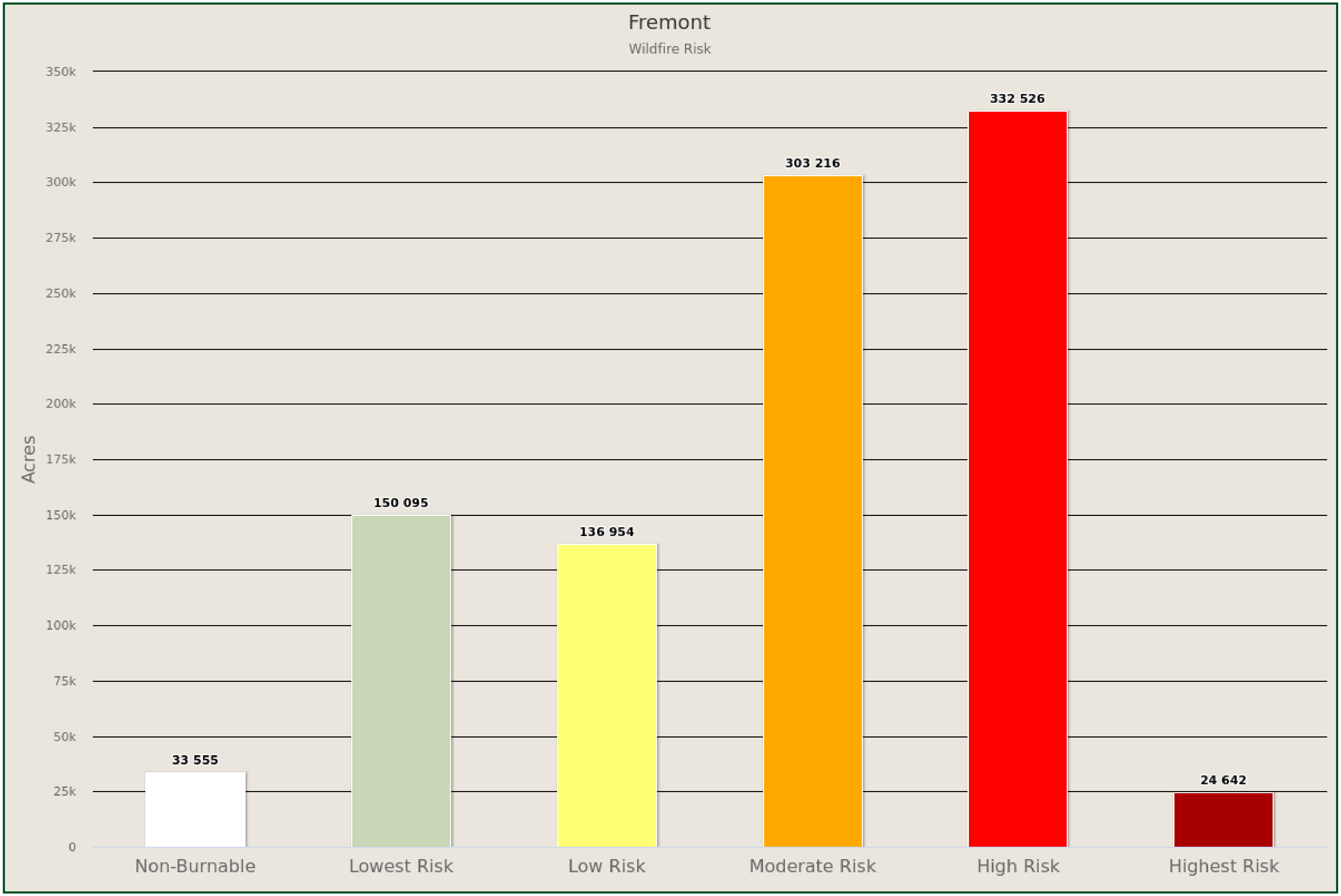
Description

Wildfire Risk is a composite risk rating obtained by combining the probability of a fire occurring with the individual values at risk layers. Risk is defined as the possibility of loss or harm occurring from a wildfire. It identifies areas with the greatest potential impacts from a wildfire – i.e. those areas most at risk - considering all values and assets combined together – WUI Risk, Drinking Water Risk, Forest Assets Risk and Riparian Areas Risk.

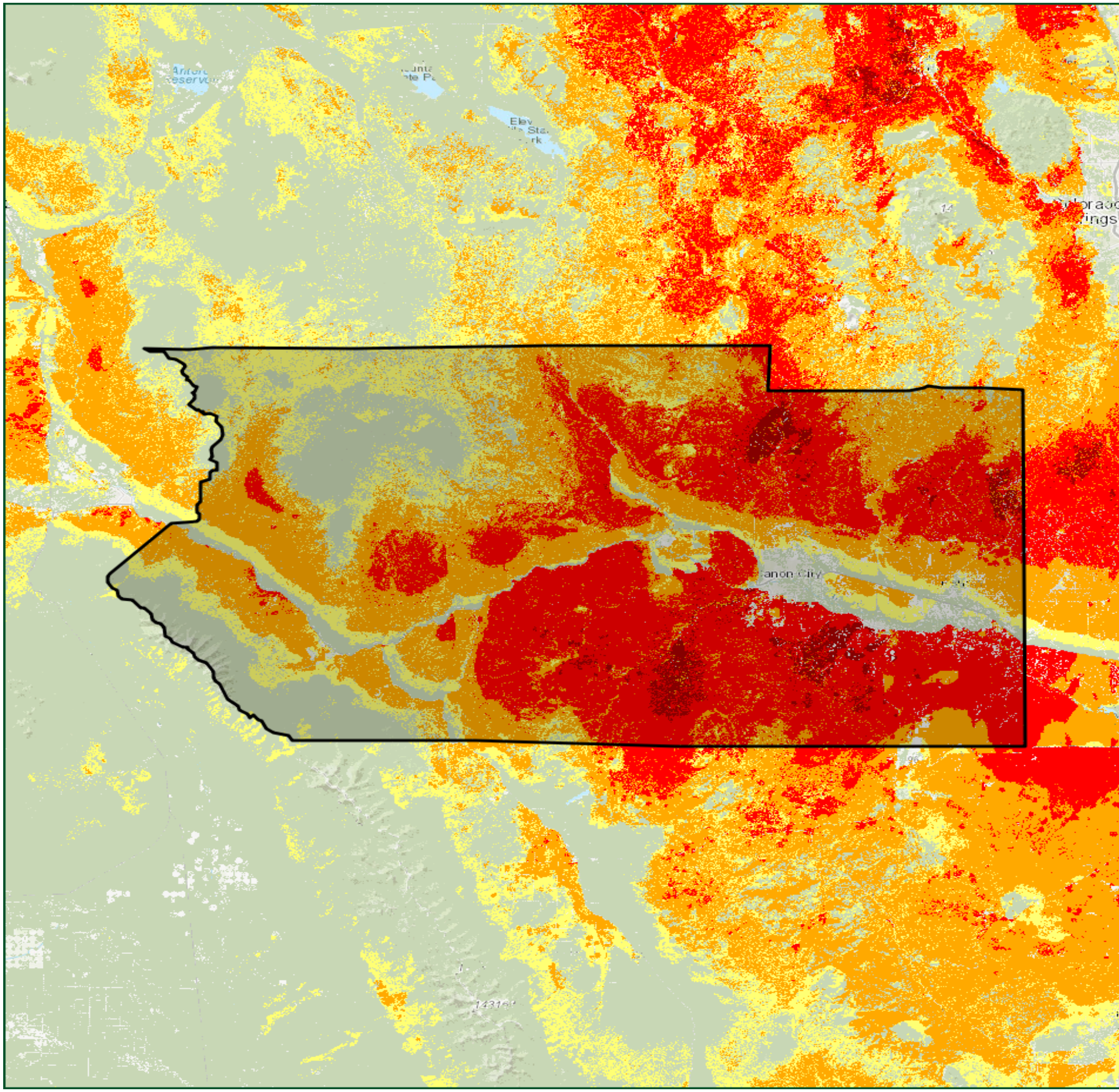
Since all areas in Colorado have risk calculated consistently, it allows for comparison and ordination of areas across the entire state. The Values at Risk Rating is a key component of Wildfire Risk. The Values at Risk Rating is comprised of several inputs focusing on values and assets at risk. This includes Wildland Urban Interface, Forest Assets, Riparian Assets and Drinking Water Importance Areas (watersheds).

To aid in the use of Wildfire Risk for planning activities, the output values are categorized into five (5) classes. These are given general descriptions from Lowest to Highest Risk.

Wildfire Risk Class		Acres	Percent
	Non-Burnable	33,555	3.4 %
	Lowest Risk	150,095	15.3 %
	Low Risk	136,954	14.0 %
	Moderate Risk	303,216	30.9 %
	High Risk	332,526	33.9 %
	Highest Risk	24,642	2.5 %
Total		980,988	100 %


Fremont
Wildfire Risk
Acres
350k
325k
300k
275k
250k
225k
200k
175k
150k
125k
100k
75k
50k
25k
0
33 555
150 095
136 954
303 216
332 526
24 642
Non-Burnable
Lowest Risk
Low Risk
Moderate Risk
High Risk
Highest Risk

Fremont



Wildfire Risk

- Non-Burnable
- Lowest Risk
- Low Risk
- Moderate Risk
- High Risk
- Highest Risk

10 mi

N

S

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Burn Probability

Description

Burn Probability (BP) is the annual probability of any location burning due to a wildfire. BP is calculated as the number of times that a 30-meter cell on the landscape is burned from millions of fire simulations. The annual BP was estimated by using a stochastic (Monte Carlo) wildfire simulation approach with Technosylva's Wildfire Analyst software (www.WildfireAnalyst.com).

A total number of 3,200,000 fires were simulated across the state, including those fires outside the Colorado border which were used in a buffer area around the state, to compute BP with a mean ignition density of 8.68 fires/km2. The simulation ignition points were spatially distributed evenly every 500 meters across the state. Only high and extreme weather conditions were used to run the simulations. All fires simulations had a duration of 10 hours.

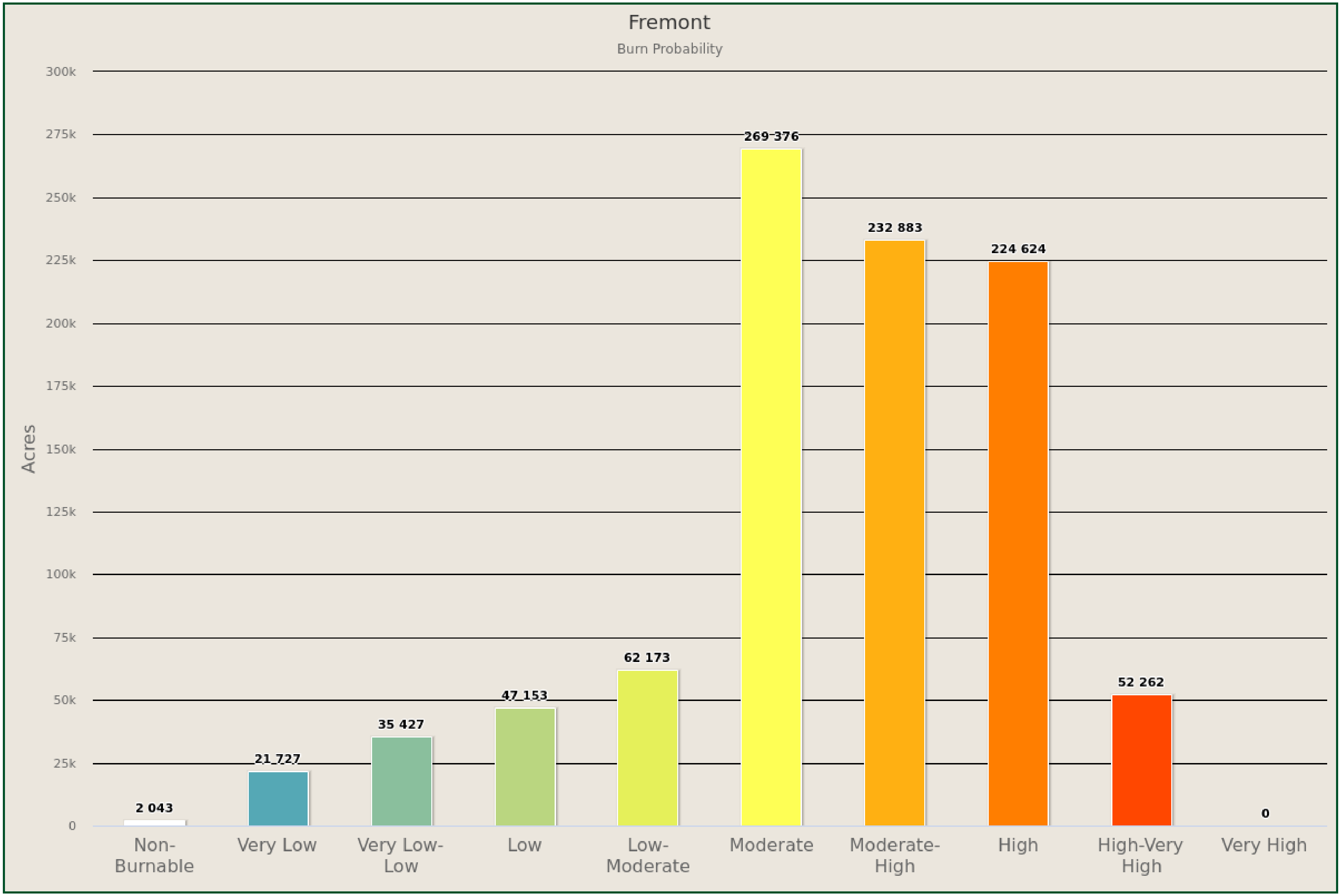
The Wildfire Analyst fire simulator considered the number of times that the simulated fires burned each cell. After that, results were weighted by considering the historical fire occurrence of those fires that burned in high and extreme weather conditions. The weighting was done by assessing the relationship between the annual historical fire ignition density in Colorado and the total number of simulated fires with varying input data in the different weather scenarios and the historical spatial distribution of the ignition points.

The probability map is derived at a 30-meter resolution. This scale of data was chosen to be consistent with the accuracy of the primary surface fuels dataset used in the assessment. While not appropriate for site specific analysis, it is appropriate for regional, county or local protection mitigation or prevention planning.

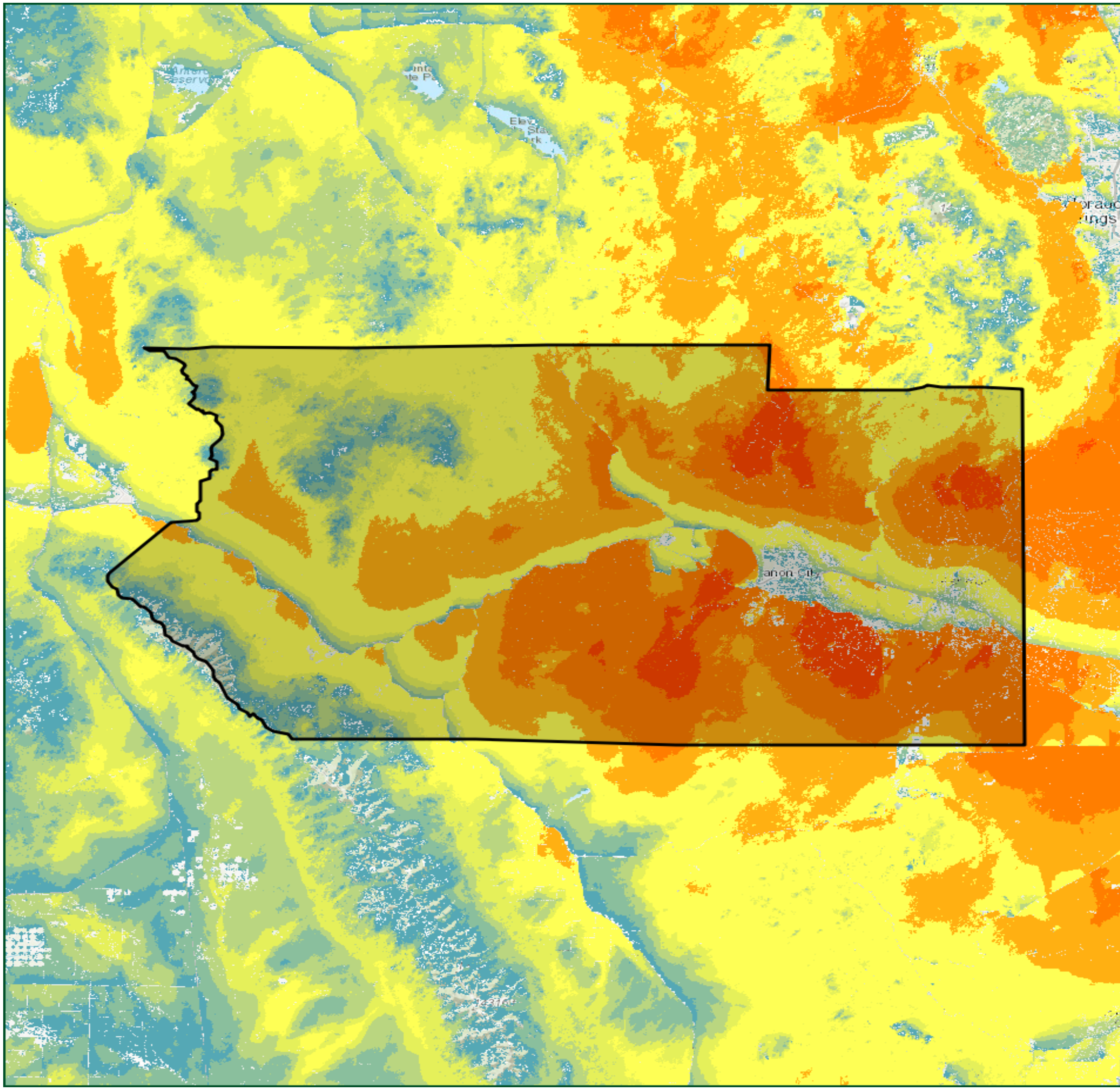
To aid in the use of Burn Probability for planning activities, the output values are categorized into 10 (ten) classes. These are given general descriptions from Lowest to Highest Probability.

A more detailed description of the risk assessment algorithms is provided in the Colorado WRA Final Report, which can be downloaded from www.ColoradoForestAtlas.org.

Burn Probability Class	Acres	Percent
Non-Burnable	2,043	0.2 %
Very Low	21,727	2.3 %
Very Low-Low	35,427	3.7 %
Low	47,153	5.0 %
Low-Moderate	62,173	6.6 %
Moderate	269,376	28.4 %
Moderate-High	232,883	24.6 %
High	224,624	23.7 %
High-Very High	52,262	5.5 %
Very High	0	0 %
Total	**947,668**	**100 %**



Fremont
Burn Probability
Acres
300k
275k
250k
225k
200k
175k
150k
125k
100k
75k
50k
25k
0
2 043
21 727
35 427
47 153
62 173
269 376
232 883
224 624
52 262
0
Non-Burnable
Very Low
Very Low-Low
Low
Low-Moderate
Moderate
Moderate-High
High
High-Very High
Very High



Fremont

Burn Probability

- Non-Burnable
- Very Low
- Very Low-Low
- Low
- Low-Moderate
- Moderate
- Moderate-High
- High
- High-Very High
- Very High

10 mi

N

S

COLORADO STATE FOREST SERVICE

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Values at Risk Rating

Description

Represents those values or assets that would be adversely impacted by a wildfire. The Values at Risk Rating is an overall rating that combines the risk ratings for Wildland Urban Interface (WUI), Forest Assets, Riparian Assets, and Drinking Water Importance Areas into a single measure of values-at-risk. The individual ratings for each value layer were derived using a Response Function approach.

Response functions are a method of assigning a net change in the value to a resource or asset based on susceptibility to fire at different intensity levels. A resource or asset is any of the Fire Effects input layers, such as WUI, Forest Assets, etc. These net changes can be adverse (negative) or positive (beneficial).

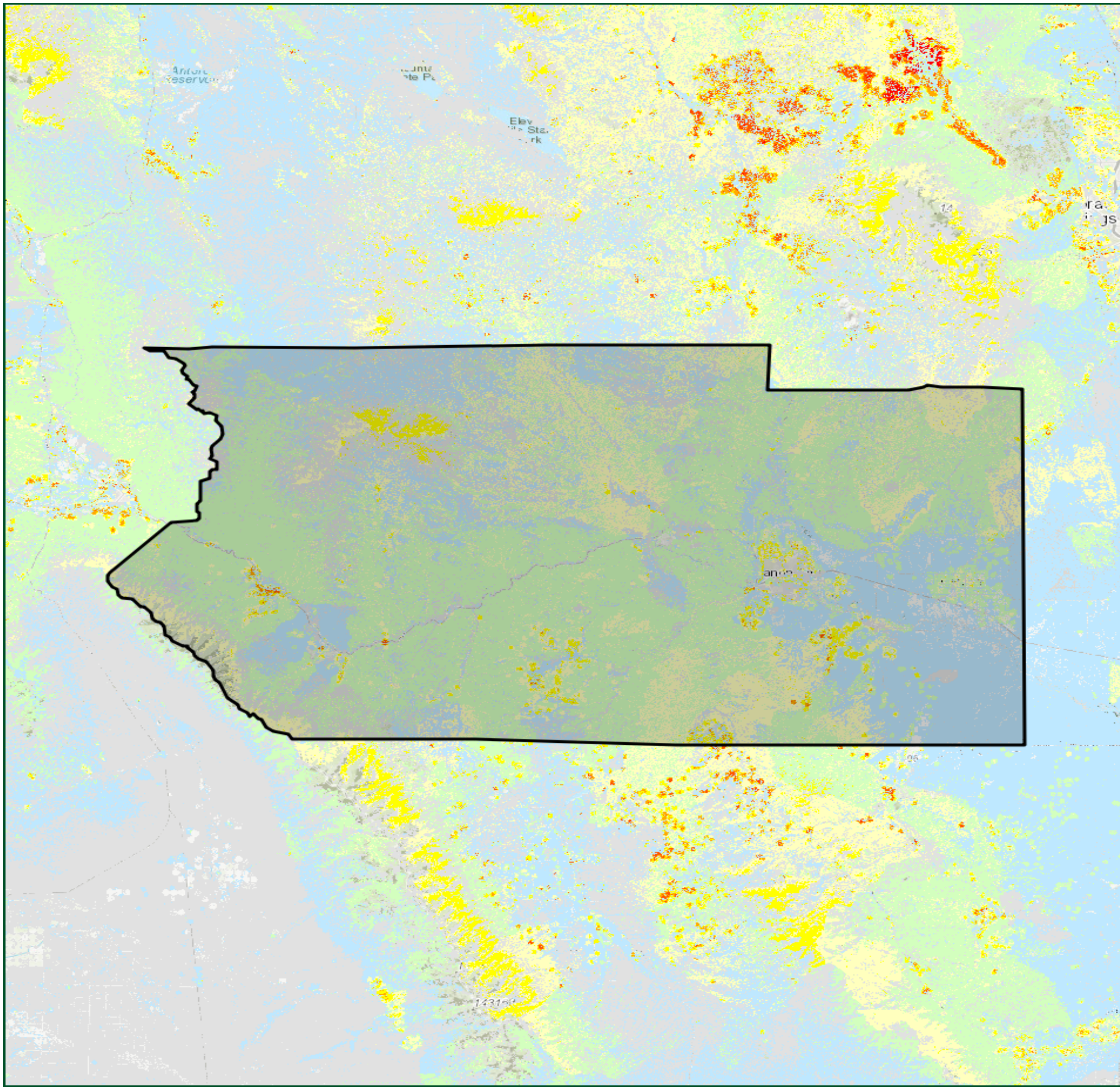
Calculating the Values at Risk Rating at a given location requires spatially defined estimates of the intensity of fire integrated with the identified resource value. This interaction is quantified through the use of response functions that estimate expected impacts to resources or assets at the specified fire intensity levels. The measure of fire intensity level used in the Colorado assessment is flame length for a location. Response Function outputs were derived for each input dataset and then combined to derive the Values Impacted Rating.

Different weightings are used for each of the input layers with the highest priority placed on protection of people and structures (i.e. WUI). The weightings represent the value associated with those assets. Weightings were developed by a team of experts during the assessment to reflect priorities for fire protection planning in Colorado. Refer to the Colorado WRA Final Report for more information about the layer weightings.

Since all areas in Colorado have the Values at Risk Rating calculated consistently, it allows for comparison and ordination of areas across the entire state. The data were derived at a 30-meter resolution.

Values at Risk Class	Acres	Percent
-1 (Least Negative Impact)	143,773	15.0 %
-2	223,718	23.4 %
-3	417,142	43.7 %
-4	154,437	16.2 %
-5	15,020	1.6 %
-6	1,034	0.1 %
-7	273	0.0 %
-8	1	0.0 %
-9 (Most Negative Impact)	0	0 %
Total	955,397	100 %


Fremont
Values at Risk Rating
450k
400k
350k
300k
250k
200k
150k
100k
50k
0
Acres
143 773
223 718
417 142
154 437
15 020
1 034
273
1
0
-1 (Least Negative Impact)
-2
-3
-4
-5
-6
-7
-8
-9 (Most Negative Impact)



Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Suppression Difficulty Rating

Description

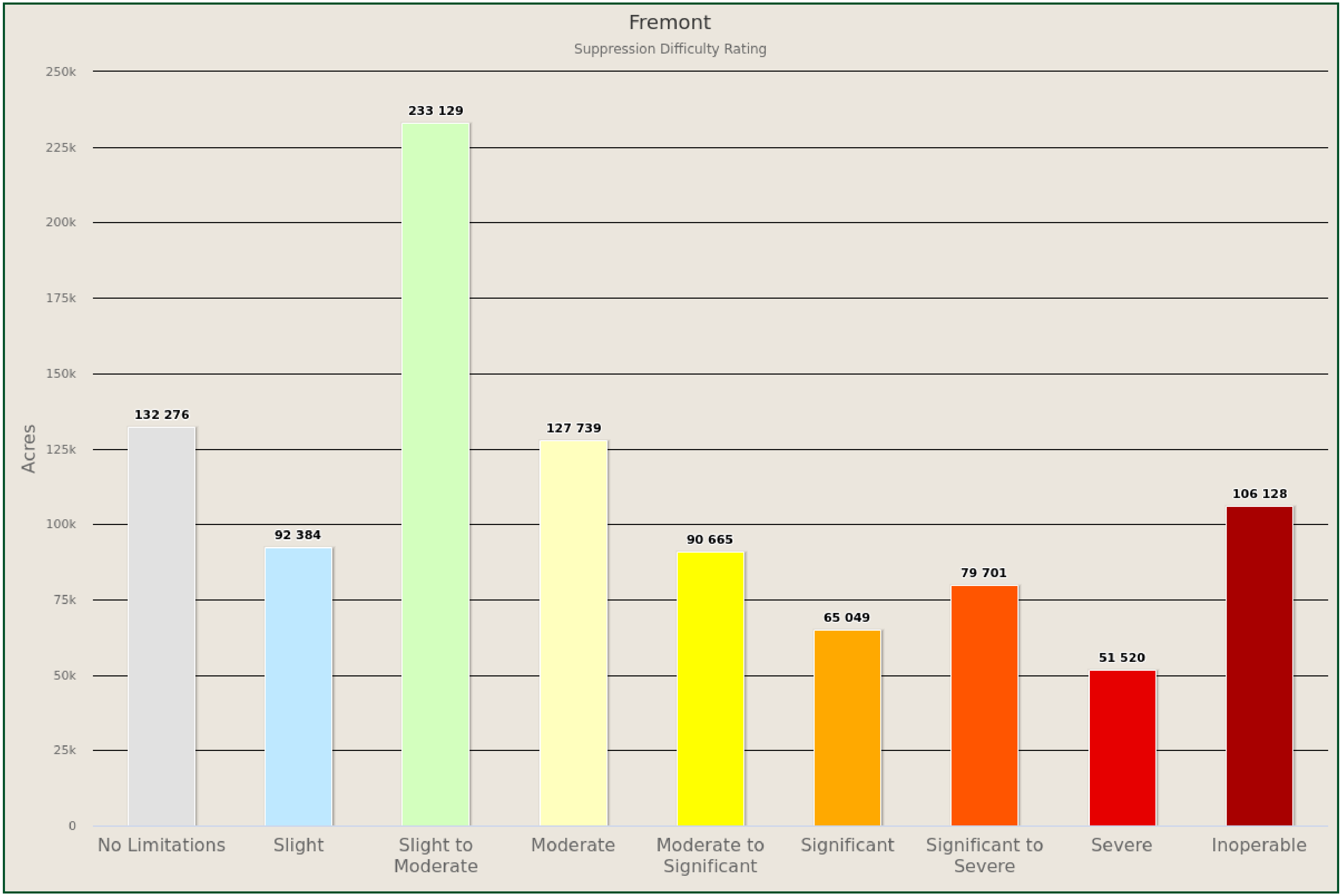
Reflects the difficulty or relative cost to suppress a fire given the terrain and vegetation conditions that may impact machine operability. This layer is an overall index that combines the slope steepness and the vegetation/fuel type characterization to identify areas where it would be difficult or costly to suppress a fire due to the underlying terrain and vegetation conditions that would impact machine operability (in particular Type II dozer).

The rating was calculated based on the fireline production rates for hand crews and engines with modifications for slope, as documented in the NWCG Fireline Handbook 3, PMS 401-1.

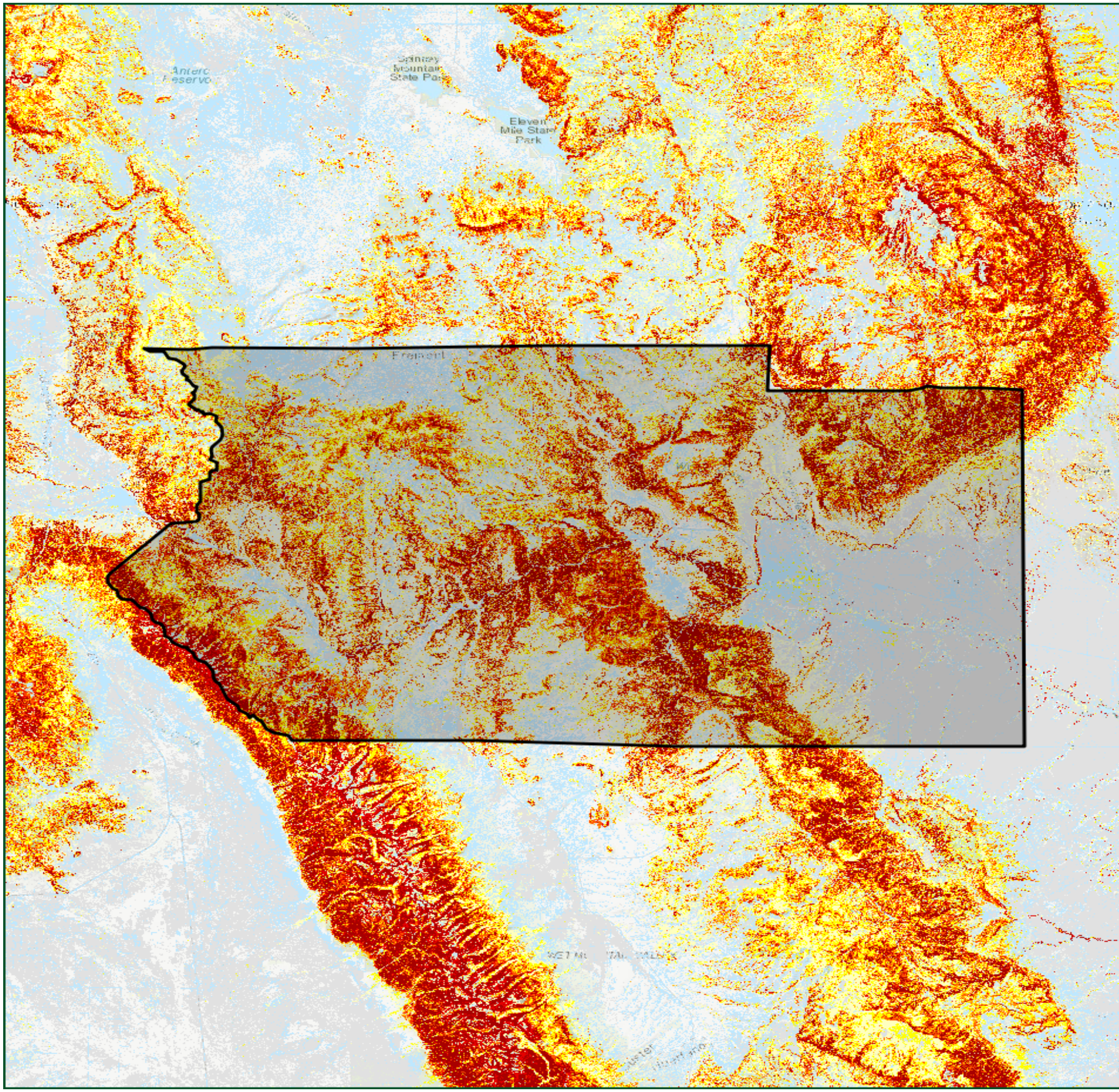
The burnable fuel models in the Colorado WRA were grouped into ten categories: Grass, Grass/Shrub, Shrub/Regeneration, Moderate Forest, Heavy Forest, Swamp/Marsh, Agriculture, Barren, Urban/Developed, Water/Ice.

Fireline production capability on six slope classes was used as the basic reference to obtain the suppression difficulty score. The response function category is assigned to each combination of fuel model group and slope category.

SDR Class	Acres	Percent
No Limitations	132,276	13.5 %
Slight	92,384	9.4 %
Slight to Moderate	233,129	23.8 %
Moderate	127,739	13.1 %
Moderate to Significant	90,665	9.3 %
Significant	65,049	6.6 %
Significant to Severe	79,701	8.1 %
Severe	51,520	5.3 %
Inoperable	106,128	10.8 %
Total	978,591	100 %



Fremont
Suppression Difficulty Rating
Acres
250k
225k
200k
175k
150k
125k
100k
75k
50k
25k
0
132 276
92 384
233 129
127 739
90 665
65 049
79 701
51 520
106 128
No Limitations
Slight
Slight to Moderate
Moderate
Moderate to Significant
Significant
Significant to Severe
Severe
Inoperable



Fremont

Suppression Difficulty

- No Limitations
- Slight
- Slight to Moderate
- Moderate
- Moderate to Significant
- Significant
- Significant to Severe
- Severe
- Inoperable

10 mi

N
S

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Fire Occurrence

Description

Fire Occurrence is an ignition density that represents the likelihood of a wildfire starting based on historical ignition patterns. Occurrence is derived by modeling historic wildfire ignition locations to create an ignition density map.

Historic fire report data were used to create the ignition points for all Colorado fires. The compiled fire occurrence database was cleaned to remove duplicate records and to correct inaccurate locations. The database was then modeled to create a density map reflecting historical fire ignition rates.

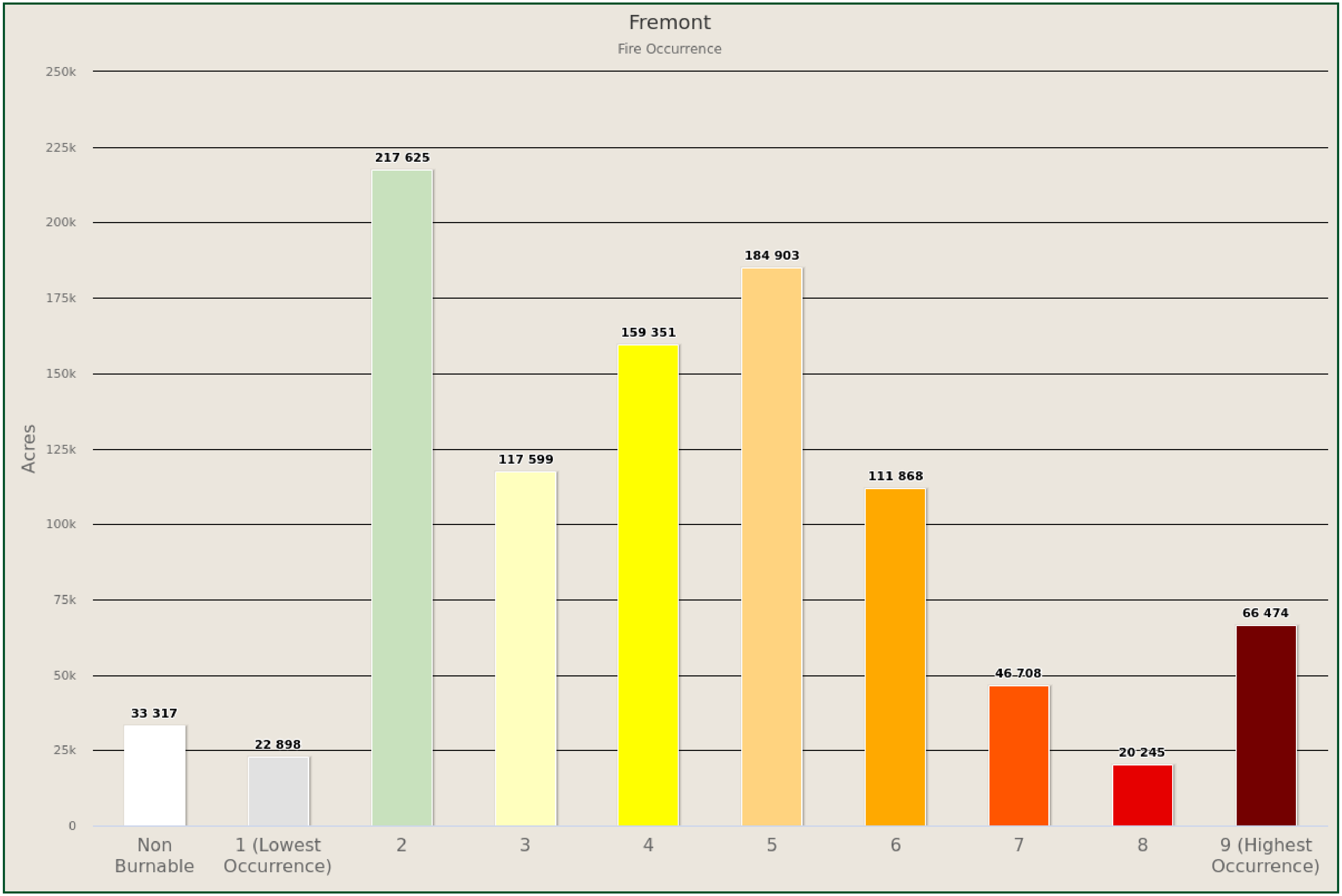
Historic fire report data were used to create the ignition points for all Colorado fires. This included both federal and non-federal fire ignition locations.

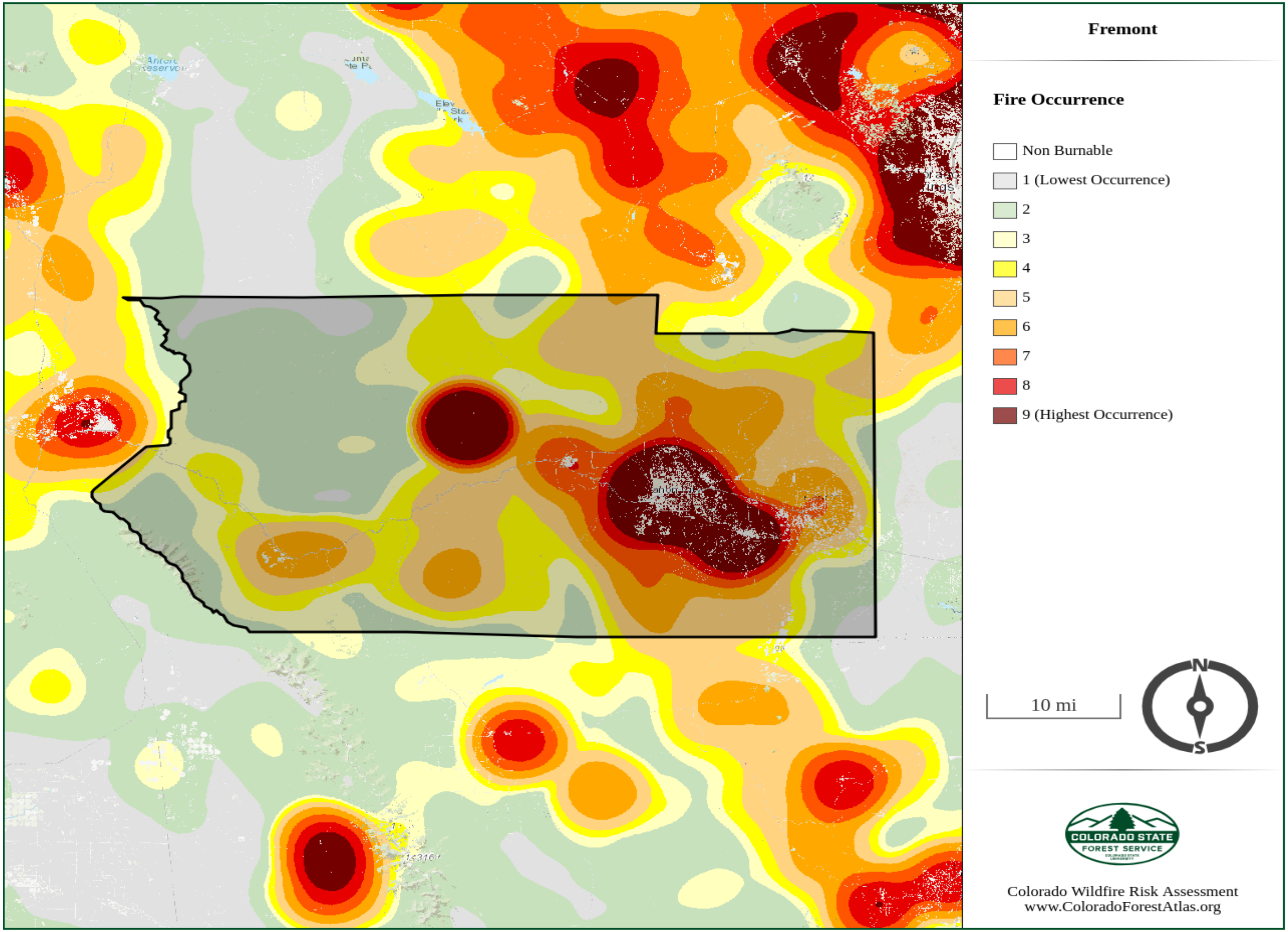
The class breaks are determined by analyzing the Fire Occurrence output values for the entire state and determining cumulative percent of acres (i.e. Class 9 has the top 1.5% of acres with the highest occurrence rate). Refer to the Colorado WRA Final Report for a more detailed description of the mapping classes and the methods used to derive these.

The Fire Occurrence map is derived at a 30-meter resolution. This scale of data was chosen to be consistent with the accuracy of the primary surface fuels dataset used in the assessment. While not sufficient for site specific analysis, it is appropriate for regional, county or local protection mitigation or prevention planning.

A more detailed description of the risk assessment algorithms is provided in the Colorado WRA Final Report, which can be downloaded from www.ColoradoForestAtlas.org.

Fire Occurrence Class	Acres	Percent
Non Burnable	33,317	3.4 %
1 (Lowest Occurrence)	22,898	2.3 %
2	217,625	22.2 %
3	117,599	12.0 %
4	159,351	16.2 %
5	184,903	18.8 %
6	111,868	11.4 %
7	46,708	4.8 %
8	20,245	2.1 %
9 (Highest Occurrence)	66,474	6.8 %
Total	**980,988**	**100 %**


Fremont
Fire Occurrence
Acres
250k
225k
200k
175k
150k
125k
100k
75k
50k
25k
0
33 317
22 898
217 625
117 599
159 351
184 903
111 868
46 708
20 245
66 474
Non Burnable
1 (Lowest Occurrence)
2
3
4
5
6
7
8
9 (Highest Occurrence)

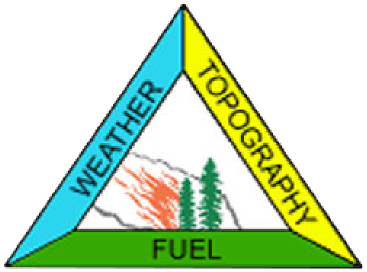

Fremont
Fire Occurrence
Non Burnable
1 (Lowest Occurrence)
2
3
4
5
6
7
8
9 (Highest Occurrence)
10 mi
N
S
COLORADO STATE
FOREST SERVICE
Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Fire Behavior

Description

Fire behavior is the manner in which a fire reacts to the following environmental influences:

1. **Fuels**
2. **Weather**
3. **Topography**



Fire behavior characteristics are attributes of wildland fire that pertain to its spread, intensity, and growth. Fire behavior characteristics utilized in the Colorado WRA include fire type, rate of spread, flame length and fireline intensity (fire intensity scale). These metrics are used to determine the potential fire behavior under different weather scenarios. Areas that exhibit moderate to high fire behavior potential can be identified for mitigation treatments, especially if these areas are in close proximity to homes, business, or other assets.

Fuels

The Colorado WRA includes composition and characteristics for both surface fuels and canopy fuels. Assessing canopy fire potential and surface fire potential allows identification of areas where significant increases in fire behavior affects the potential of a fire to transition from a surface fire to a canopy fire.

Fuel datasets required to compute both surface and canopy fire potential include:

1. **Surface Fuels** are typically categorized into one of four primary fuel types based on the primary carrier of the surface fire: 1) grass, 2) shrub/brush, 3) timber litter, and 4) slash. They are generally referred to as fire behavior fuel models and provide the input parameters needed to compute surface fire behavior. The 2017 assessment uses the latest 2017 calibrated fuels for Colorado.
2. **Canopy Cover** is the horizontal percentage of the ground surface that is covered by tree crowns. It is used to compute wind-reduction factors and shading.
3. **Canopy Ceiling Height/Stand Height** is the height above the ground of the highest canopy layer where the density of the crown mass within the layer is high enough to support vertical movement of a fire. A good estimate of canopy ceiling height is the average height of the dominant and co-dominant trees in a stand. It is used to compute wind reduction to mid-flame height, and spotting distances from torching trees.
4. **Canopy Base** Height is the lowest height above the ground above which sufficient canopy fuel exists to vertically propagate fire (Scott & Reinhardt, 2001). Canopy base height is a property of a plot, stand or group of trees, not an individual tree. For fire modeling, canopy base height is an effective value that incorporates ladder fuels, such as tall shrubs and small trees. Canopy base height is used to determine whether a surface fire will transition to a canopy fire.

5. **Canopy Bulk Density** is the mass of available canopy fuel per unit canopy volume (Scott & Reinhardt, 2001). Canopy bulk density is a bulk property of a stand, plot or group of trees, not an individual tree. Canopy bulk density is used to predict whether an active crown fire is possible.

Weather

Environmental weather parameters needed to compute fire behavior characteristics include 1-hour, 10-hour and 100-hour time-lag fuel moistures, herbaceous fuel moisture, woody fuel moisture and the 20-foot, 10-minute average wind speed. To collect this information, Weather data (1988-2017) from NCEP (National Center for Environmental Prediction) was used to analyse potential weather scenarios in which assessing fire behavior and spread. In particular, the North American Regional Reanalysis (NARR) product from NCEP was selected because of it provides high resolution weather data for all of Colorado. The following percentiles (97th, 90th, 50th and 25th) were analysed for each variable in each 30km NARR point to create four weather scenarios to run the fire behavior analysis: “Extreme”, “High”, “Moderate” and “Low”. After computing the weather percentiles of the NARR variables, an IDW algorithm was used to derive 30m resolution data to match the surface fuels dataset.

The four percentile weather categories are intended to represent low, moderate, high and extreme fire weather days. Fire behavior outputs are computed for each percentile weather category to determine fire potential under different weather scenarios.

For a detailed description of the methodology, refer to the 2017 Colorado Wildfire Risk Assessment Final Report at www.ColoradoForestAtlas.org.

Topography

Topography datasets required to compute fire behavior characteristics are elevation, slope and aspect.

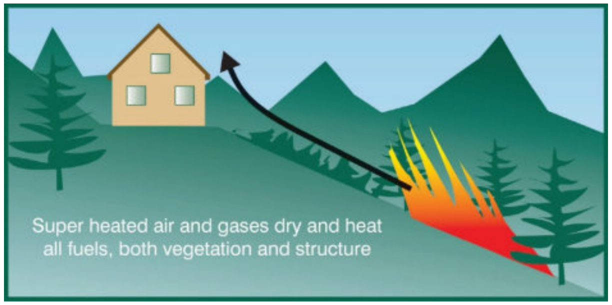
FIRE BEHAVIOR CHARACTERISTICS

Fire behavior characteristics provided in this report include:

- **Characteristic Rate of Spread**
- **Characteristic Flame Length**
- **Fire Intensity Scale**
- **Fire Type – Extreme Weather**

Characteristic Rate of Spread

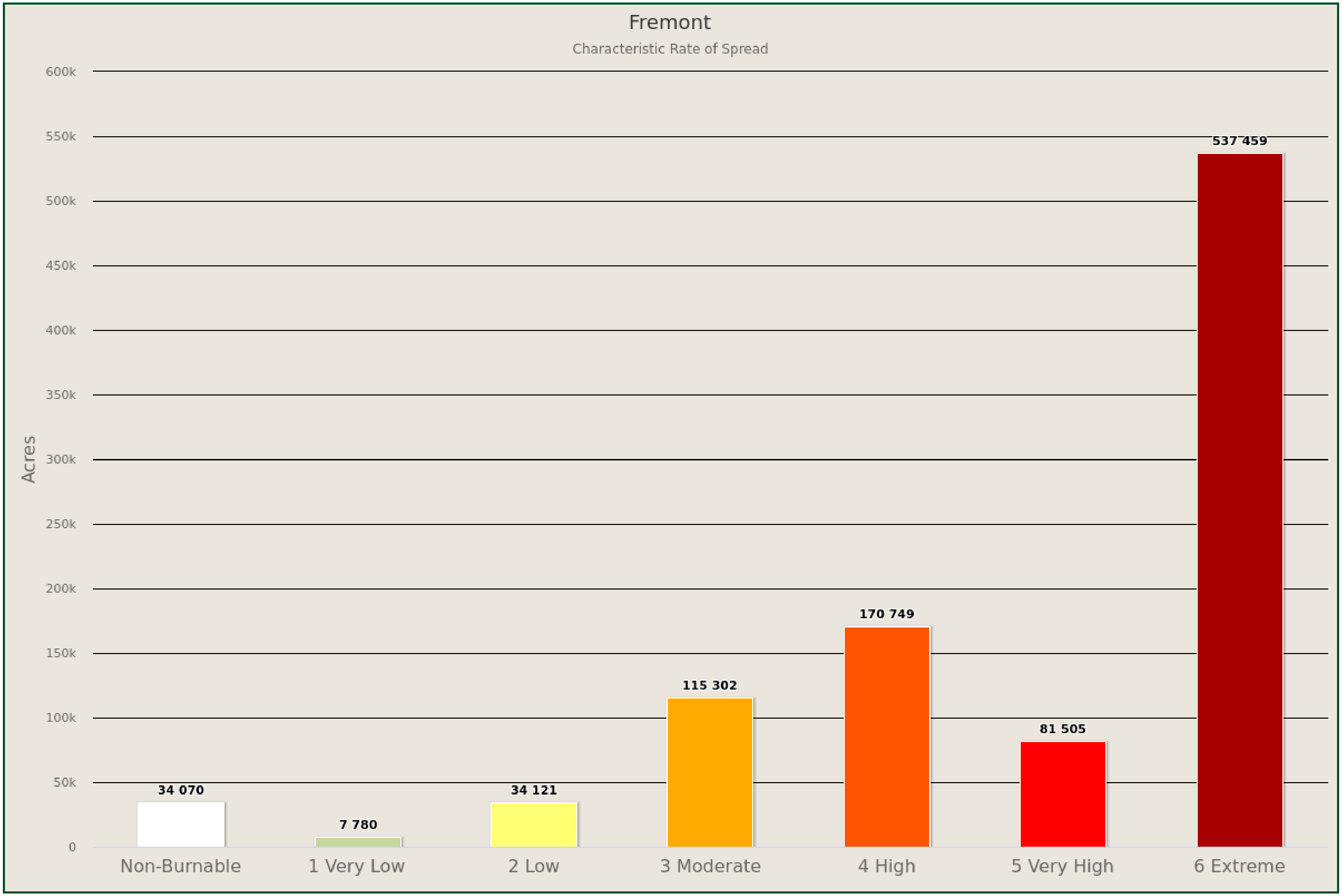
Characteristic Rate of Spread is the typical or representative rate of spread of a potential fire based on a weighted average of four percentile weather categories. Rate of spread is the speed with which a fire moves in a horizontal direction across the landscape, usually expressed in chains per hour (ch/hr) or feet per minute (ft/min). For purposes of the Colorado WRA, this measurement represents the maximum rate of spread of the fire front. Rate of Spread is used in the calculation of Wildfire Threat in the Colorado WRA.



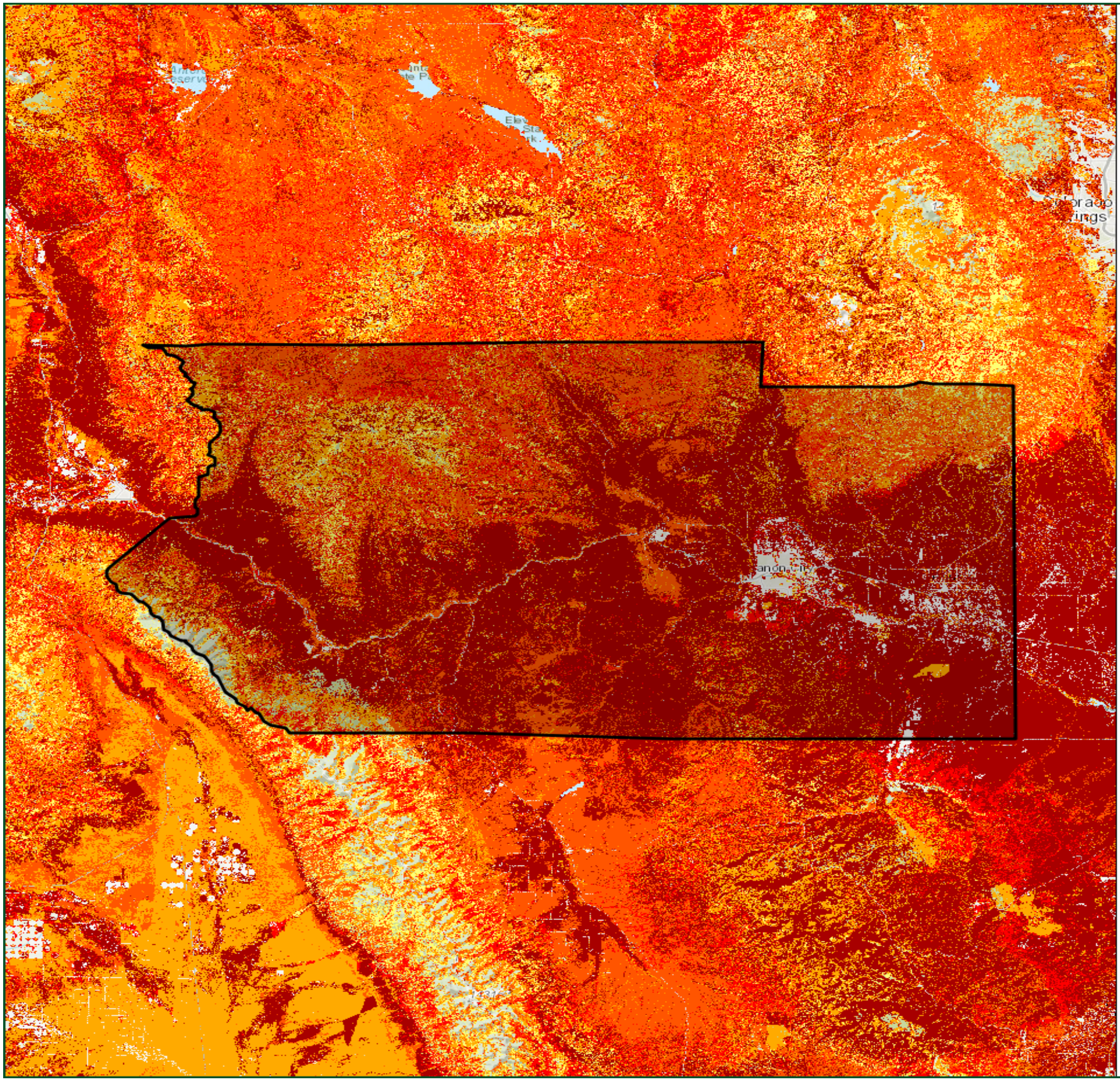
Rate of spread is a fire behavior output, which is influenced by three environmental factors - fuels, weather, and topography. Weather is by far the most dynamic variable as it changes frequently. To account for this variability, four percentile weather categories were created from historical weather observations to represent low, moderate, high, and extreme weather days for each 30-meter cell in Colorado. Thirty (30) meter resolution is the baseline for the Colorado WRA, matching the source surface fuels dataset.

The “characteristic” output represents the weighted average for all four weather percentiles. While not shown in this report, the individual percentile weather ROS outputs are available in the Colorado WRA data.

Rate of Spread	Acres	Percent
Non-Burnable	34,070	3.5 %
1 Very Low	7,780	0.8 %
2 Low	34,121	3.5 %
3 Moderate	115,302	11.8 %
4 High	170,749	17.4 %
5 Very High	81,505	8.3 %
6 Extreme	537,459	54.8 %
Total	980,988	100 %


Fremont
Characteristic Rate of Spread
Acres
600k
550k
500k
450k
400k
350k
300k
250k
200k
150k
100k
50k
0
34 070
7 780
34 121
115 302
170 749
81 505
537 459
Non-Burnable
1 Very Low
2 Low
3 Moderate
4 High
5 Very High
6 Extreme

Fremont



Characteristic Rate of Spread

- 1 Very Low
- 2 Low
- 3 Moderate
- 4 High
- 5 Very High
- 6 Extreme

10 mi

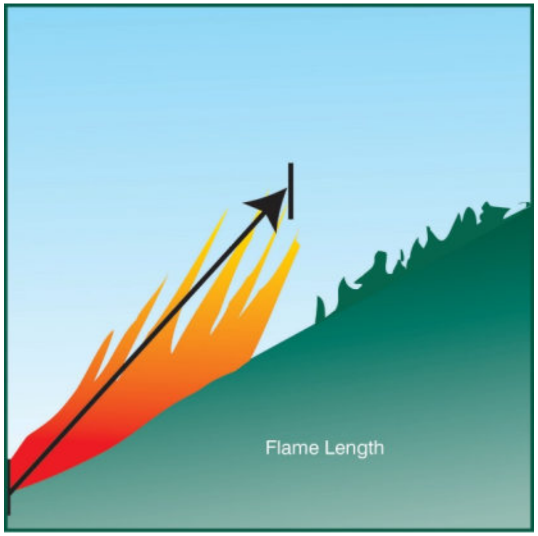
N
S

COLORADO STATE FOREST SERVICE

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Characteristic Flame Length

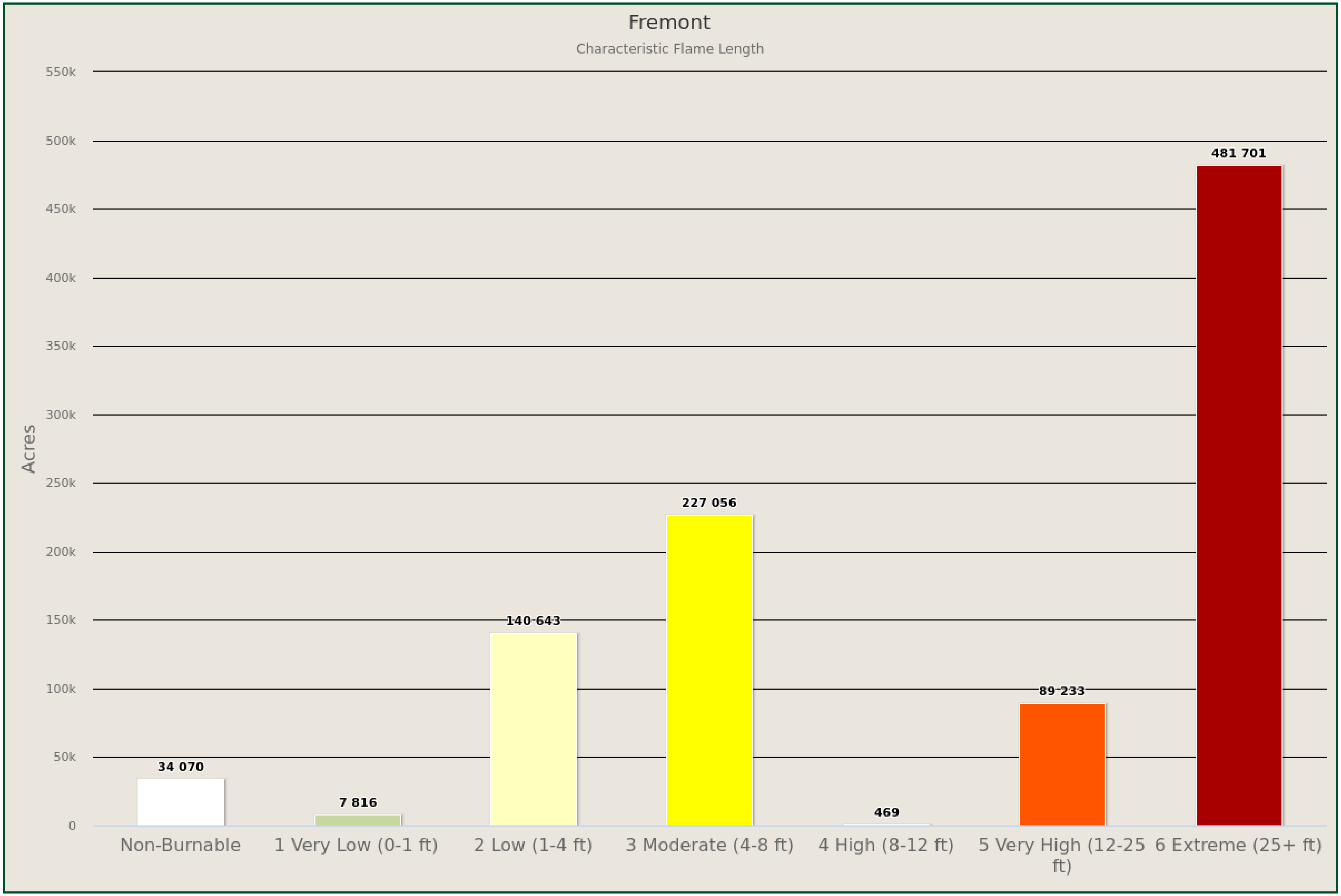
Characteristic Flame Length is the typical or representative flame length of a potential fire based on a weighted average of four percentile weather categories. Flame Length is defined as the distance between the flame tip and the midpoint of the flame depth at the base of the flame, which is generally the ground surface. It is an indicator of fire intensity and is often used to estimate how much heat the fire is generating. Flame length is typically measured in feet (ft). Flame length is the measure of fire intensity used to generate the Fire Effects outputs for the Colorado WRA.

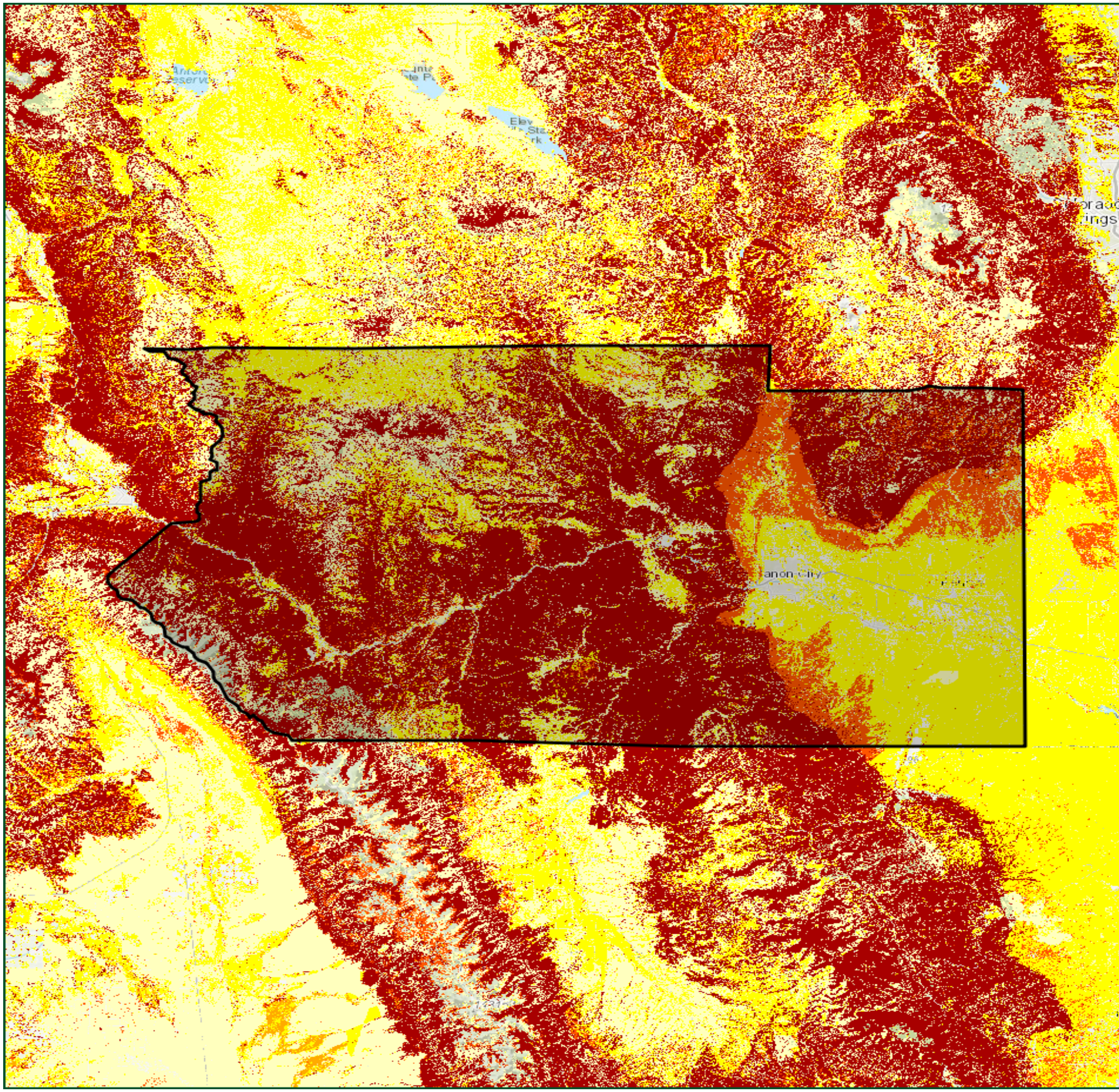


Flame length is a fire behavior output, which is influenced by three environmental factors - fuels, weather, and topography. Weather is by far the most dynamic variable as it changes frequently. To account for this variability, four percentile weather categories were created from historical weather observations to represent low, moderate, high, and extreme weather days for each 30-meter cell in Colorado.

This output represents the weighted average for all four weather percentiles. While not shown in this report, the individual percentile weather Flame Length outputs are available in the Colorado WRA data.

Flame Length	Acres	Percent
Non-Burnable	34,070	3.5 %
1 Very Low (0-1 ft)	7,816	0.8 %
2 Low (1-4 ft)	140,643	14.3 %
3 Moderate (4-8 ft)	227,056	23.1 %
4 High (8-12 ft)	469	0.0 %
5 Very High (12-25 ft)	89,233	9.1 %
6 Extreme (25+ ft)	481,701	49.1 %
Total	980,988	100 %


Fremont
Characteristic Flame Length
Acres
550k
500k
450k
400k
350k
300k
250k
200k
150k
100k
50k
0
34 070
7 816
140 643
227 056
469
89 233
481 701
Non-Burnable
1 Very Low (0-1 ft)
2 Low (1-4 ft)
3 Moderate (4-8 ft)
4 High (8-12 ft)
5 Very High (12-25 ft)
6 Extreme (25+ ft)



Fremont

Characteristic Flame Length

- Non-Burnable
- 1 Very Low (0-1 ft)
- 2 Low (1-4 ft)
- 3 Moderate (4-8 ft)
- 4 High (8-12 ft)
- 5 Very High (12-25 ft)

10 mi

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Fire Intensity Scale

Description

Fire Intensity Scale (FIS) specifically identifies areas where significant fuel hazards and associated dangerous fire behavior potential exist. Similar to the Richter scale for earthquakes, FIS provides a standard scale to measure potential wildfire intensity. FIS consist of five (5) classes where the order of magnitude between classes is ten-fold. The minimum class, Class 1, represents very low wildfire intensities and the maximum class, Class 5, represents very high wildfire intensities.

1. **Class 1, Lowest Intensity:**

   Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment.

2. **Class2, Low:**

   Small flames, usually less than two feet long; small amount of very short-range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools.

3. **Class 3, Moderate:**

   Flames up to 8 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property.

4. **Class 4, High:**

   Large Flames, up to 30 feet in length; short-range spotting 1. common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property.

5. **Class 5, Highest Intensity:**

   Very large flames up to 150 feet in length; profuse short-range spotting, frequent long-range spotting; strong fire-induced winds. Indirect attack marginally effective at the head of the fire. Great potential for harm or damage to life and property.

Burn Probability and Fire Intensity Scale are designed to complement each other. The Fire Intensity Scale does not incorporate historical occurrence information. It only evaluates the potential fire behavior for an area, regardless if any fires have occurred there in the past. This additional information allows mitigation planners to quickly identify areas where dangerous fire behavior potential exists in relationship to nearby homes or other valued assets.

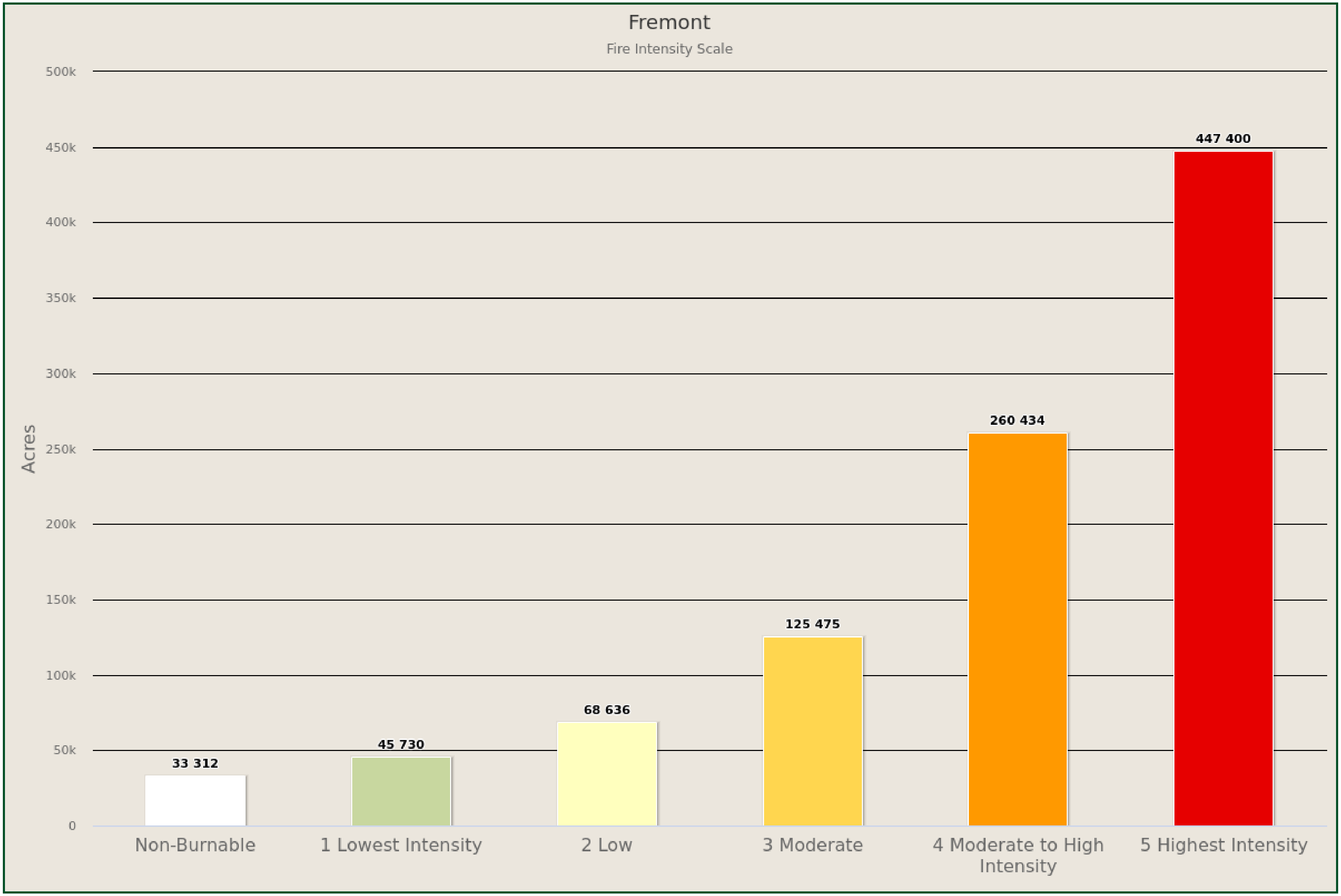
Since all areas in Colorado have fire intensity scale calculated consistently, it allows for comparison and ordination of areas across the entire state. For example, a high fire intensity area in Eastern Colorado is equivalent to a high fire intensity area in Western Colorado.

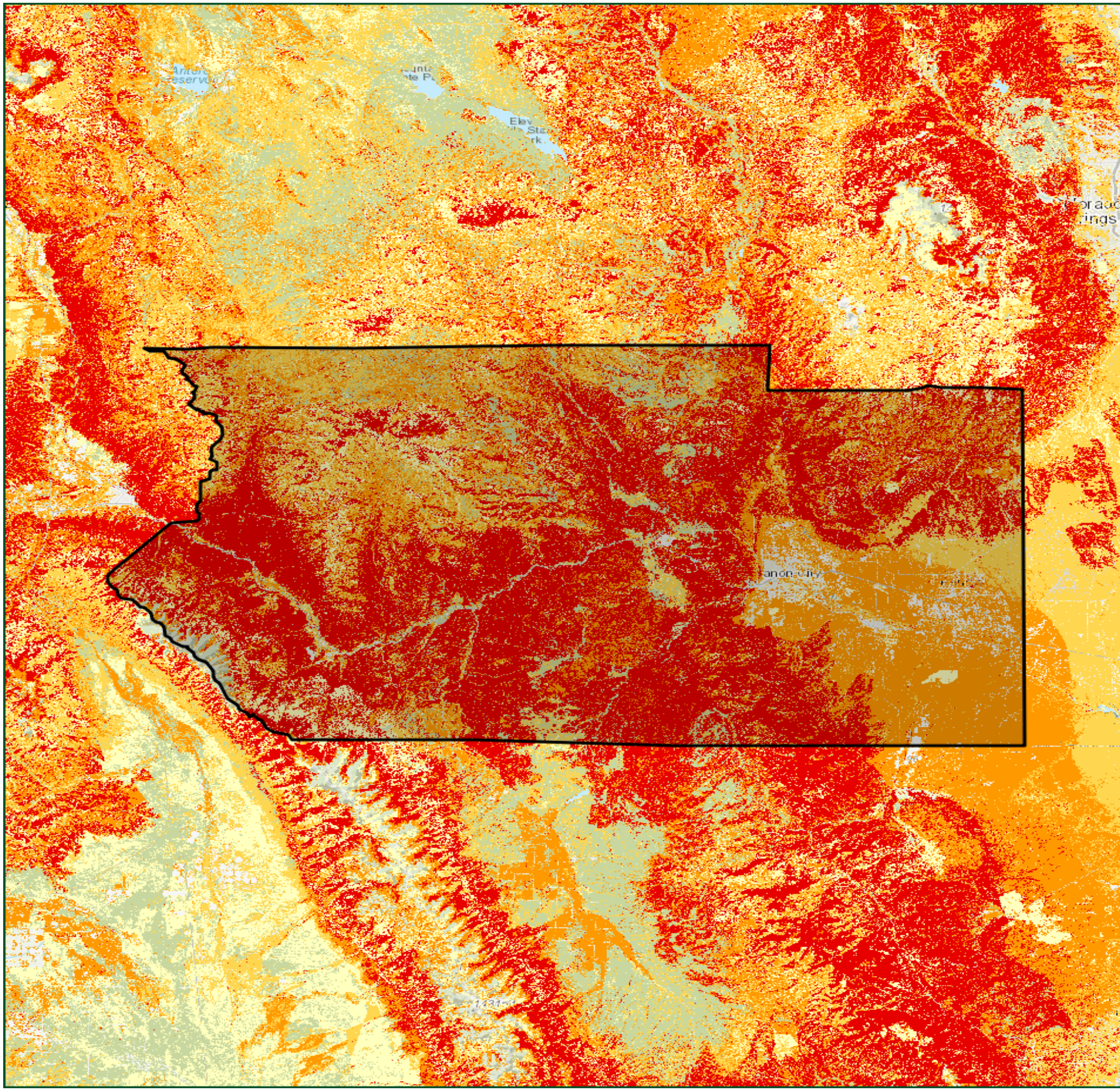
Fire intensity scale is a fire behavior output, which is influenced by three environmental factors - fuels, weather, and topography. Weather is by far the most dynamic variable as it changes frequently.

To account for this variability, four percentile weather categories were created from historical weather observations to represent low, moderate, high, and extreme weather days for each 30-meter cell in Colorado. The FIS represents the weighted average for all four weather percentiles.

The fire intensity scale map is derived at a 30-meter resolution. This scale of data was chosen to be consistent with the accuracy of the primary surface fuels dataset used in the assessment. While not appropriate for site specific analysis, it is appropriate for regional, county or local planning efforts.

FIS Class	Acres	Percent
Non-Burnable	33,312	3.4 %
1 Lowest Intensity	45,730	4.7 %
2 Low	68,636	7.0 %
3 Moderate	125,475	12.8 %
4 Moderate to High Intensity	260,434	26.5 %
5 Highest Intensity	447,400	45.6 %
Total	**980,988**	**100 %**


Fremont
Fire Intensity Scale
Acres
500k
450k
400k
350k
300k
250k
200k
150k
100k
50k
0
33 312
45 730
68 636
125 475
260 434
447 400
Non-Burnable
1 Lowest Intensity
2 Low
3 Moderate
4 Moderate to High Intensity
5 Highest Intensity



Fremont

Fire Intensity Scale

- Non-Burnable
- 1 Lowest Intensity
- 2 Low
- 3 Moderate
- 4 Moderate to High Intensity
- 5 Highest Intensity

10 mi

N S

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Fire Type – Extreme Weather

Fire Type – Extreme represents the potential fire type under the extreme percentile weather category. The extreme percentile weather category represents the average weather based on the top three percent fire weather days in the analysis period. It is not intended to represent a worst-case scenario weather event. Accordingly, the potential fire type is based on fuel conditions, extreme percentile weather, and topography.

Canopy fires are very dangerous, destructive and difficult to control due to their increased fire intensity. From a planning perspective, it is important to identify where these conditions are likely to occur on the landscape so that special preparedness measure can be taken if necessary. Typically canopy fires occur in extreme weather conditions. The Fire Type – Extreme layer shows the footprint of where these areas are most likely to occur. However, it is important to note that canopy fires are not restricted to these areas. Under the right conditions, it can occur in other canopied areas.

There are two primary fire types – surface fire and canopy fire. Canopy fire can be further subdivided into passive canopy fire and active canopy fire. A short description of each of these is provided below.

Surface Fire

A fire that spreads through surface fuel without consuming any overlying canopy fuel. Surface fuels include grass, timber litter, shrub/brush, slash and other dead or live vegetation within about 6 feet of the ground.

Passive Canopy Fire

A type of crown fire in which the crowns of individual trees or small groups of trees burn, but solid flaming in the canopy cannot be maintained except for short periods (Scott & Reinhardt, 2001).

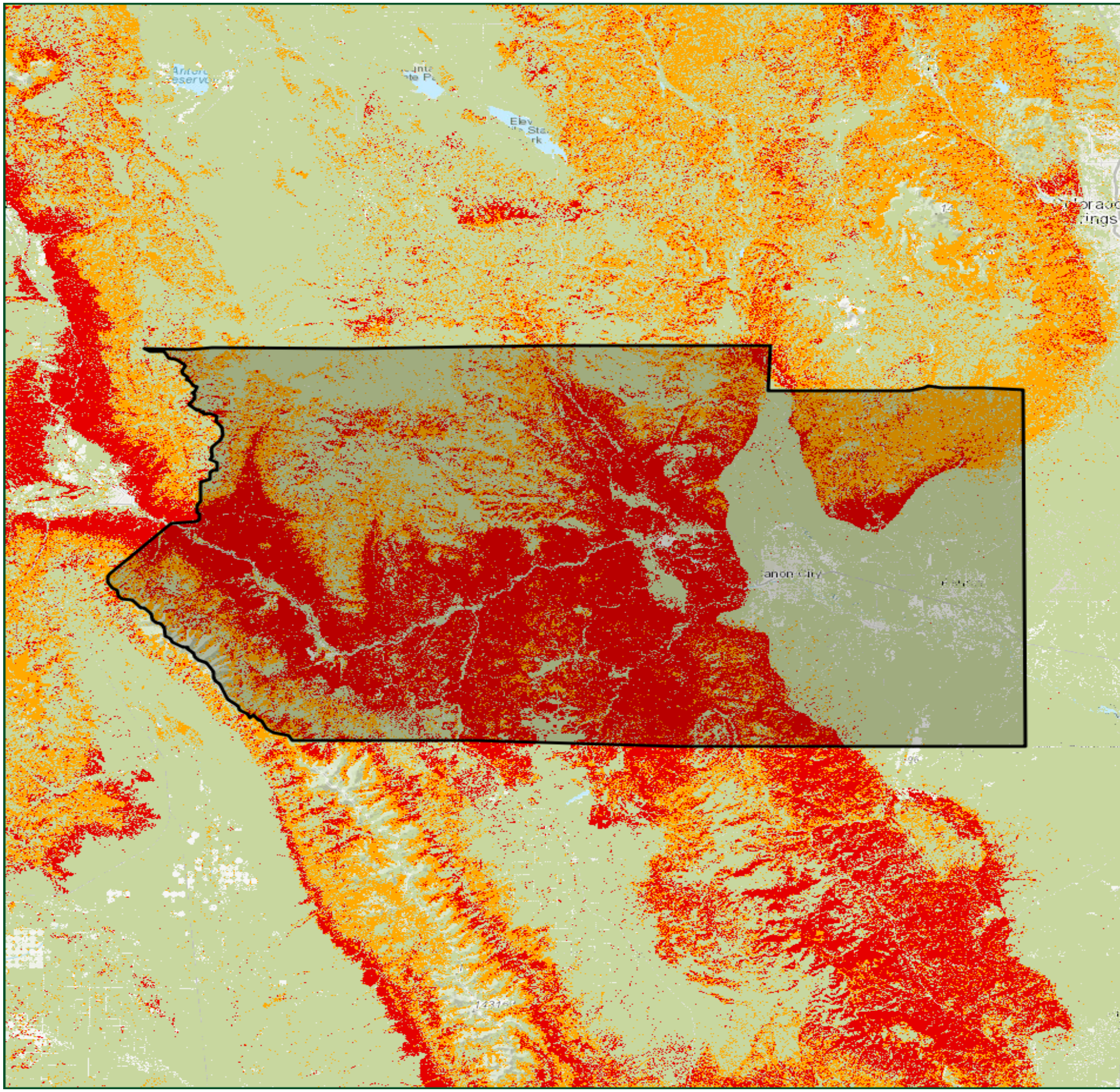
Active Canopy Fire

A crown fire in which the entire fuel complex (canopy) is involved in flame, but the crowning phase remains dependent on heat released from surface fuel for continued spread (Scott & Reinhardt, 2001).

The Fire Type - Extreme Weather map is derived at a 30-meter resolution. This scale of data was chosen to be consistent with the accuracy of the primary surface fuels dataset used in the assessment. While not appropriate for site specific analysis, it is appropriate for regional, county or local planning efforts.

Fire Type - Extreme Weather	Acres	Percent
Surface Fire	435,614	46.0 %
Passive Canopy Fire	164,555	17.4 %
Active Canopy Fire	347,507	36.7 %
Total	947,676	100 %


Fremont
Fire Type – Extreme Weather
Acres
500k
450k
400k
350k
300k
250k
200k
150k
100k
50k
0
435 614
164 555
347 507
Surface Fire
Passive Canopy Fire
Active Canopy Fire



Fremont

Fire Type Extreme Weather

Surface Fire

Passive Canopy Fire

Active Canopy Fire

10 mi

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Surface Fuels

Description

Surface fuels, or fire behavior fuel models as they are technically referred to, contain the parameters required by the Rothermel (1972) surface fire spread model to compute surface fire behavior characteristics, including rate of spread, flame length, fireline intensity and other fire behavior metrics. As the name might suggest, surface fuels account only for surface fire potential. Canopy fire potential is computed through a separate but linked process. The Colorado WRA accounts for both surface and canopy fire potential in the fire behavior outputs. However, only surface fuels are shown in this risk report.

Surface fuels typically are categorized into one of four primary fuel types based on the primary carrier of the surface fire: 1) grass, 2) shrub/brush, 3) timber litter, and 4) slash. Two standard fire behavior fuel model sets have been published. The Fire Behavior Prediction System 1982 Fuel Model Set (Anderson, 1982) contains 13 fuel models, and the Fire Behavior Prediction System 2005 Fuel Model Set (Scott & Burgan, 2005) contains 40 fuel models. The Colorado WRA uses fuel models from the 2005 Fuel Model Set.

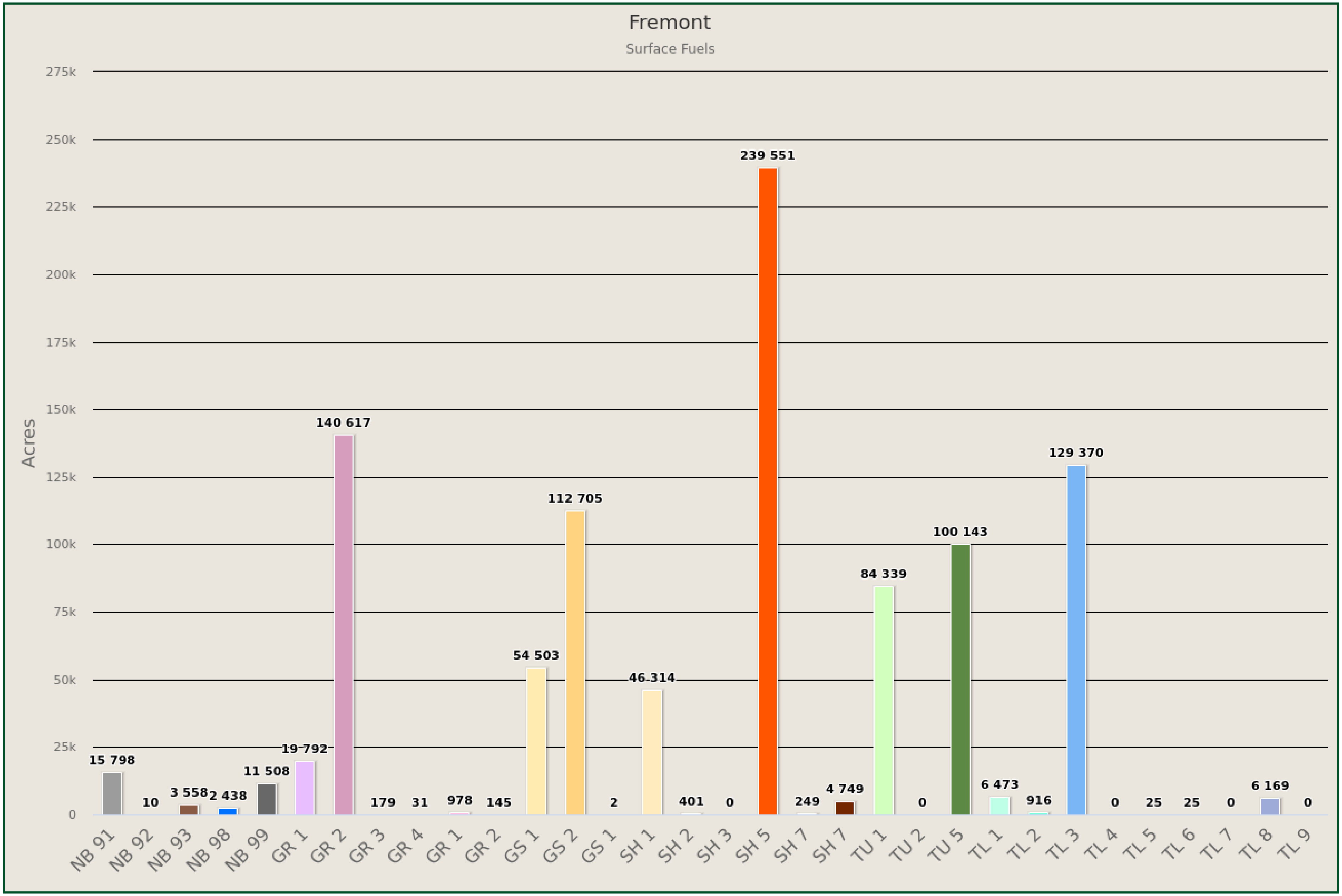
Unmanaged forest with dead and downed trees and branches

Slash on the ground indicates that forest management treatments have occurred in this area

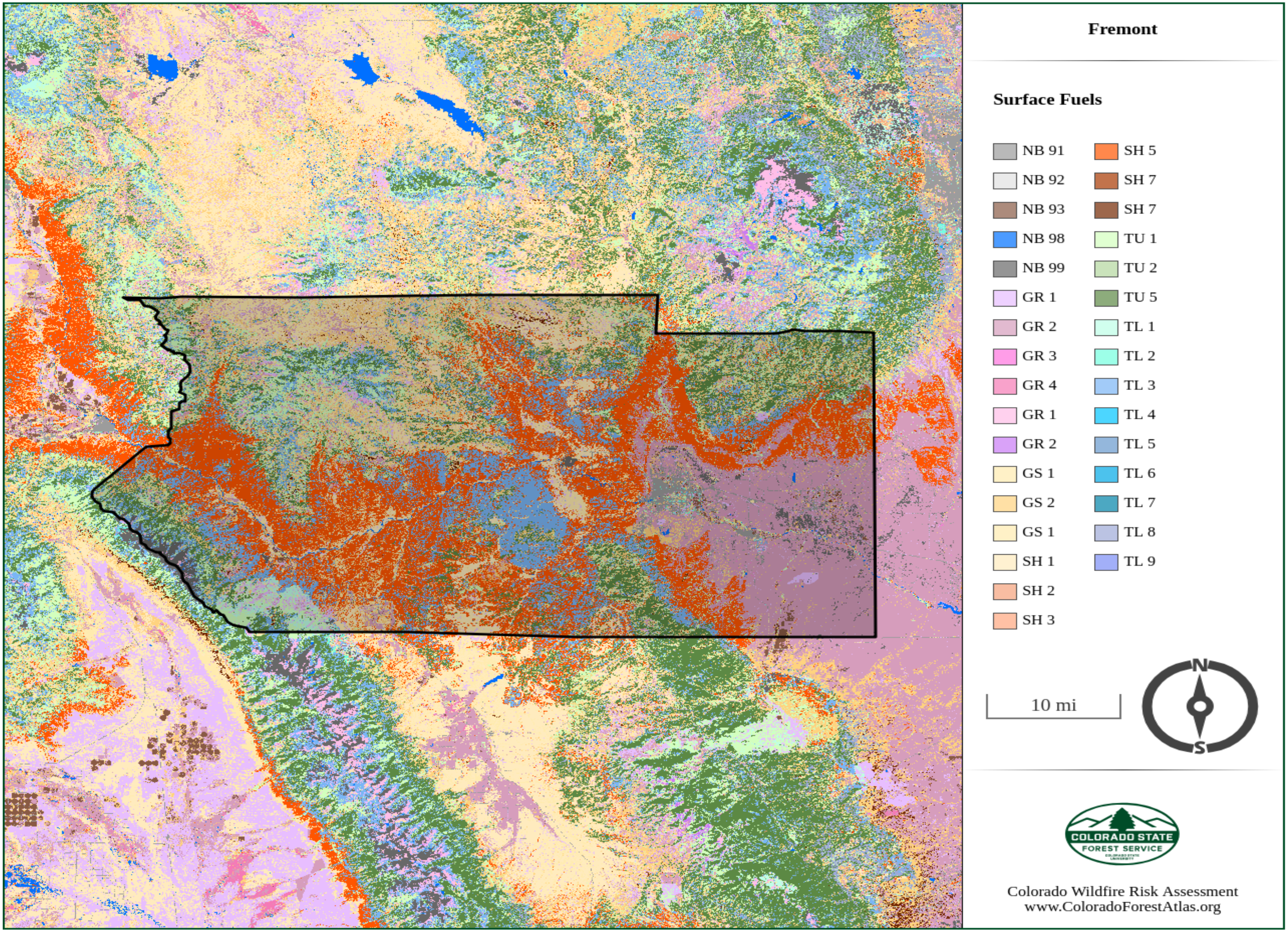
The 2017 Colorado Surface Fuels were derived by enhancing the baseline LANDFIRE 2014 products with modifications to reflect local conditions and knowledge. A team of fuels and fire behavior experts, led by the CSFS, conducted a detailed calibration of the LANDFIRE 2014 fuels datasets. This calibration involved correcting LANDFIRE mapping zone seamlines errors; adding recent disturbances from 2013 to 2017 for fires, insect and disease, and treatments; correcting fuels for high elevations; adjusting fuels for oak-shrublands and pinyon-juniper areas; and modifying SH7 fuel designations. This calibration effort resulted in an accurate and up-to-date surface fuels dataset that is the basis for the fire behavior and risk calculations in the 2017 Colorado Wildfire Risk Assessment Update.

A detailed description of the fuels calibration methods and results is provided in the CSFS 2017 Fuels Calibration Final Report (July 2018).

Surface Fuels		Description	Acres	Percent
	NB 91	Urban/Developed	15,798	1.6 %
	NB 92	Snow/Ice	10	0.0 %
	NB 93	Agriculture	3,558	0.4 %
	NB 98	Water	2,438	0.2 %
	NB 99	Barren	11,508	1.2 %
	GR 1	Short, sparse, dry climate grass	19,792	2.0 %
	GR 2	Low load, dry climate grass	140,617	14.3 %
	GR 3	Low load, very coarse, humid climate grass	179	0.0 %
	GR 4	Moderate load, dry climate grass	31	0.0 %
	GR 1	GT 10,000 ft elevation	978	0.1 %
	GR 2	GT 10,000 ft elevation	145	0.0 %
	GS 1	Low load, dry climate grass-shrub	54,503	5.6 %
	GS 2	Moderate load, dry climate grass-shrub	112,705	11.5 %
	GS 1	GT 10,000 ft elevation	2	0.0 %
	SH 1	Low load, dry climate shrub	46,314	4.7 %
	SH 2	Moderate load, dry climate shrub	401	0.0 %
	SH 3	Moderate load, humid climate shrub	0	0 %
	SH 5	High load, humid climate shrub	239,551	24.4 %
	SH 7	Very high load, dry climate shrub	249	0.0 %
	SH 7	Oak Shrubland without changes	4,749	0.5 %
	TU 1	Light load, dry climate timber-grass-shrub	84,339	8.6 %
	TU 2	Moderate load, humid climate timber-shrub	0	0 %
	TU 5	Very high load, dry climate timber-shrub	100,143	10.2 %
	TL 1	Low load, compact conifer litter	6,473	0.7 %
	TL 2	Low load, broadleaf litter	916	0.1 %
	TL 3	Moderate load, conifer litter	129,370	13.2 %
	TL 4	Small downed logs	0	0 %
	TL 5	High load, conifer litter	25	0.0 %
	TL 6	Moderate load, broadleaf litter	25	0.0 %
	TL 7	Large downed logs	0	0 %
	TL 8	Long-needle litter	6,169	0.6 %
	TL 9	Very high load, broadleaf litter	0	0 %
Total			980,988	100 %



Fremont
Surface Fuels
Acres
275k
250k
225k
200k
175k
150k
125k
100k
75k
50k
25k
0
15 798
10
3 558
2 438
11 508
19 792
140 617
179
31
978
145
54 503
112 705
2
46 314
401
0
239 551
249
4 749
84 339
0
100 143
6 473
916
129 370
0
25
25
0
6 169
0
NB 91
NB 92
NB 93
NB 98
NB 99
GR 1
GR 2
GR 3
GR 4
GR 1
GR 2
GS 1
GS 2
GS 1
SH 1
SH 2
SH 3
SH 5
SH 7
SH 7
TU 1
TU 2
TU 5
TL 1
TL 2
TL 3
TL 4
TL 5
TL 6
TL 7
TL 8
TL 9


Fremont
Surface Fuels
NB 91
NB 92
NB 93
NB 98
NB 99
GR 1
GR 2
GR 3
GR 4
GR 1
GR 2
GS 1
GS 2
GS 1
SH 1
SH 2
SH 3
SH 5
SH 7
SH 7
TU 1
TU 2
TU 5
TL 1
TL 2
TL 3
TL 4
TL 5
TL 6
TL 7
TL 8
TL 9
10 mi
N
S
Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Vegetation

Description

The Vegetation map describes the general vegetation and landcover types across the state of Colorado. In the Colorado WRA, the Vegetation dataset is used to support the development of the Surface Fuels, Canopy Cover, Canopy Stand Height, Canopy Base Height, and Canopy Bulk Density datasets.

The LANDFIRE 2014 version of data products (Existing Vegetation Type) was used to compile the Vegetation data for the Colorado WRA. This reflects data current to 2014. The LANDFIRE EVT data were classified to reflect general vegetation cover types for representation with CO-WRAP.

Oak shrublands are commonly found along dry foothills and lower mountain slopes, and are often situated above Piñyon-juniper.

Piñyon-juniper woodlands are common in southern and southwestern Colorado.

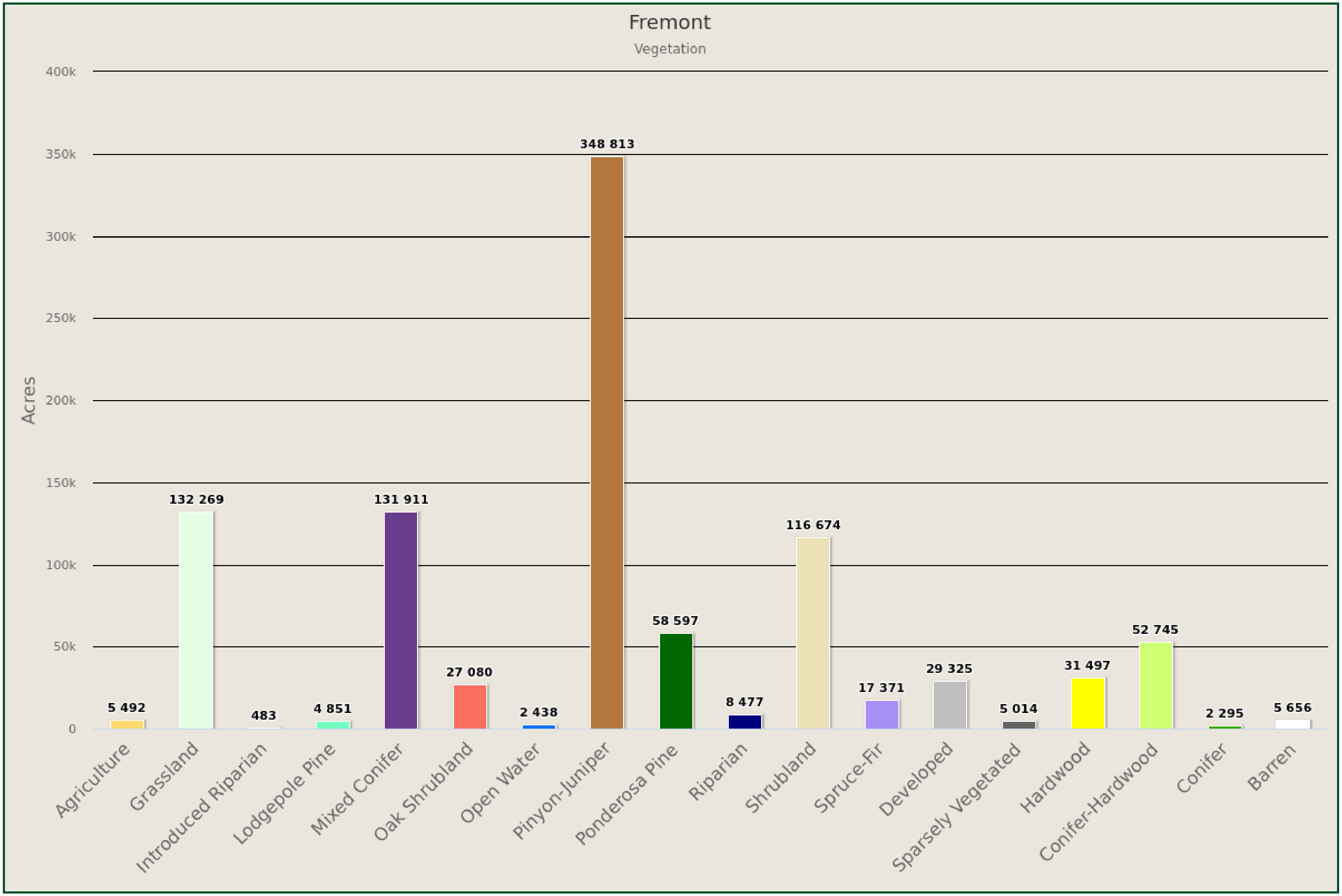
Douglas-fir understory in a ponderosa pine forest.

Grasslands occur both on Colorado's Eastern Plains and on the Western Slope.

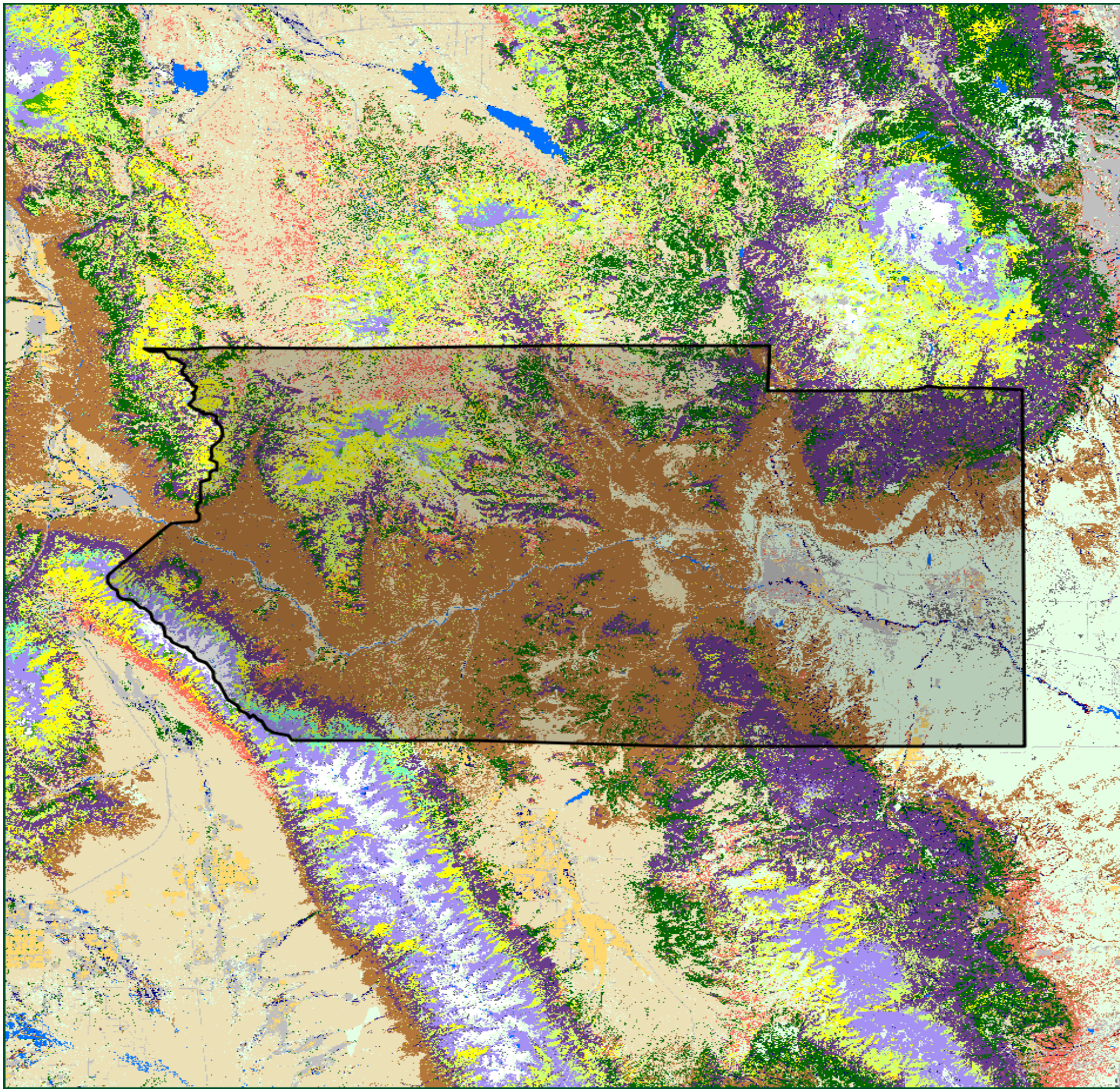
Wildland fire threat increases in lodgepole pine as the dense forests grow old.

Overly dense ponderosa pine, a dominant species of the montane zone.

Vegetation Class	Acres	Percent
Agriculture	5,492	0.6 %
Grassland	132,269	13.5 %
Introduced Riparian	483	0.0 %
Lodgepole Pine	4,851	0.5 %
Mixed Conifer	131,911	13.4 %
Oak Shrubland	27,080	2.8 %
Open Water	2,438	0.2 %
Pinyon-Juniper	348,813	35.6 %
Ponderosa Pine	58,597	6.0 %
Riparian	8,477	0.9 %
Shrubland	116,674	11.9 %
Spruce-Fir	17,371	1.8 %
Developed	29,325	3.0 %
Sparsely Vegetated	5,014	0.5 %
Hardwood	31,497	3.2 %
Conifer-Hardwood	52,745	5.4 %
Conifer	2,295	0.2 %
Barren	5,656	0.6 %
Total	**980,988**	**100 %**


Fremont
Vegetation
Acres
400k
350k
300k
250k
200k
150k
100k
50k
0
5 492
132 269
483
4 851
131 911
27 080
2 438
348 813
58 597
8 477
116 674
17 371
29 325
5 014
31 497
52 745
2 295
5 656
Agriculture
Grassland
Introduced Riparian
Lodgepole Pine
Mixed Conifer
Oak Shrubland
Open Water
Pinyon-Juniper
Ponderosa Pine
Riparian
Shrubland
Spruce-Fir
Developed
Sparsely Vegetated
Hardwood
Conifer-Hardwood
Conifer
Barren

Fremont



Vegetation

- Agriculture
- Barren
- Grassland
- Introduced Riparian
- Lodgepole Pine
- Mixed Conifer
- Oak Shrubland
- Open Water
- Pinyon-Juniper
- Ponderosa Pine
- Riparian
- Shrubland
- Spruce-Fir
- Developed
- Sparsely Vegetated
- Hardwood
- Conifer-Hardwood
- Conifer

10 mi

N S

COLORADO STATE FOREST SERVICE

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Drinking Water Importance Areas

Description

Drinking Water Importance Areas is the measure of quality and quantity of public surface drinking water categorized by watershed. This layer identifies an index of surface drinking water importance, reflecting a measure of water quality and quantity, characterized by Hydrologic Unit Code 12 (HUC 12) watersheds. The Hydrologic Unit system is a standardized watershed classification system developed by the USGS. Areas that are a source of drinking water are of critical importance and adverse effects from fire are a key concern.

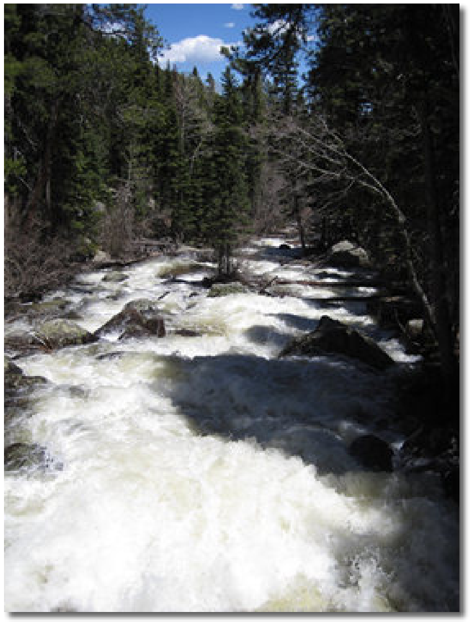
The U.S. Forest Service Forests to Faucets (F2F) project is the primary source of the drinking water data set. This project used GIS modeling to develop an index of importance for supplying drinking water using HUC 12 watersheds as the spatial resolution. Watersheds are ranked from 1 to 100 reflecting relative level of importance, with 100 being the most important and 1 the least important.

Several criteria were used in the F2F project to derive the importance rating including water supply, flow analysis, and downstream drinking water demand. The final model of surface drinking water importance used in the F2F project combines the drinking water protection model, capturing the flow of water and water demand, with a model of mean annual water supply.

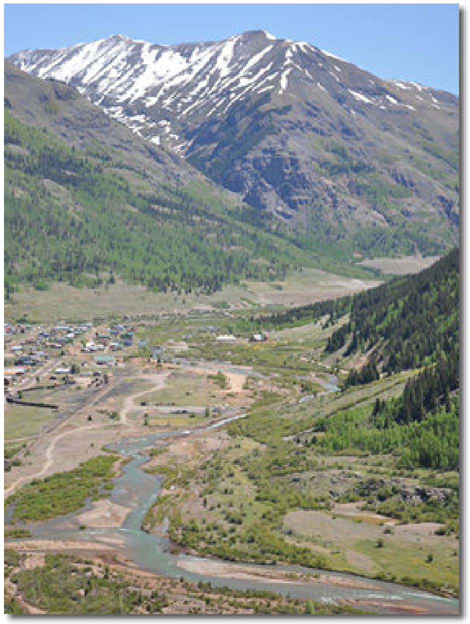
The values generated by the drinking water protection model are simply multiplied by the results of the model of mean annual water supply to create the final surface drinking water importance index.

Water is critical to sustain life. Human water usage has further complicated nature's already complex aquatic system. Plants, including trees, are essential to the proper functioning of water movement within the environment. Forests receive precipitation, utilize it for their sustenance and growth, and influence its storage and/or passage to other parts of the environment.

Four major river systems – the Platte, Colorado, Arkansas and Rio Grande – originate in the Colorado mountains and fully drain into one-third of the landmass of the lower 48 states. Mountain snows supply 75 percent of the water to these river systems.



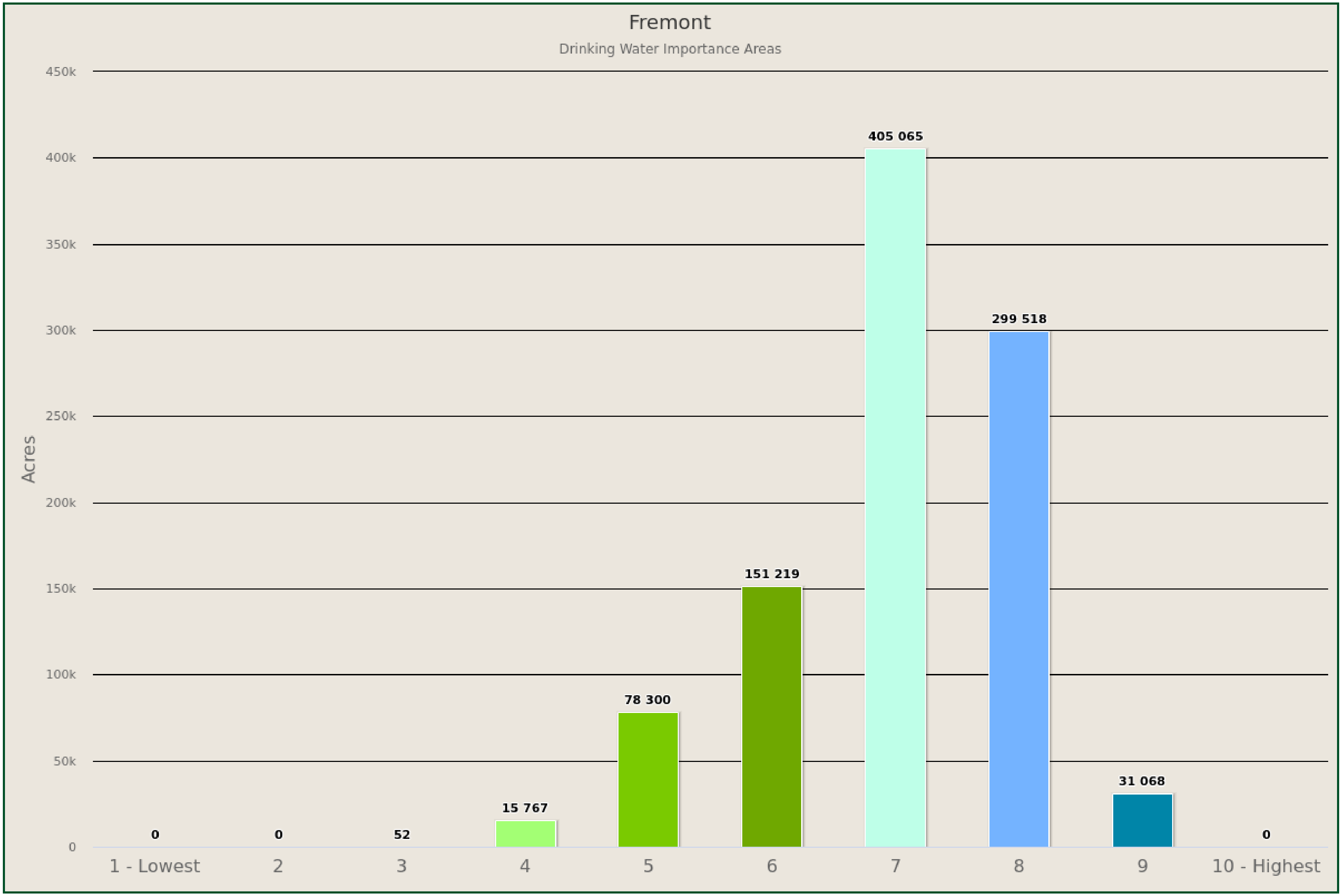
Virtually all of Colorado's drinking water comes from snowmelt carried at some point by a river.



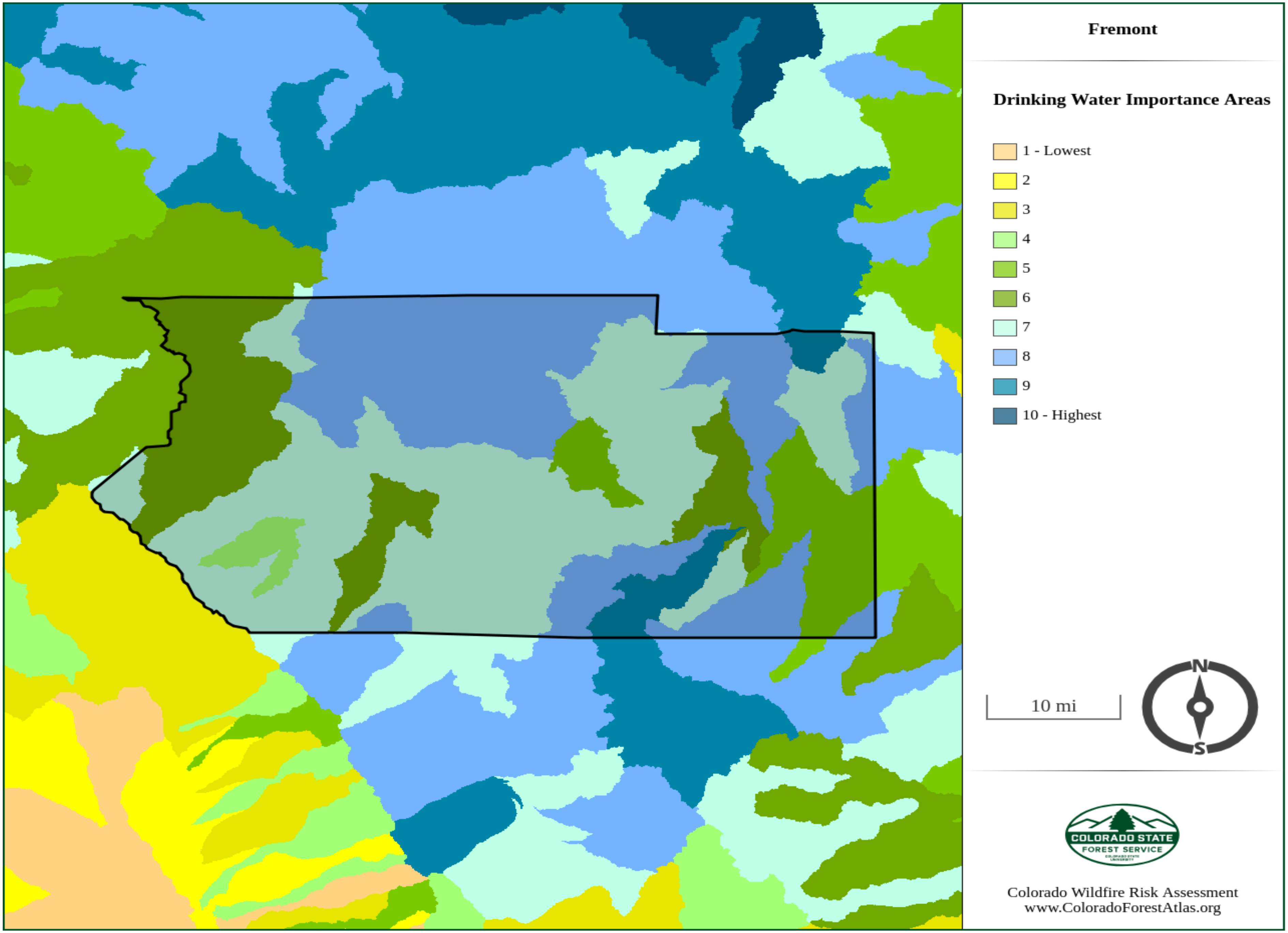
The headwaters of the Animas River begin near Silverton, CO at elevations greater than 12,000 feet.

Approximately 40 percent of the water comes from the highest 20 percent of the land, most of which lies in national forests. National forests yield large portions of the total water in these river systems. The potential is great for forests to positively and negatively influence the transport of water over such immense distances.

Drinking Water Class		Acres	Percent
	1 - Lowest	0	0 %
	2	0	0 %
	3	52	0.0 %
	4	15,767	1.6 %
	5	78,300	8.0 %
	6	151,219	15.4 %
	7	405,065	41.3 %
	8	299,518	30.5 %
	9	31,068	3.2 %
	10 - Highest	0	0 %
Total		**980,988**	**100 %**



Fremont
Drinking Water Importance Areas
Acres
450k
400k
350k
300k
250k
200k
150k
100k
50k
0
0
0
52
15 767
78 300
151 219
405 065
299 518
31 068
0
1 - Lowest
2
3
4
5
6
7
8
9
10 - Highest


Fremont
Drinking Water Importance Areas
1 - Lowest
2
3
4
5
6
7
8
9
10 - Highest
10 mi
N
S
COLORADO STATE
FOREST SERVICE
Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Drinking Water Risk Index

Description

Drinking Water Risk Index is a measure of the risk to DWIAs based on the potential negative impacts from wildfire.

In areas that experience low-severity burns, fire events can serve to eliminate competition, rejuvenate growth and improve watershed conditions. But in landscapes subjected to high, or even moderate-burn severity, the post-fire threats to public safety and natural resources can be extreme.

High-severity wildfires remove virtually all forest vegetation – from trees, shrubs and grasses down to discarded needles, decomposed roots and other elements of ground cover or duff that protect forest soils. A severe wildfire also can cause certain types of soil to become hydrophobic by forming a waxy, water-repellent layer that keeps water from penetrating the soil, dramatically amplifying the rate of runoff.

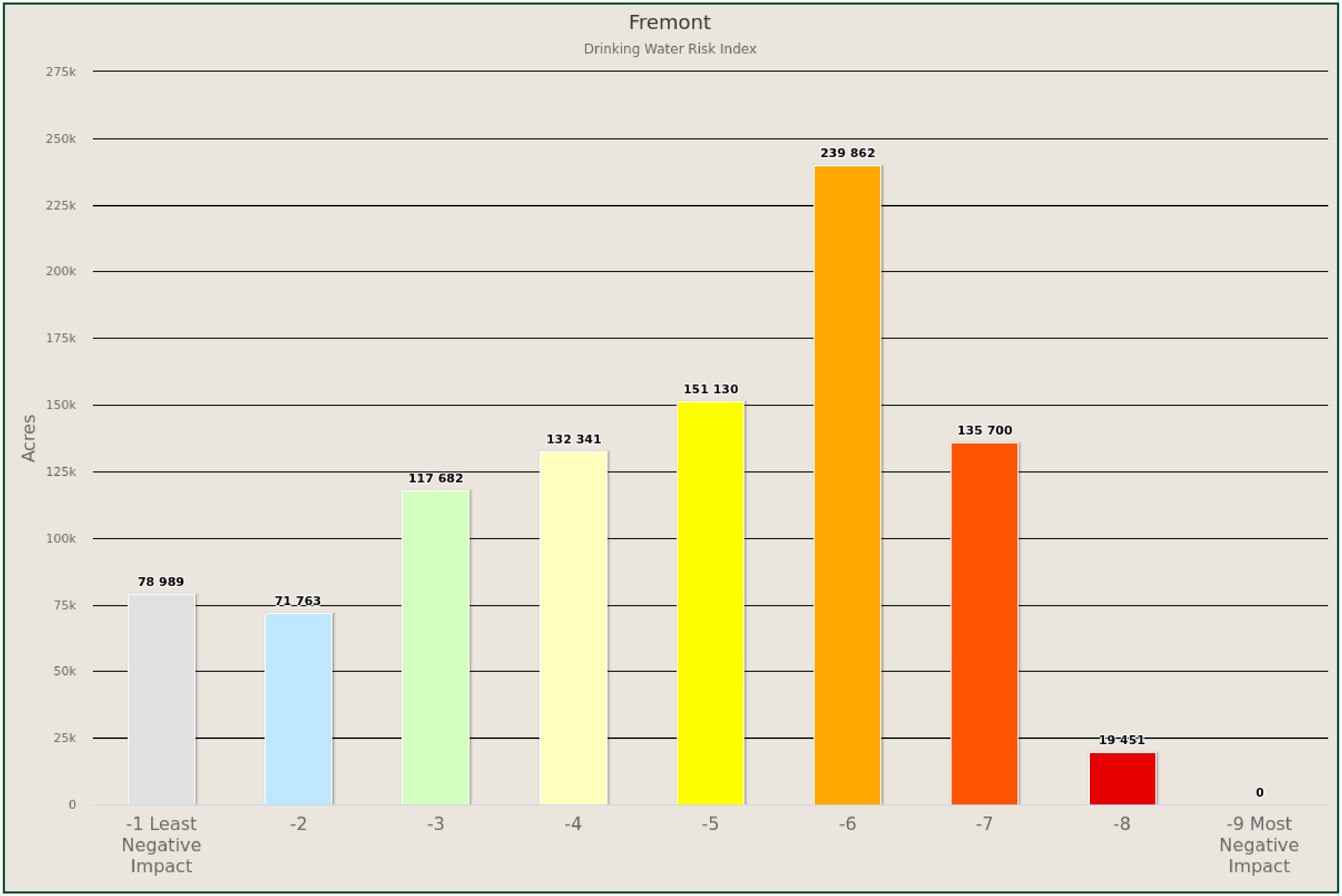
The loss of critical surface vegetation leaves forested slopes extremely vulnerable to large-scale soil erosion and flooding during subsequent storm events. In turn, these threats can impact the health, safety and integrity of communities and natural resources downstream. The likelihood that such a post-fire event will occur in Colorado is increased by the prevalence of highly erodible soils in several parts of the state, and weather patterns that frequently bring heavy rains on the heels of fire season.

In the aftermath of the 2002 fire season, the Colorado Department of Health estimated that 26 municipal water storage facilities were shut down due to fire and post-fire impacts.

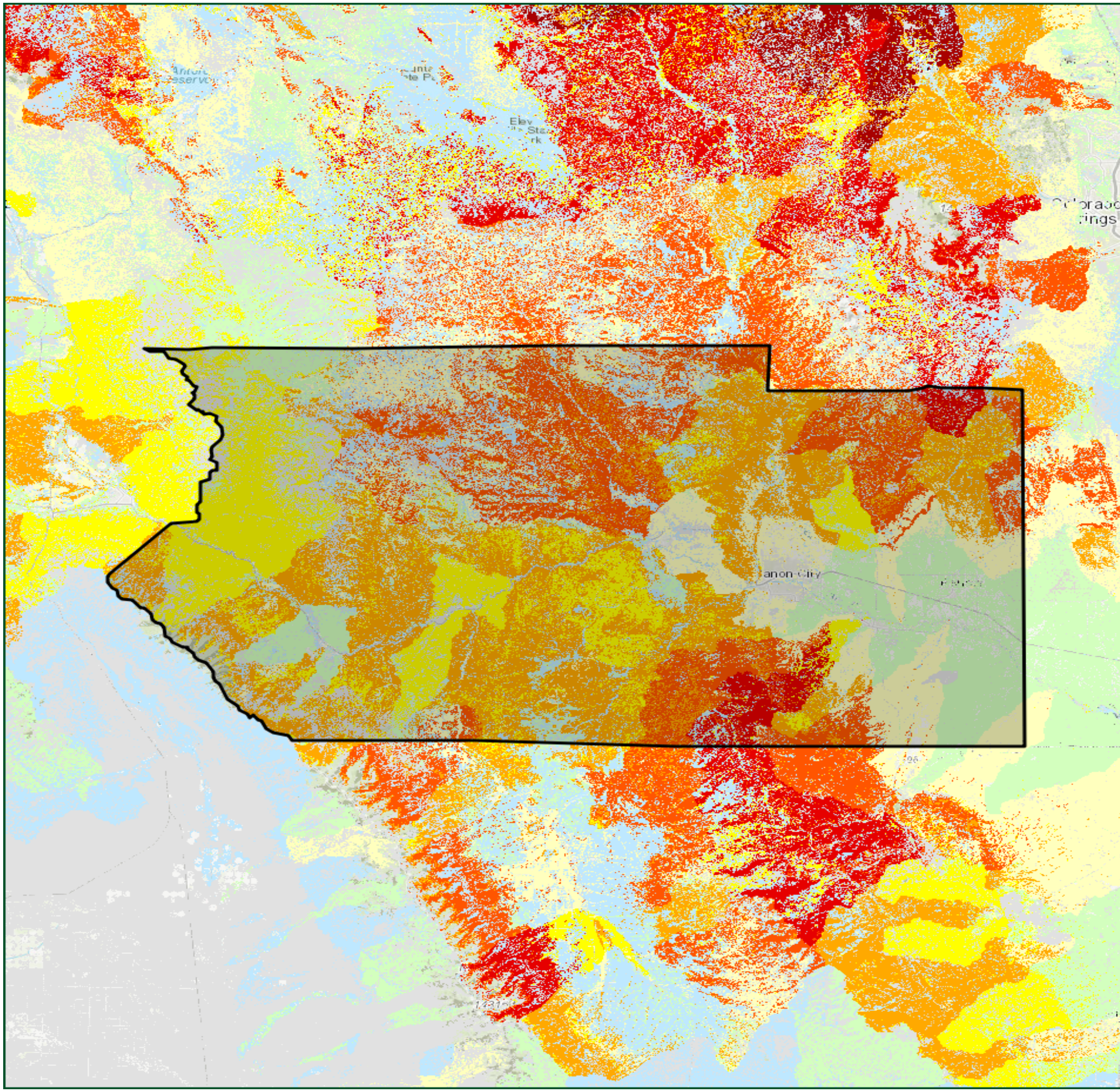
The potential for severe soil erosion is a consequence of wildfire because as a fire burns, it destroys plant material and the litter layer. Shrubs, forbs, grasses, trees and the litter layer disperse water during severe rainstorms. Plant roots stabilize the soil, and stems and leaves slow the water to give it time to percolate into the soil profile. Fire can destroy this soil protection.

The range of values is from -1 to -9, with -1 representing the least negative impact and -9 representing the most negative impact.

Class	Acres	Percent
-1 Least Negative Impact	78,989	8.3 %
-2	71,763	7.6 %
-3	117,682	12.4 %
-4	132,341	14.0 %
-5	151,130	16.0 %
-6	239,862	25.3 %
-7	135,700	14.3 %
-8	19,451	2.1 %
-9 Most Negative Impact	0	0 %
Total	946,917	100 %



Fremont
Drinking Water Risk Index
Acres
275k
250k
225k
200k
175k
150k
125k
100k
75k
50k
25k
0
78 989
71 763
117 682
132 341
151 130
239 862
135 700
19 451
0
-1 Least Negative Impact
-2
-3
-4
-5
-6
-7
-8
-9 Most Negative Impact



Fremont

Drinking Water Risk Index

- -1 Least Negative Impact
- -2
- -3
- -4
- -5
- -6
- -7
- -8
- -9 Most Negative Impact

10 mi

N

S

Colorado State Forest Service

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Riparian Assets

Description

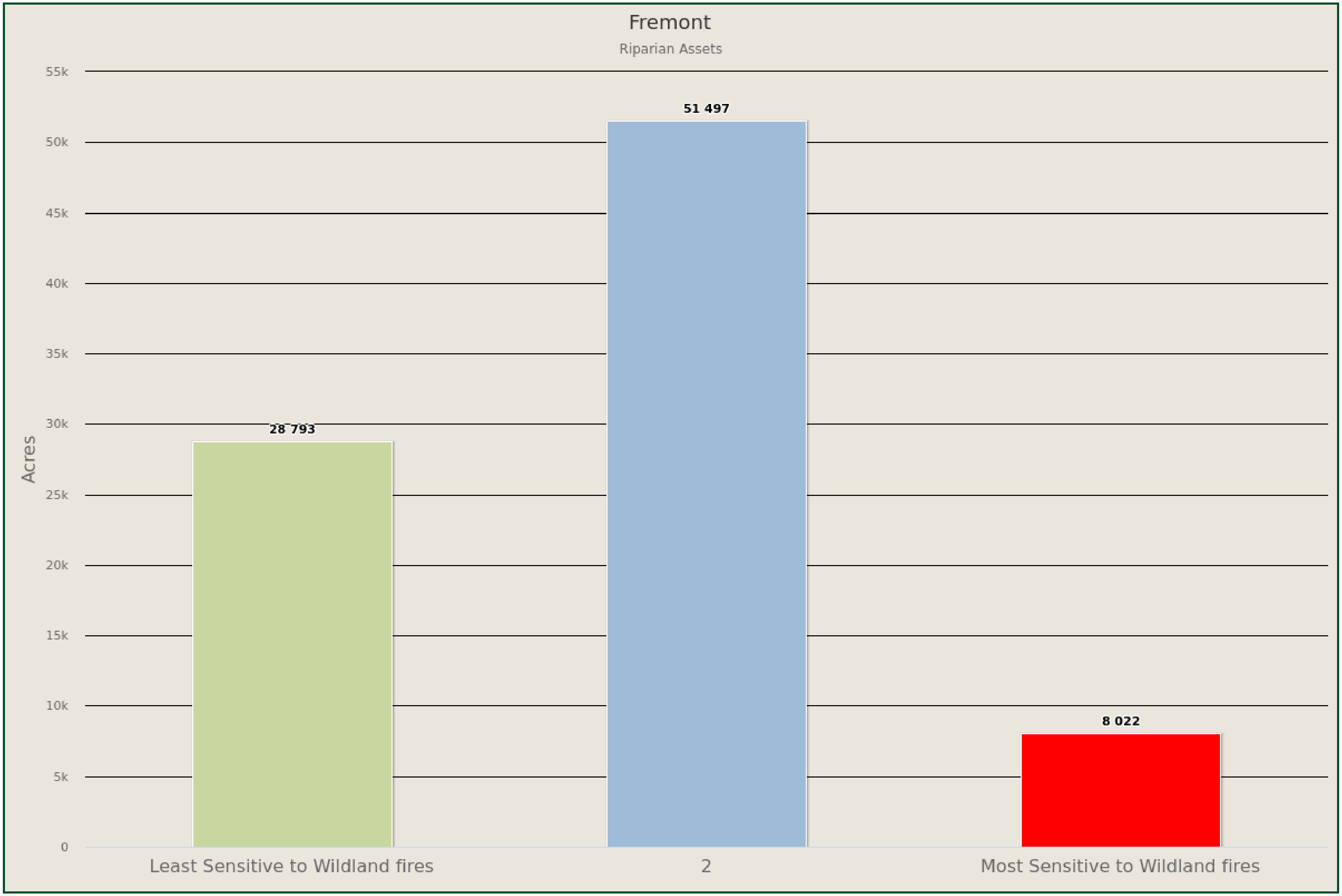
Riparian Assets are forested riparian areas characterized by functions of water quantity and quality, and ecology. This layer identifies riparian areas that are important as a suite of ecosystem services, including both terrestrial and aquatic habitat, water quality, water quantity, and other ecological functions. Riparian areas are considered an especially important element of the landscape in the west. Accordingly, riparian assets are distinguished from other forest assets so they can be evaluated separately.

The process for defining these riparian areas involved identifying the riparian footprint and then assigning a rating based upon two important riparian functions – water quantity and quality, and ecological significance. A scientific model was developed by the West Wide Risk Assessment technical team with in-kind support from CAL FIRE state representatives. Several input datasets were used in the model including the National Hydrography Dataset and the National Wetland Inventory.

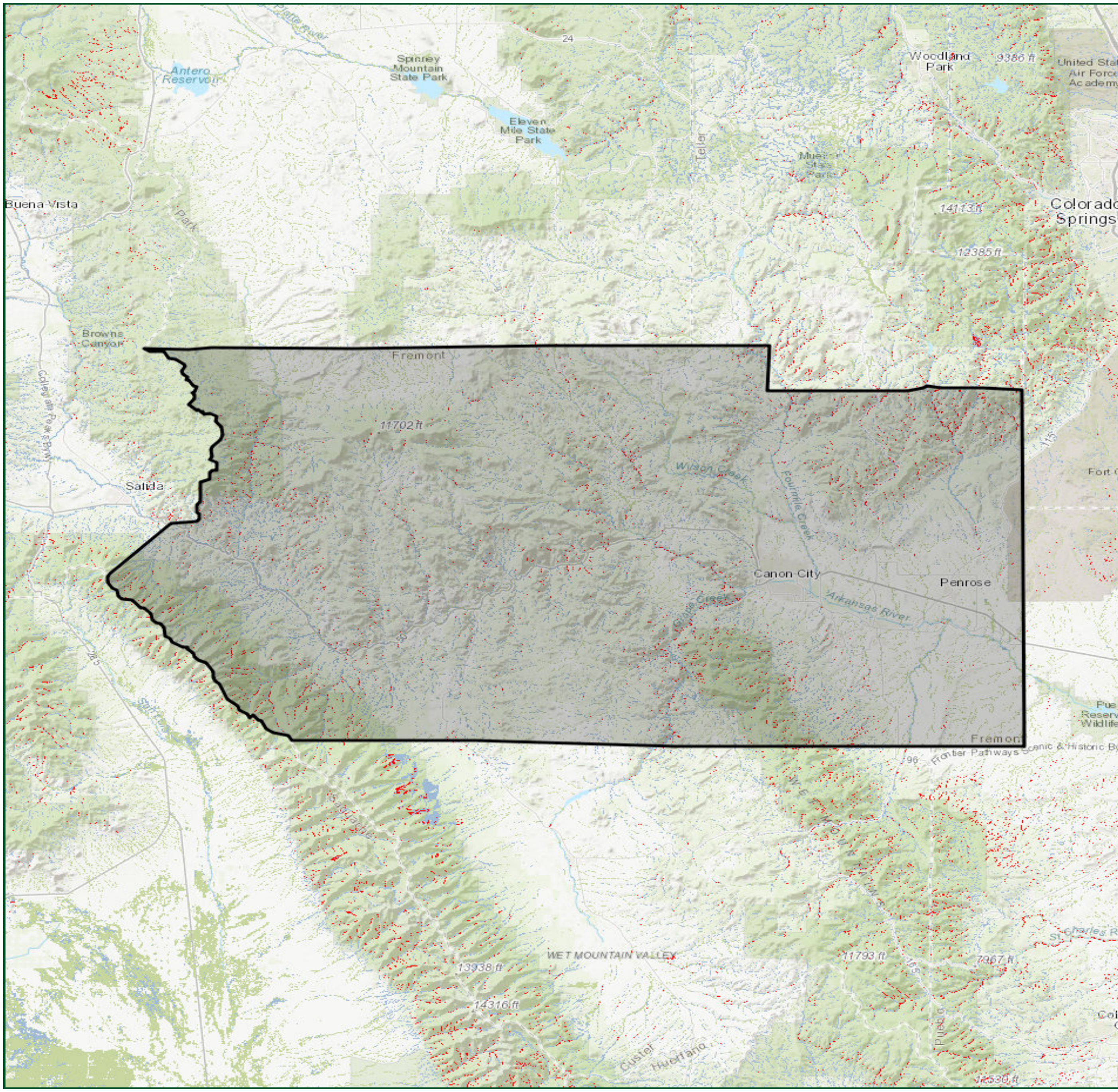
The National Hydrography Data Set (NHD) was used to represent hydrology. A subset of streams and water bodies, which represents perennial, intermittent, and wetlands, was created. The NHD water bodies dataset was used to determine the location of lakes, ponds, swamps, and marshes (wetlands).

To model water quality and quantity, erosion potential (K-factor) and annual average precipitation was used as key variables. The Riparian Assets data are an index of class values that range from 1 to 3 representing increasing importance of the riparian area as well as sensitivity to fire-related impacts on the suite of ecosystem services.

Riparian Assets Class	Acres	Percent
Least Sensitive to Wildland fires	28,793	32.6 %
2	51,497	58.3 %
Most Sensitive to Wildland fires	8,022	9.1 %
Total	**88,312**	**100 %**


Fremont
Riparian Assets
Acres
55k
50k
45k
40k
35k
30k
25k
20k
15k
10k
5k
0
28 793
51 497
8 022
Least Sensitive to Wildland fires
2
Most Sensitive to Wildland fires

Fremont



Riparian Assets

- Least Sensitive to Wildland fires
- 2
- Most Sensitive to Wildland fires

10 mi

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Riparian Assets Risk Index

Description

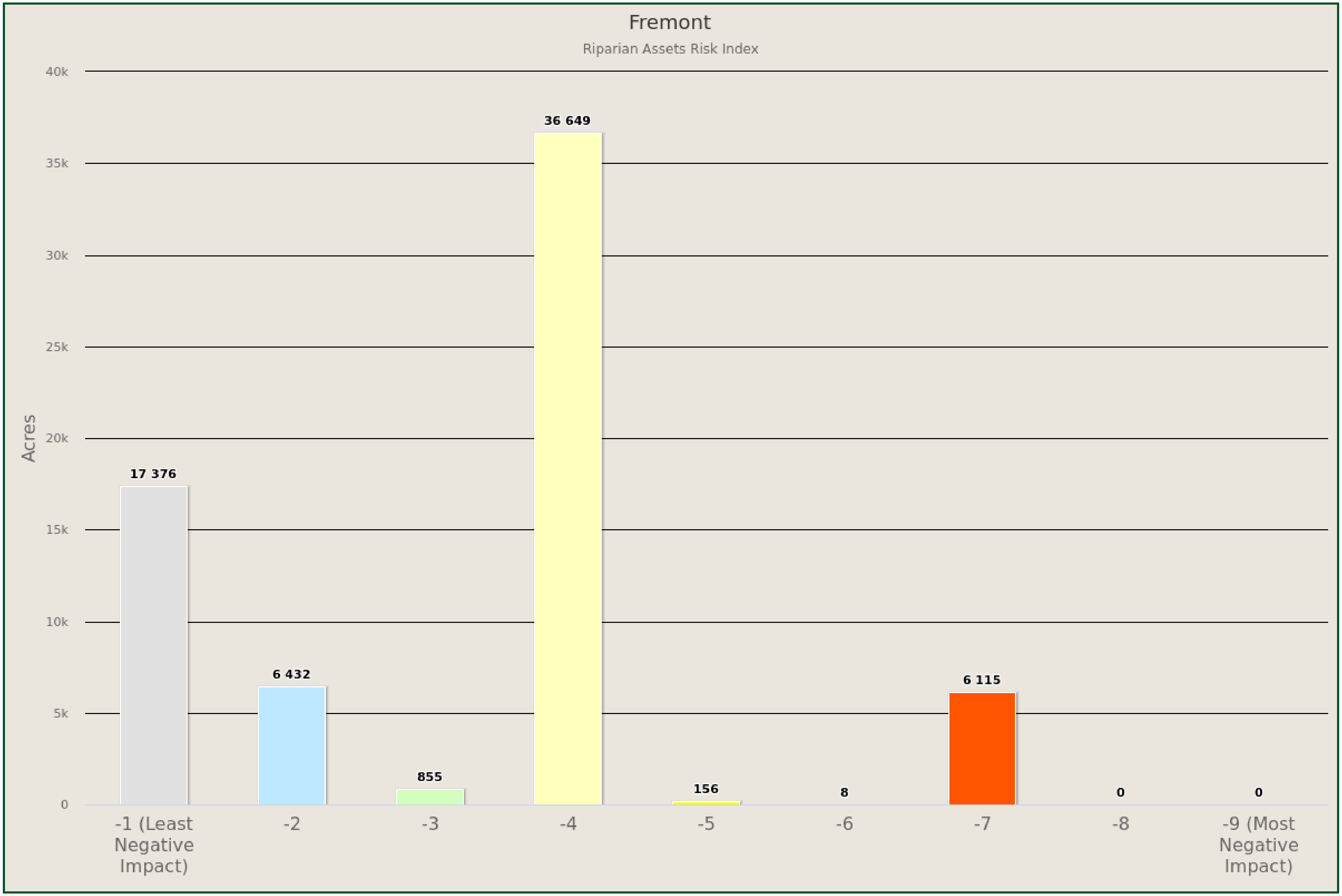
Riparian Assets Risk Index is a measure of the risk to riparian areas based on the potential negative impacts from wildfire. This layer identifies those riparian areas with the greatest potential for adverse effects from wildfire.

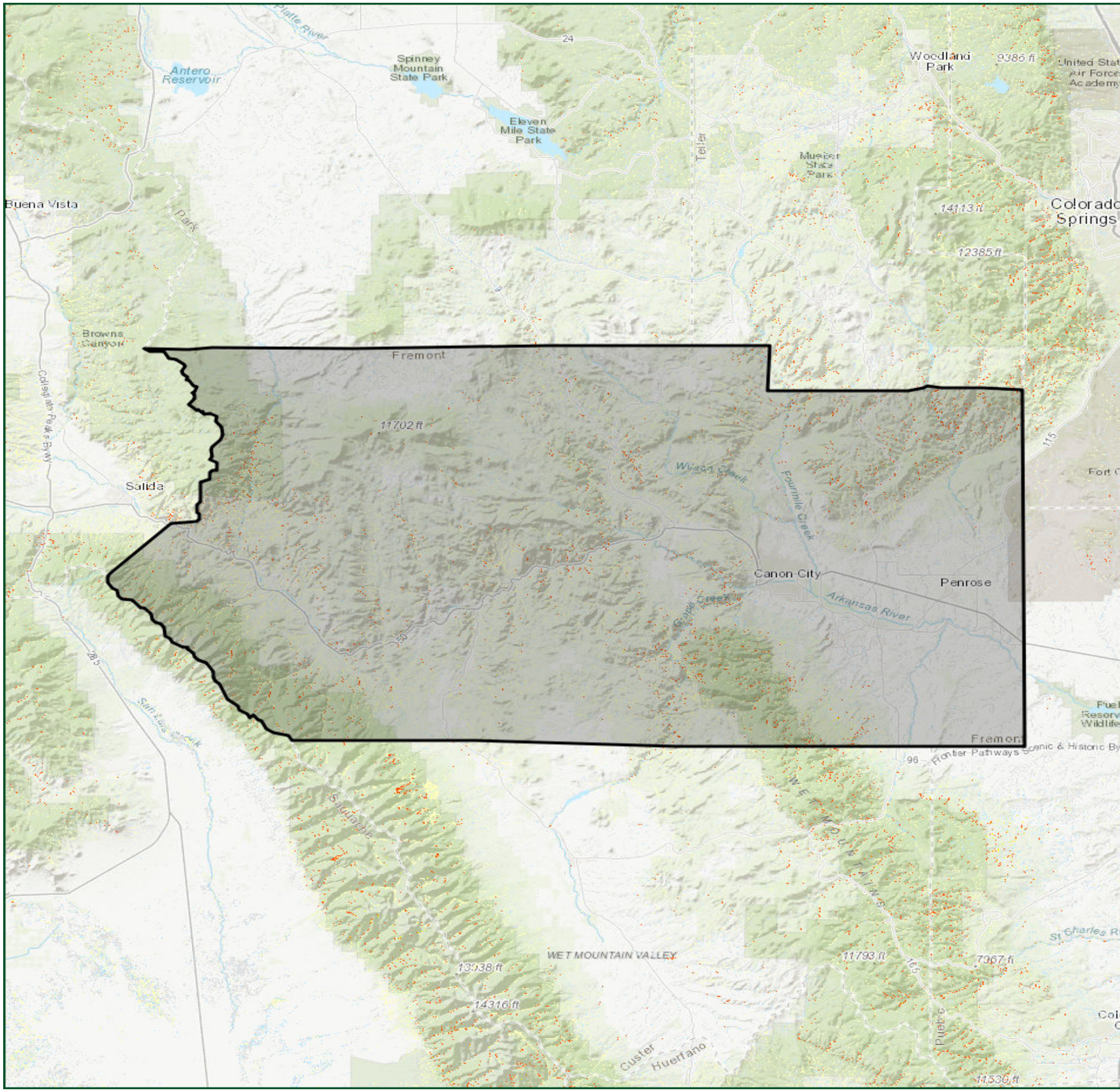
The range of values is from -1 to -9, with -1 representing the least negative impact and -9 representing the most negative impact.

The risk index has been calculated by combining the Riparian Assets data with a measure of fire intensity using a Response Function approach. Those areas with the highest negative impact (-9) represent areas with high potential fire intensity and high importance for ecosystem services. Those areas with the lowest negative impact (-1) represent those areas with low potential fire intensity and a low importance for ecosystem services.

This risk output is intended to supplement the Drinking Water Risk Index by identifying wildfire risk within the more detailed riparian areas.

Riparian Assets Risk Class	Acres	Percent
-1 (Least Negative Impact)	17,376	25.7 %
-2	6,432	9.5 %
-3	855	1.3 %
-4	36,649	54.2 %
-5	156	0.2 %
-6	8	0.0 %
-7	6,115	9.0 %
-8	0	0 %
-9 (Most Negative Impact)	0	0 %
Total	**67,591**	**100 %**


Fremont
Riparian Assets Risk Index
Acres
40k
35k
30k
25k
20k
15k
10k
5k
0
17 376
6 432
855
36 649
156
8
6 115
0
0
-1 (Least Negative Impact)
-2
-3
-4
-5
-6
-7
-8
-9 (Most Negative Impact)



Fremont

Riparian Assets Risk Index

- -1 (Least Negative Impact)
- -2
- -3
- -4
- -5
- -6
- -7
- -8
- -9 (Most Negative Impact)

10 mi

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Forest Assets

Description

Forest Assets are forested areas categorized by height, cover, and susceptibility/response to fire. This layer identifies forested land categorized by height, cover and susceptibility or response to fire. Using these characteristics allows for the prioritization of landscapes reflecting forest assets that would be most adversely affected by fire. The rating of importance or value of the forest assets is relative to each state's interpretation of those characteristics considered most important for their landscapes.

Canopy cover from LANDFIRE 2014 was re-classified into two categories, open or sparse and closed. Areas classified as open or sparse have a canopy cover less than 60%. Areas classified as closed have a canopy cover greater than 60%.

Canopy height from LANDFIRE 2014 was re-classified into two categories, 0-10 meters and greater than 10 meters.

Response to fire was developed from the LANDFIRE 2014 existing vegetation type (EVT) dataset. There are over 1,000 existing vegetation types in the project area. Using a crosswalk defined by project ecologists, a classification of susceptibility and response to fire was defined and documented by fire ecologists into the three fire response classes.

These three classes are sensitive, resilient and adaptive.

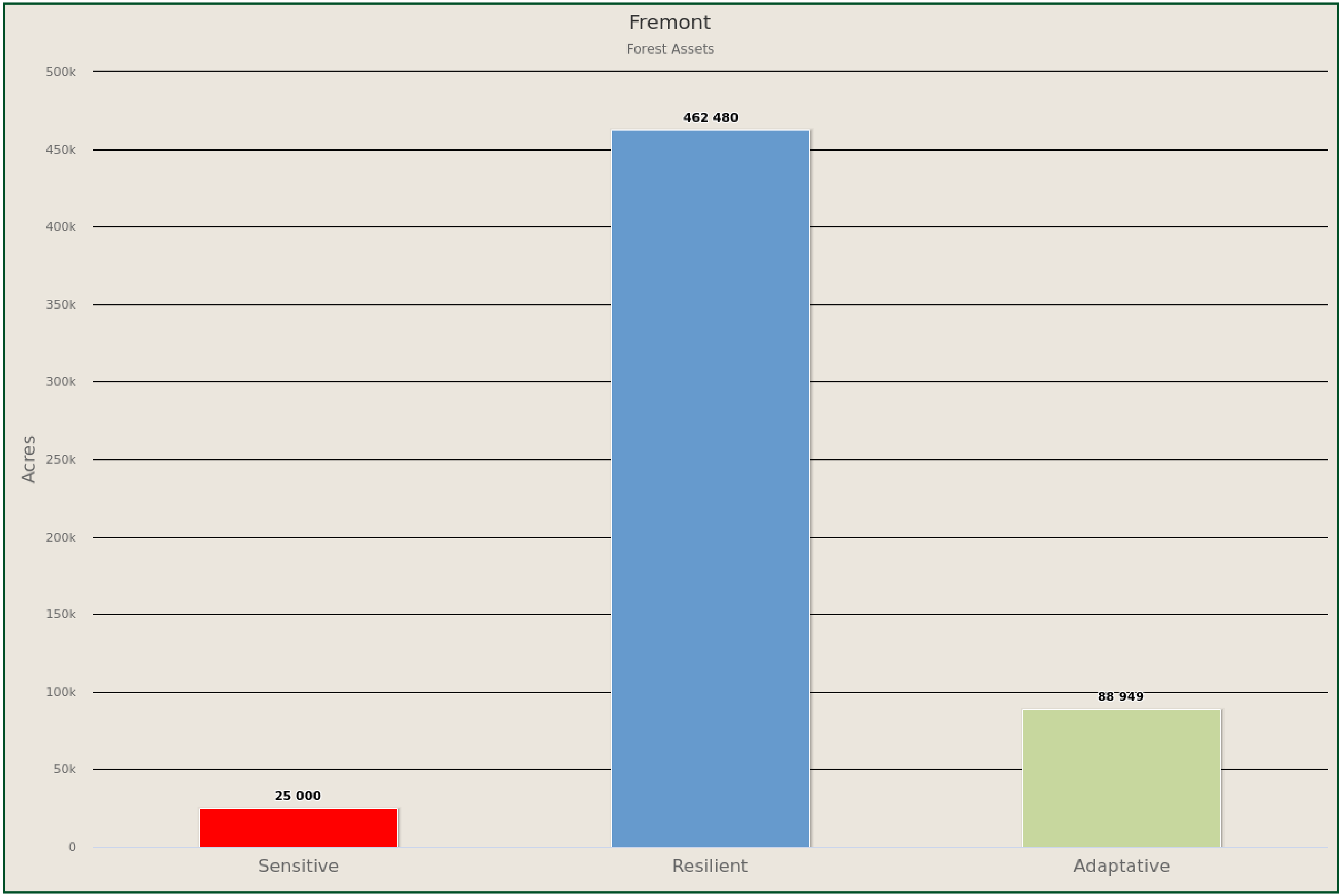
- **Sensitive** = These are tree species that are intolerant or sensitive to damage from fire with low intensity.
- **Resilient** = These are tree species that have characteristics that help the tree resist damage from fire and whose adult stages can survive low intensity fires.
- **Adaptive** = These are tree species adapted with the ability to regenerate following fire by sprouting or serotinous cones

The range of values is from -1 to -9, with -1 representing the least negative impact and -9 representing the most negative impact.

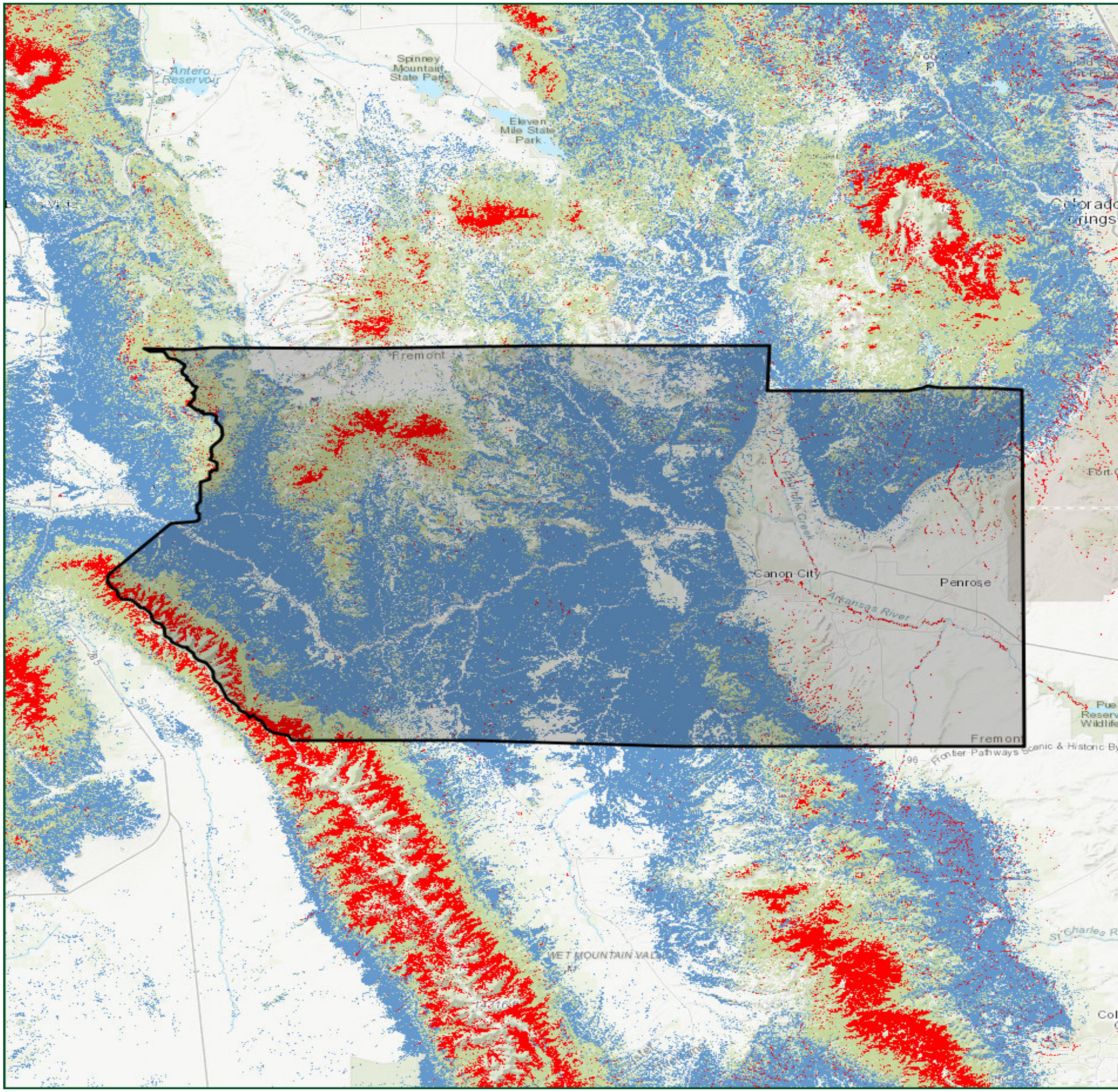
The risk index has been calculated by combining the Forest Assets data with a measure of fire intensity using a Response Function approach. Those areas with the highest negative impact (-9) represent areas with high potential fire intensity and low resilience or adaptability to fire. Those areas with the lowest negative impact (-1) represent those areas with low potential fire intensity and high resilience or adaptability to fire.

This risk output is intended to provide an overall forest index for potential impact from wildfire. This can be applied to consider aesthetic values, ecosystem services, or economic values of forested lands.

Forest Assets	Acres	Percent
Sensitive	25,000	4.3 %
Resilient	462,480	80.2 %
Adaptative	88,949	15.4 %
Total	576,429	100 %


Fremont
Forest Assets
Acres
500k
450k
400k
350k
300k
250k
200k
150k
100k
50k
0
25 000
462 480
88 949
Sensitive
Resilient
Adaptative

Fremont



Forest Assets

- Sensitive
- Resilient
- Adaptative

10 mi

N
S

Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org

Forest Assets Risk Index

Description

Forest Assets Risk Index is a measure of the risk to forested areas based on the potential negative impacts from wildfire. This layer identifies those forested areas with the greatest potential for adverse effects from wildfire.

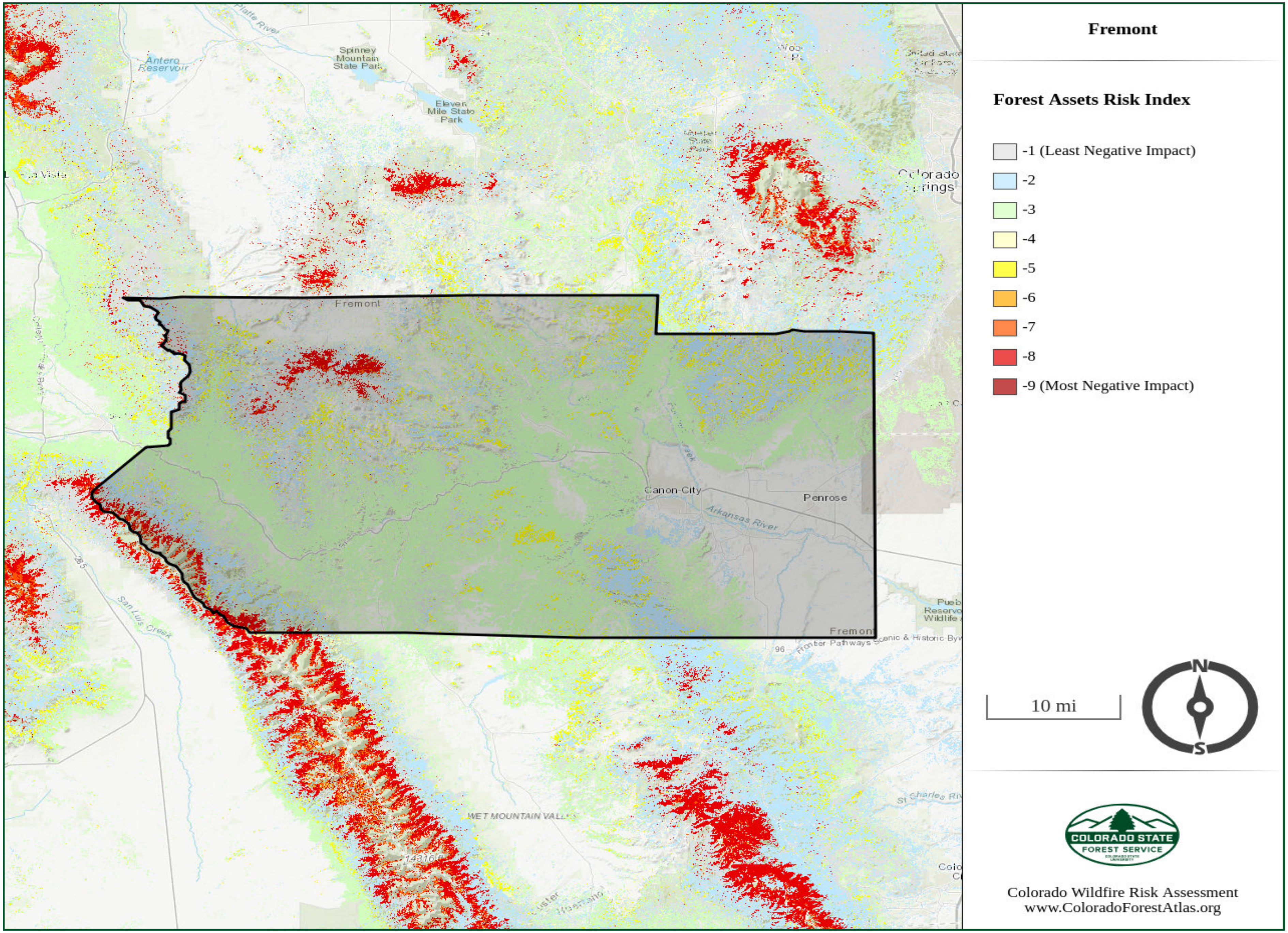
The range of values is from -1 to -9, with -1 representing the least negative impact and -9 representing the most negative impact.

The risk index has been calculated by combining the Forest Assets data with a measure of fire intensity using a Response Function approach. Those areas with the highest negative impact (-9) represent areas with high potential fire intensity and low resilience or adaptability to fire. Those areas with the lowest negative impact (-1) represent those areas with low potential fire intensity and high resilience or adaptability to fire.

This risk output is intended to provide an overall forest index for potential impact from wildfire. This can be applied to consider aesthetic values, ecosystem services, or economic values of forested lands.

Forest Assets Risk Class	Acres	Percent
-1 (Least Negative Impact)	96,097	15.6 %
-2	119,461	19.4 %
-3	334,452	54.3 %
-4	10,743	1.7 %
-5	37,817	6.1 %
-6	99	0.0 %
-7	2,987	0.5 %
-8	13,148	2.1 %
-9 (Most Negative Impact)	886	0.1 %
Total	615,690	100 %


Fremont
Forest Assets Risk Index
Acres
400k
350k
300k
250k
200k
150k
100k
50k
0
96 097
119 461
334 452
10 743
37 817
99
2 987
13 148
886
-1 (Least Negative Impact)
-2
-3
-4
-5
-6
-7
-8
-9 (Most Negative Impact)


Fremont
Forest Assets Risk Index
-1 (Least Negative Impact)
-2
-3
-4
-5
-6
-7
-8
-9 (Most Negative Impact)
10 mi
N
S
COLORADO STATE FOREST SERVICE
Colorado Wildfire Risk Assessment
www.ColoradoForestAtlas.org
Antero Reservoir
Spinney Mountain State Park
Eleven Mile State Park
Fremont
Canon City
Penrose
Arkansas River
San Luis Creek
WET MOUNTAIN VALLEY
Frontier Pathways Scenic & Historic Byway

References

Anderson, H. E. (1982). Aids to determining fuel models for estimating fire behavior. USDA For. Serv. Gen. Tech. Rep. INT-122.

Colorado State Forest Service (November 2018). Colorado Wildfire Risk Assessment Final Report. A final report developed by CSFS and Technosylva Inc. (La Jolla, CA) documenting the technical methods and results for the Colorado wildfire risk assessment update project.

Colorado State Forest Service (July 2018). Fuels Calibration Final Report. A final report developed by CSFS and Technosylva Inc. (La Jolla, CA) documenting the technical methods and results for the Colorado fuels calibration project.

Colorado State Forest Service (2012). Colorado Wildfire Risk Assessment 2012 Final Report. A final report developed by CSFS and DTS (Fort Collins, CO) documenting the technical methods and specifications for the Colorado WRA project.

National Wildfire Coordinating Group (NWCG). (2008). Glossary of Wildland Fire Terminology. Publication Management System document PMS-205.

National Wildfire Coordinating Group (2004). Fireline Handbook. NWCG Handbook 3. PMS 410-1. NFES 0065. National Interagency Fire Center. Boise, Idaho 83705.

Scott, J. H., & Burgan, R. E. (2005). Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model. Ft. Collins, CO, Rocky Mountain Research Station: USDA Forest Service, Gen. Tech. Rpt. RMRS-GTR-153.

Scott, J. H., & Reinhardt, E. D. (2001). Assessing the Crown Fire Potential by Linking Models of Surface and Crown Fire Behavior. Ft. Collins, CO, Rocky Mountain Research Station: USDA Forest Service, Research Paper RMRS-RP-29.

COLORADO STATE FOREST SERVICE
COLORADO STATE UNIVERSITY

Appendix C: Flood Hazus Risk Report

Hazus: Flood Global Risk Report

Region Name: Fremont100yrFL30m

Flood Scenario: 100yr

Print Date: Thursday, July 30, 2020

Disclaimer:

This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Colorado

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is approximately 1,534 square miles and contains 3,285 census blocks. The region contains over 17 thousand households and has a total population of 46,824 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 19,240 buildings in the region with a total building replacement value (excluding contents) of 3,692 million dollars. Approximately 91.68% of the buildings (and 79.34% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 19,240 buildings in the region which have an aggregate total replacement value of 3,692 million dollars. Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	2,929,571	79.3%
Commercial	458,355	12.4%
Industrial	125,299	3.4%
Agricultural	19,923	0.5%
Religion	71,394	1.9%
Government	48,432	1.3%
Education	39,293	1.1%
Total	**3,692,267**	**100%**

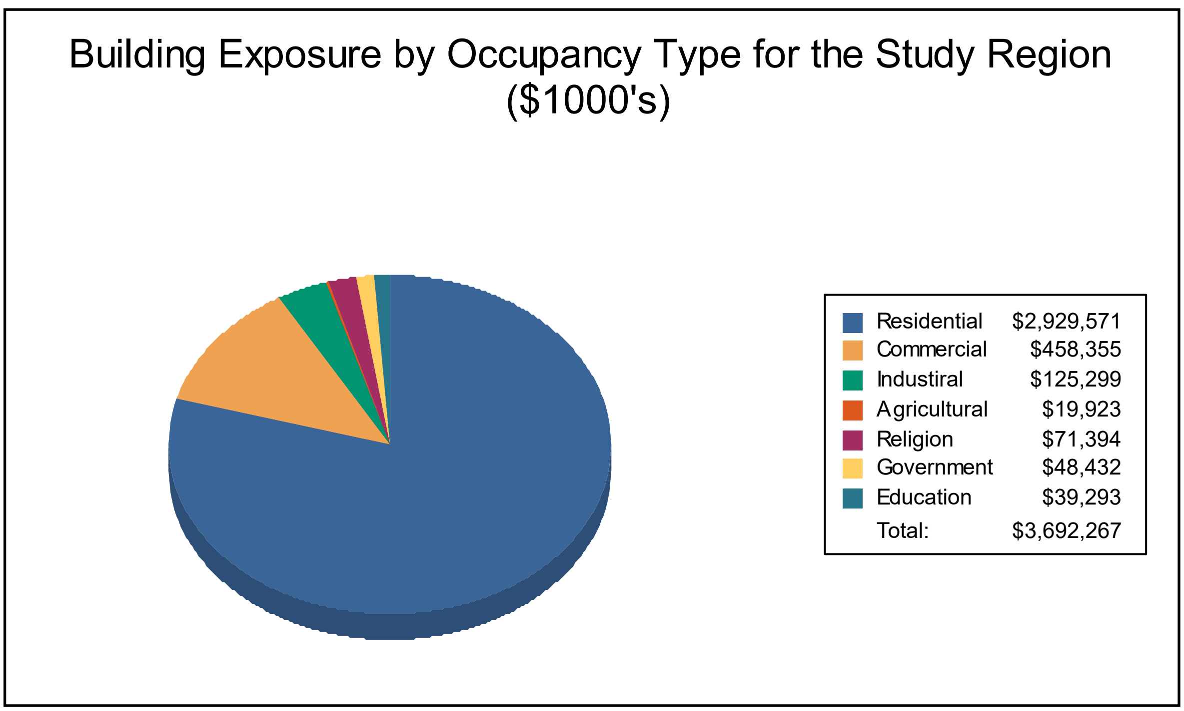
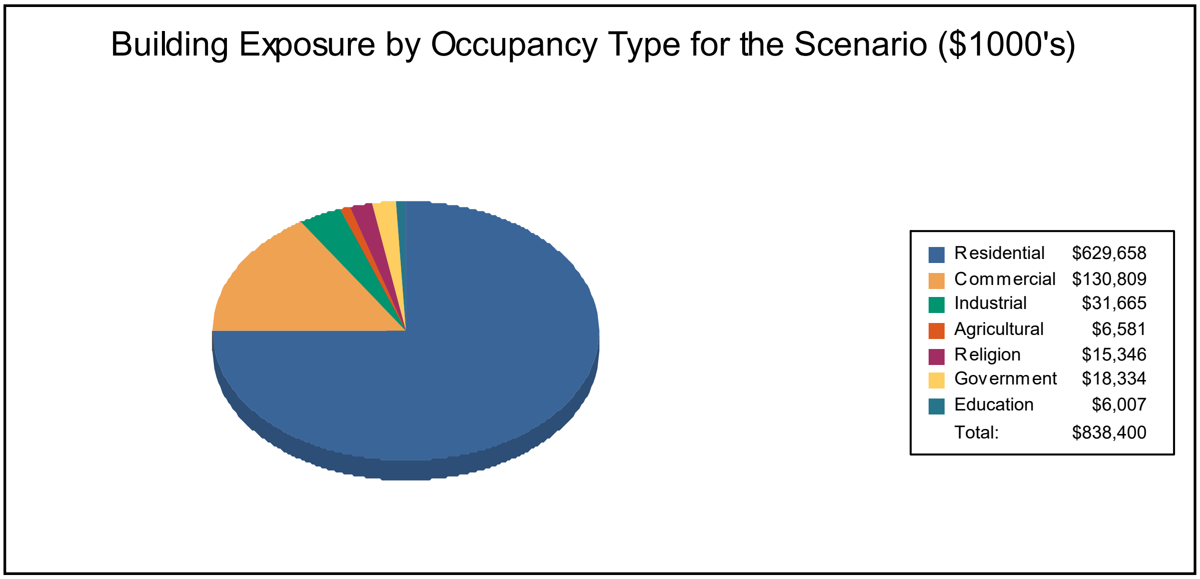


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	629,658	75.1%
Commercial	130,809	15.6%
Industrial	31,665	3.8%
Agricultural	6,581	0.8%
Religion	15,346	1.8%
Government	18,334	2.2%
Education	6,007	0.7%
Total	**838,400**	**100%**



Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 25 beds. There are 19 schools, 15 fire stations, 10 police stations and no emergency operation centers.

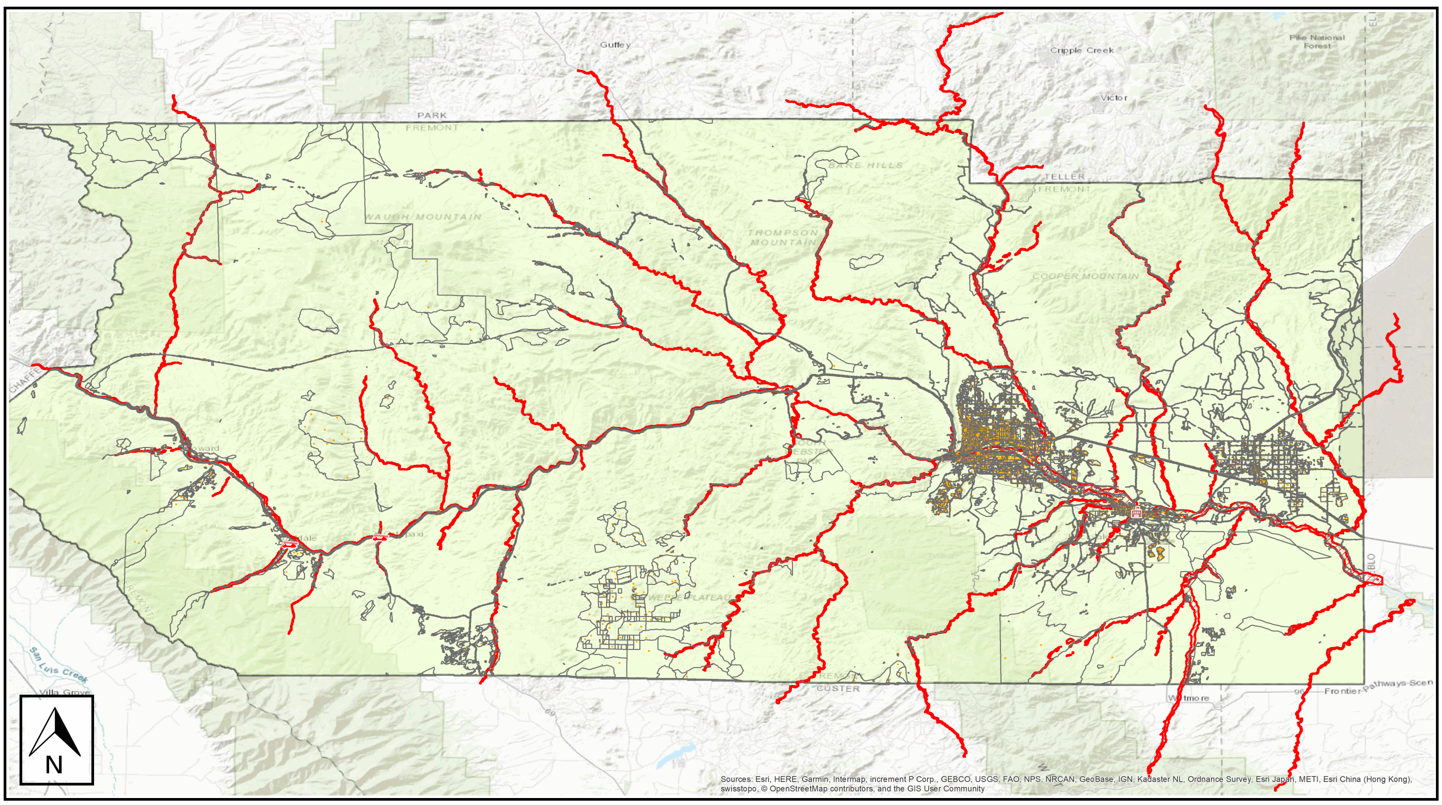
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Fremont100yrFL30m
Scenario Name:	100yr
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Building Damage

General Building Stock Damage

Hazus estimates that about 227 buildings will be at least moderately damaged. This is over 54% of the total number of buildings in the scenario. There are an estimated 68 buildings that will be completely destroyed. The definition of the ‘damage states’ is provided in the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

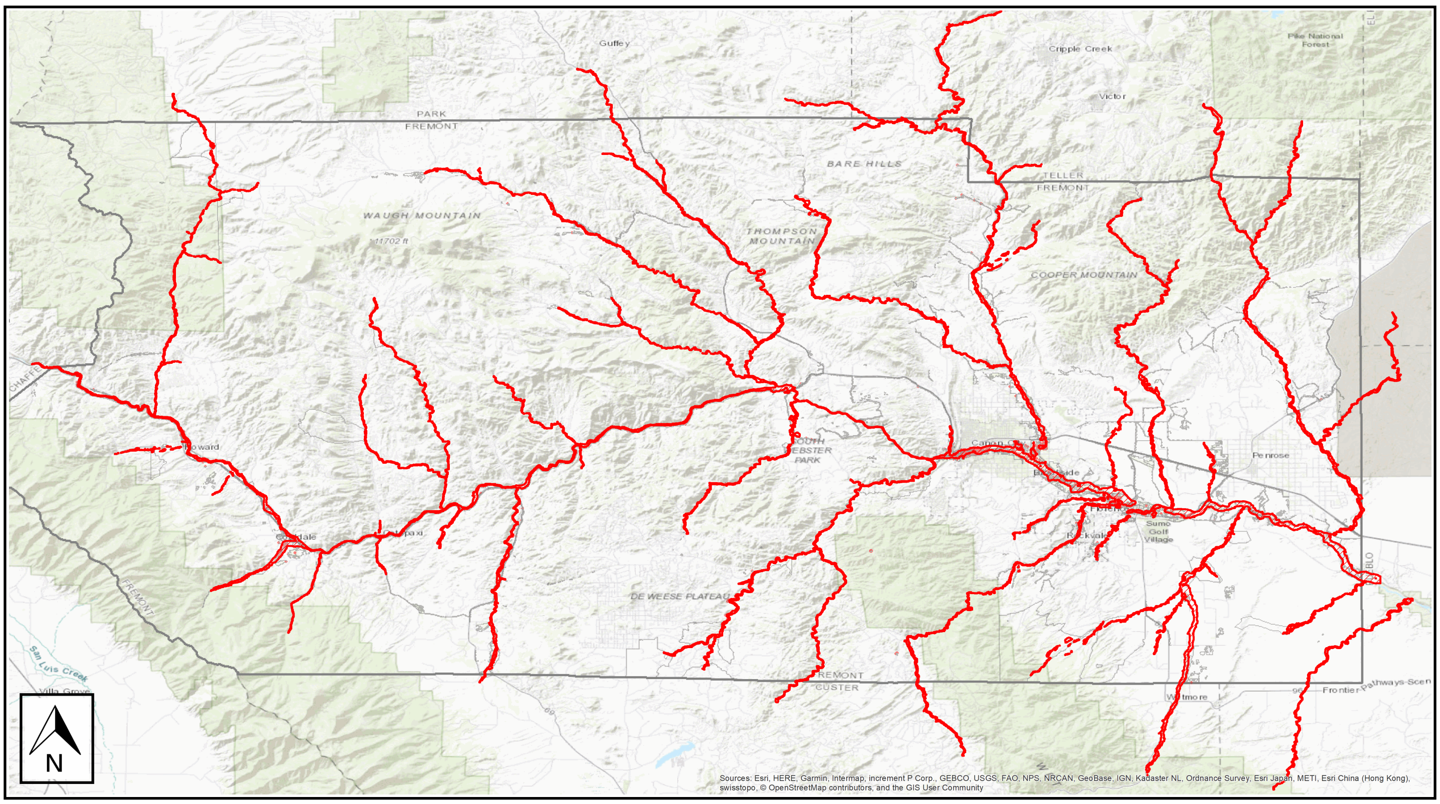


Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	1	100	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	69	23	95	32	25	8	24	8	14	5	68	23
Total	**69**		**96**		**25**		**24**		**14**		**68**	

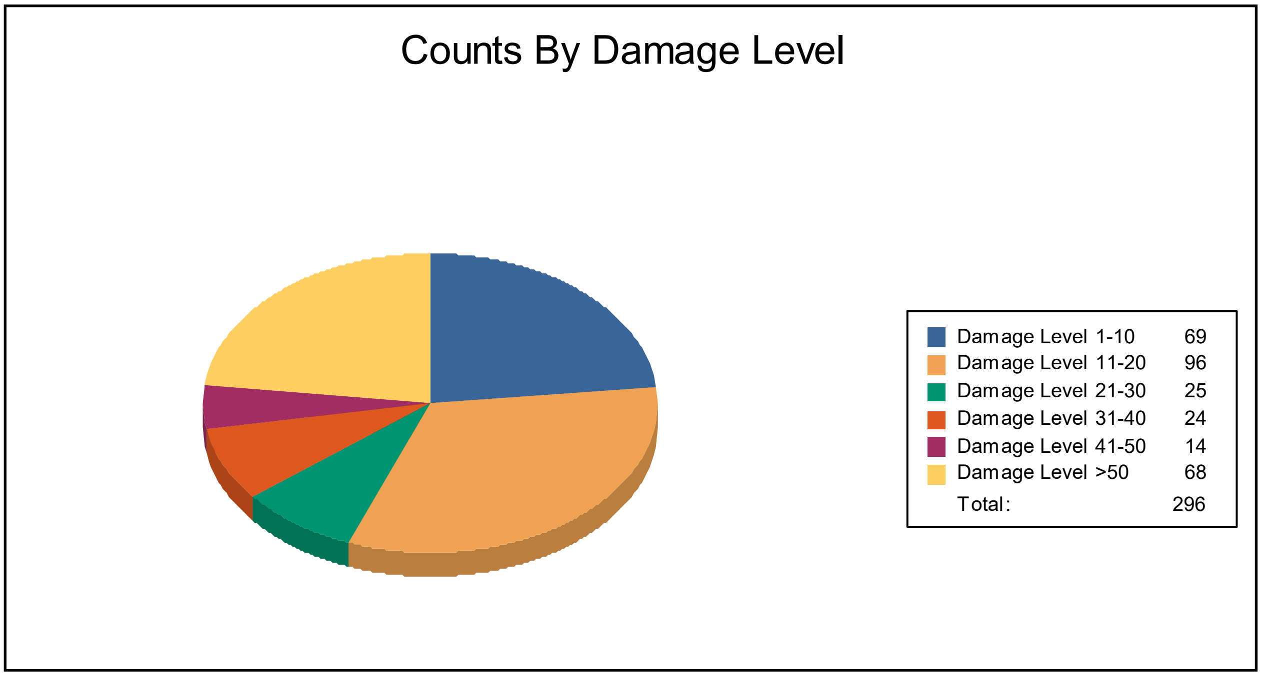


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	18	100
Masonry	4	17	10	43	1	4	2	9	1	4	5	22
Steel	0	0	0	0	0	0	0	0	0	0	0	0
Wood	65	26	85	33	24	9	22	9	13	5	45	18

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 25 hospital beds available for use. On the day of the scenario flood event, the model estimates that 25 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operation Centers	0	0	0	0
Fire Stations	15	1	1	2
Hospitals	1	0	0	0
Police Stations	10	0	0	0
Schools	19	1	0	1

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

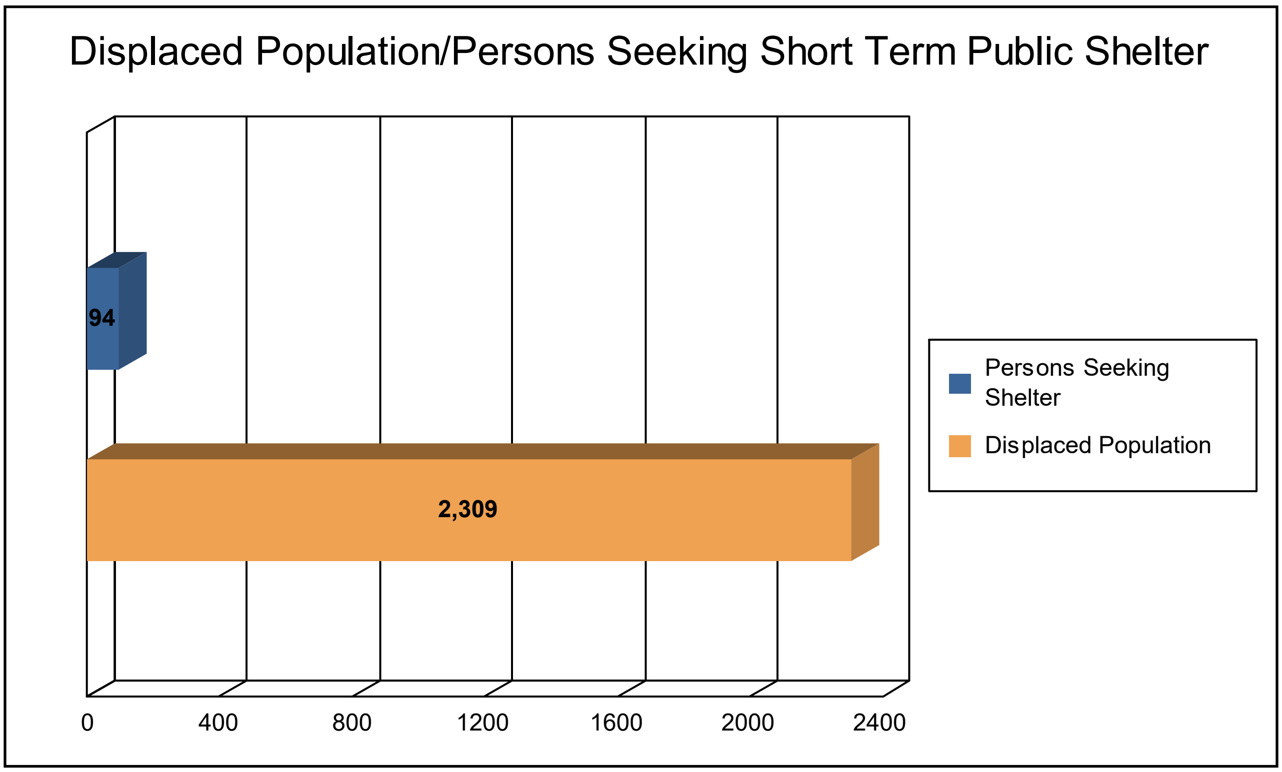
Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

Analysis has not been performed for this Scenario.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 770 households (or 2,309 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 94 people (out of a total population of 46,824) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 189.65 million dollars, which represents 22.62 % of the total replacement value of the scenario buildings.

Building-Related Losses

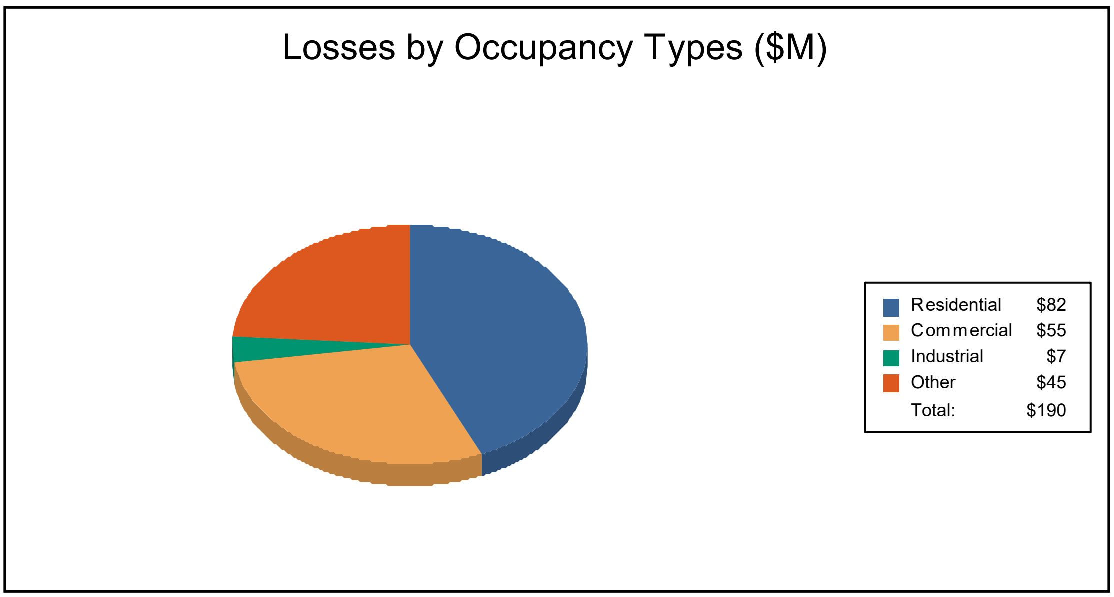
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 98.90 million dollars. 48% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 43.35% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	40.73	5.56	2.10	1.49	49.88
	Content	21.65	15.11	3.97	7.29	48.02
	Inventory	0.00	0.21	0.69	0.09	1.00
	Subtotal	**62.38**	**20.88**	**6.76**	**8.87**	**98.90**
Business Interruption						
	Income	0.63	14.69	0.09	2.19	17.60
	Relocation	12.76	2.47	0.08	1.41	16.72
	Rental Income	4.95	1.84	0.02	0.31	7.12
	Wage	1.50	15.35	0.18	32.28	49.31
	Subtotal	**19.83**	**34.36**	**0.37**	**36.19**	**90.75**
ALL	**Total**	**82.21**	**55.24**	**7.13**	**45.06**	**189.65**



Appendix A: County Listing for the Region

Colorado

- Fremont

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Colorado				
Fremont	46,824	2,929,571	762,696	3,692,267
Total	**46,824**	**2,929,571**	**762,696**	**3,692,267**
Total Study Region	**46,824**	**2,929,571**	**762,696**	**3,692,267**

Appendix D: Earthquake Hazus Risk Report

Hazus: Earthquake Global Risk Report

Region Name FremontCO_EQ

Earthquake Scenario: Fremont 2,500yr Probabalistic

Print Date: July 17, 2020

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Colorado

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 1,533.54 square miles and contains 14 census tracts. There are over 16 thousand households in the region which has a total population of 46,824 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 19 thousand buildings in the region with a total building replacement value (excluding contents) of 3,692 (millions of dollars). Approximately 92.00 % of the buildings (and 79.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,590 and 921 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 19 thousand buildings in the region which have an aggregate total replacement value of 3,692 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 60% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 25 beds. There are 19 schools, 15 fire stations, 10 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 3 hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 2,511.00 (millions of dollars). This inventory includes over 147.89 miles of highways, 137 bridges, 6,330.53 miles of pipes.

Table 1: Transportation System Lifeline Inventory

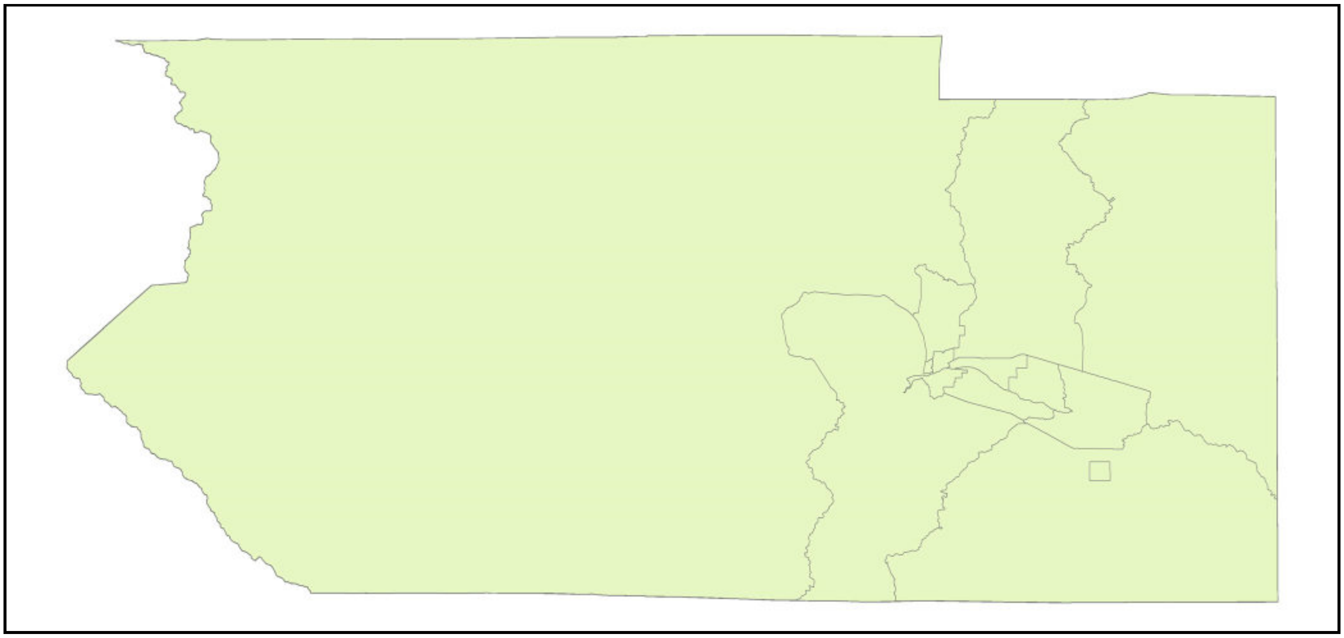
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	137	147.7293
	Segments	19	1070.3743
	Tunnels	2	6.8775
		Subtotal	**1224.9811**
Railways	Bridges	26	114.6640
	Facilities	0	0.0000
	Segments	98	205.3959
	Tunnels	0	0.0000
		Subtotal	**320.0599**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	1	1.4112
		Subtotal	**1.4112**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	1	4.4101
	Runways	2	39.2080
		Subtotal	**43.6181**
		Total	**1,590.10**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	127.1690
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**127.1690**
Waste Water	Distribution Lines	NA	76.3014
	Facilities	4	504.5218
	Pipelines	0	0.0000
		Subtotal	**580.8232**
Natural Gas	Distribution Lines	NA	50.8676
	Facilities	0	0.0000
	Pipelines	2	8.8710
		Subtotal	**59.7386**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	1	153.4734
		Subtotal	**153.4734**
Communication	Facilities	3	0.2910
		Subtotal	**0.2910**
		Total	**921.50**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	Fremont 2,500yr Probabalistic
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	2,500.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	7.00
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Direct Earthquake Damage

Building Damage

Hazus estimates that about 1,070 buildings will be at least moderately damaged. This is over 6.00 % of the buildings in the region. There are an estimated 5 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

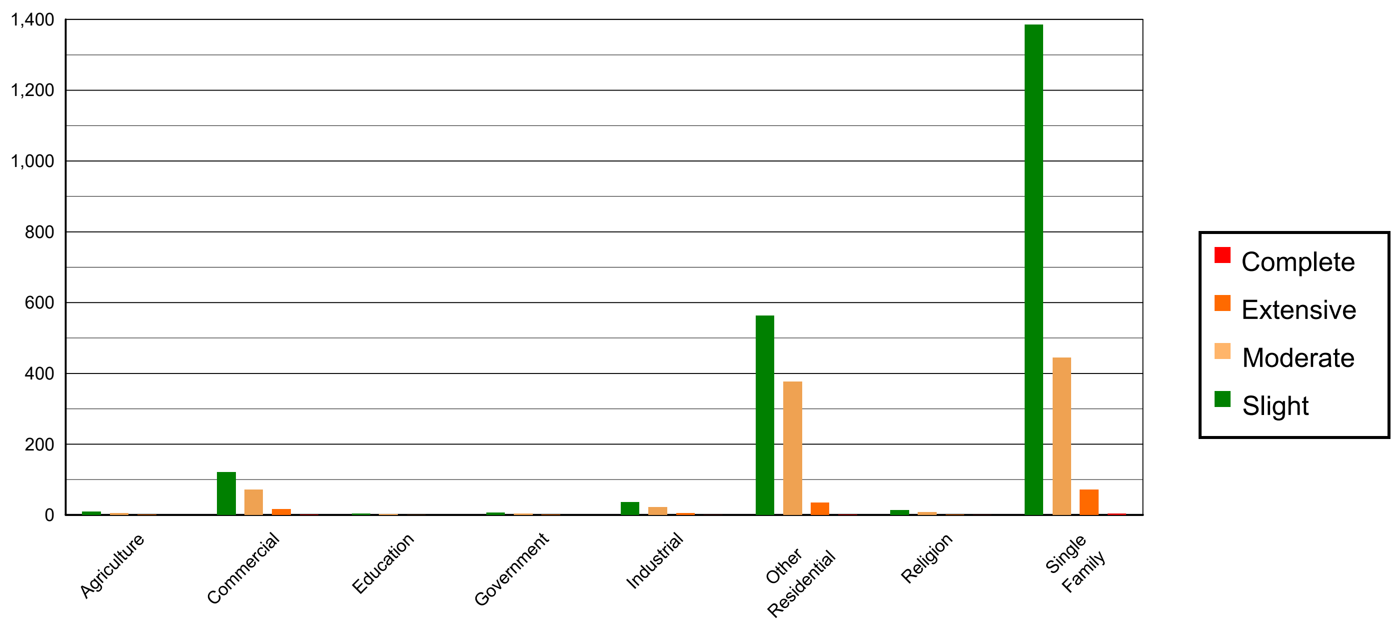


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	70.13	0.44	9.35	0.44	5.32	0.57	1.15	0.88	0.05	0.90
Commercial	800.21	4.99	121.03	5.66	71.98	7.70	15.93	12.17	0.86	14.87
Education	27.19	0.17	3.49	0.16	1.94	0.21	0.37	0.28	0.02	0.31
Government	38.68	0.24	6.02	0.28	3.62	0.39	0.65	0.50	0.03	0.59
Industrial	234.03	1.46	36.08	1.69	22.69	2.43	5.00	3.82	0.20	3.55
Other Residential	2294.89	14.32	562.57	26.31	376.99	40.35	34.29	26.20	1.27	21.97
Religion	101.57	0.63	13.61	0.64	7.43	0.80	1.33	1.01	0.07	1.21
Single Family	12464.60	77.75	1385.70	64.82	444.27	47.55	72.15	55.14	3.26	56.59
Total	**16,031**		**2,138**		**934**		**131**		**6**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	10286.13	64.16	1129.86	52.85	197.82	21.17	12.76	9.75	0.02	0.36
Steel	277.52	1.73	34.29	1.60	23.03	2.46	3.83	2.93	0.20	3.55
Concrete	240.16	1.50	40.17	1.88	21.47	2.30	2.93	2.24	0.08	1.46
Precast	211.47	1.32	33.79	1.58	32.74	3.50	10.11	7.73	0.27	4.61
RM	2767.82	17.27	285.03	13.33	231.38	24.77	50.59	38.66	0.50	8.59
URM	376.20	2.35	101.56	4.75	67.47	7.22	19.15	14.63	3.57	61.97
MH	1871.98	11.68	513.15	24.00	360.34	38.57	31.49	24.06	1.12	19.46
Total	**16,031**		**2,138**		**934**		**131**		**6**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 25 hospital beds available for use. On the day of the earthquake, the model estimates that only 22 hospital beds (90.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 99.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	1	0	0	1
Schools	19	0	0	19
EOCs	0	0	0	0
PoliceStations	10	0	0	10
FireStations	15	0	0	15

Transportation Lifeline Damage

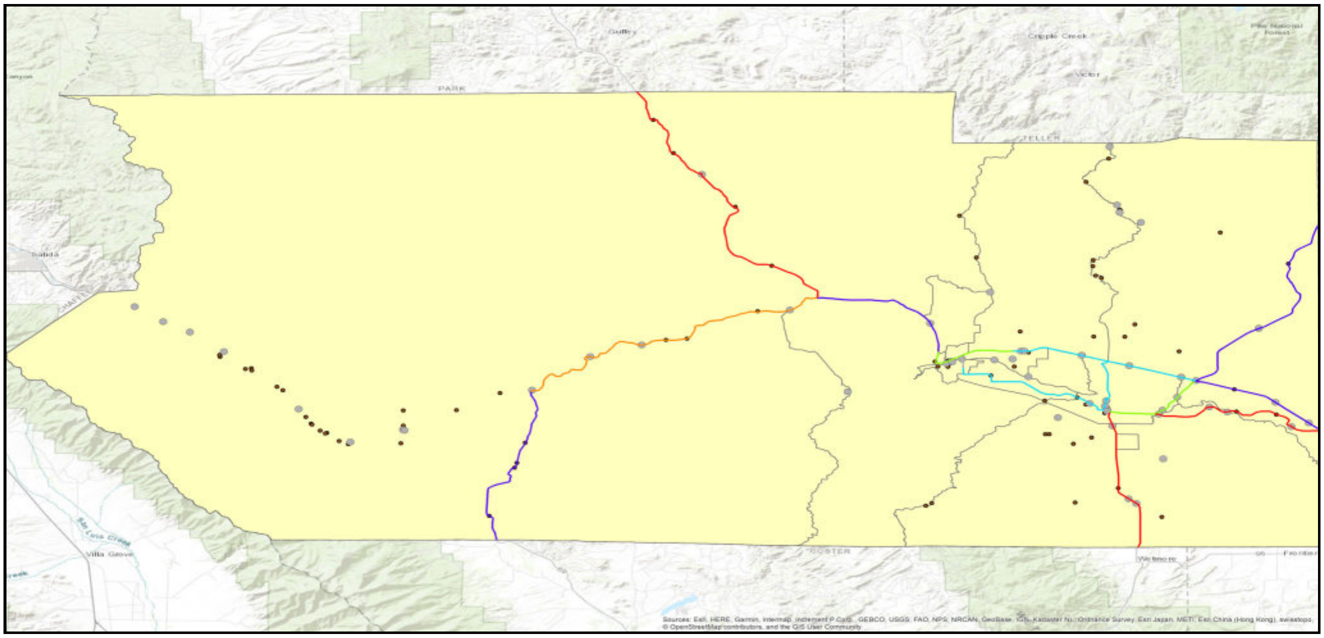


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 % After Day 1	With Functionality > 50 % After Day 7
Highway	Segments	19	0	0	19	19
	Bridges	137	0	0	137	137
	Tunnels	2	0	0	2	2
Railways	Segments	98	0	0	98	98
	Bridges	26	0	0	26	26
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	1	0	0	1	1
	Runways	2	0	0	2	2

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	4	0	0	4	4
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	1	0	0	1	1
Communication	3	0	0	3	3

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	3,951	43	11
Waste Water	2,371	21	5
Natural Gas	9	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	16,582	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

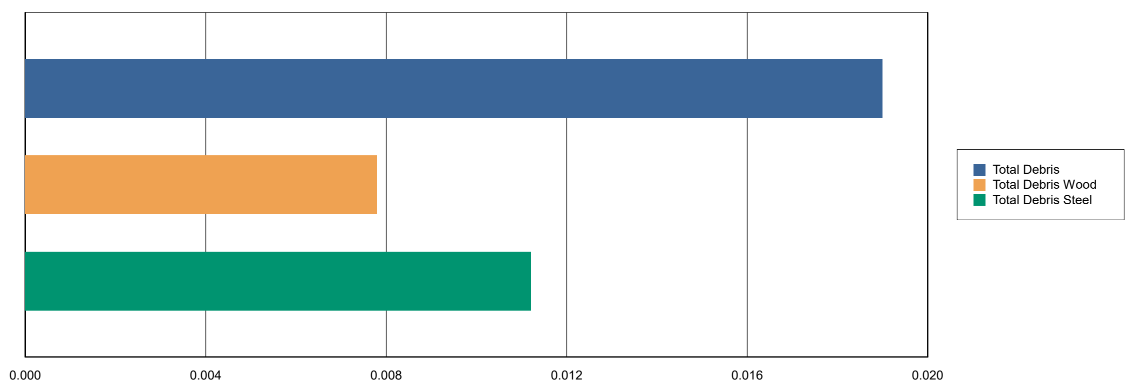
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 19,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 41.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 760 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



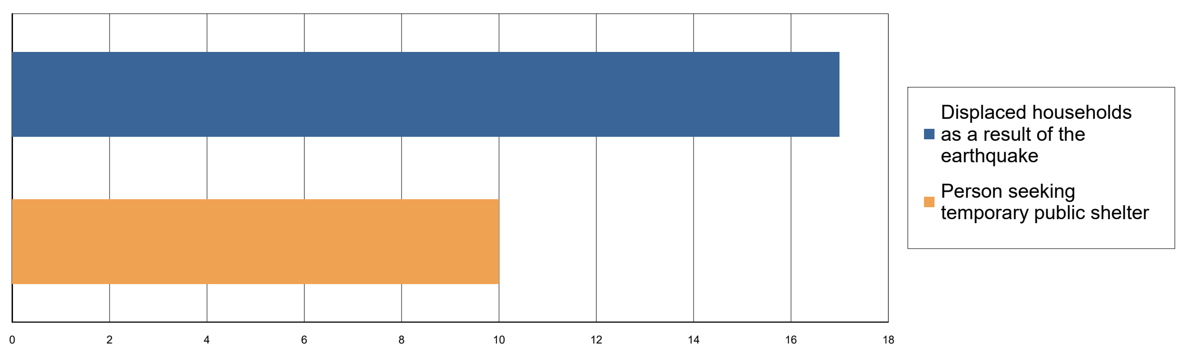
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.01	0.01	0.02	760 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 17 households to be displaced due to the earthquake. Of these, 10 people (out of a total population of 46,824) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
17	10

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

· Severity Level 1:Injuries will require medical attention but hospitalization is not needed.
· Severity Level 2:Injuries will require hospitalization but are not considered life-threatening
· Severity Level 3:Injuries will require hospitalization and can become life threatening if not promptly treated.
· Severity Level 4:Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0.12	0.02	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.12	0.02	0.00	0.00
	Other-Residential	6.84	0.86	0.05	0.11
	Single Family	6.16	0.73	0.05	0.10
	Total	**13**	**2**	**0**	**0**
2 PM	Commercial	8.32	1.16	0.10	0.18
	Commuting	0.00	0.00	0.00	0.00
	Educational	1.36	0.18	0.01	0.03
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.87	0.11	0.01	0.01
	Other-Residential	1.72	0.22	0.02	0.03
	Single Family	1.58	0.19	0.01	0.03
	Total	**14**	**2**	**0**	**0**
5 PM	Commercial	6.01	0.84	0.07	0.13
	Commuting	0.00	0.00	0.01	0.00
	Educational	0.04	0.01	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.54	0.07	0.00	0.01
	Other-Residential	2.57	0.33	0.02	0.04
	Single Family	2.38	0.29	0.02	0.04
	Total	**12**	**2**	**0**	**0**

Economic Loss

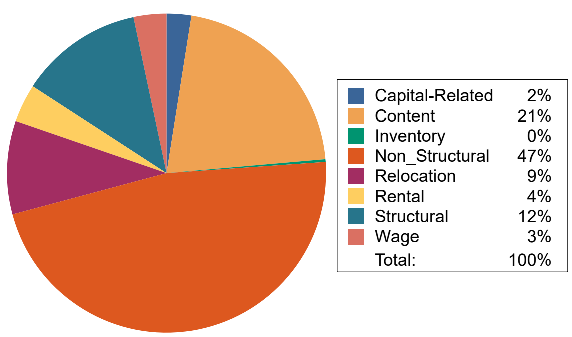
The total economic loss estimated for the earthquake is 110.52 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 67.65 (millions of dollars); 19 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 66 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

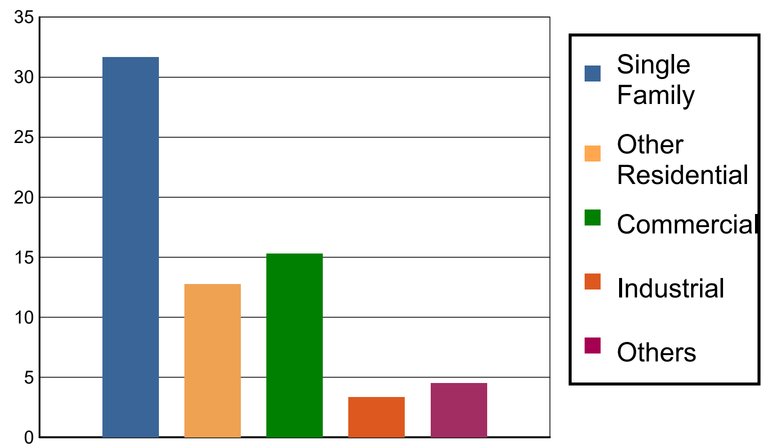


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.3209	1.6747	0.0606	0.2075	2.2637
	Capital-Related	0.0000	0.1363	1.4815	0.0357	0.0308	1.6843
	Rental	0.9363	0.6823	0.9338	0.0276	0.1060	2.6860
	Relocation	3.3143	0.8349	1.3991	0.1878	0.5705	6.3066
	Subtotal	**4.2506**	**1.9744**	**5.4891**	**0.3117**	**0.9148**	**12.9406**
Capital Stock Losses							
	Structural	4.0682	1.7944	1.6187	0.3798	0.5833	8.4444
	Non_Structural	16.5090	7.0191	4.9189	1.4966	1.8187	31.7623
	Content	6.8444	1.9672	3.1901	1.0178	1.2005	14.2200
	Inventory	0.0000	0.0000	0.0854	0.1763	0.0201	0.2818
	Subtotal	**27.4216**	**10.7807**	**9.8131**	**3.0705**	**3.6226**	**54.7085**
	Total	**31.67**	**12.76**	**15.30**	**3.38**	**4.54**	**67.65**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1070.3743	0.0000	0.00
	Bridges	147.7293	0.1221	0.08
	Tunnels	6.8775	0.0137	0.20
	Subtotal	**1224.9811**	**0.1358**	
Railways	Segments	205.3959	0.0000	0.00
	Bridges	114.6640	0.0012	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**320.0599**	**0.0012**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	1.4112	0.2049	14.52
	Subtotal	**1.4112**	**0.2049**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	4.4101	0.5749	13.04
	Runways	39.2080	0.0000	0.00
	Subtotal	**43.6181**	**0.5749**	
	Total	**1,590.07**	**0.92**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	127.1690	0.1923	0.15
	Subtotal	**127.1690**	**0.1923**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	504.5218	33.4145	6.62
	Distribution Line	76.3014	0.0966	0.13
	Subtotal	**580.8232**	**33.5111**	
Natural Gas	Pipelines	8.8710	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	50.8676	0.0331	0.07
	Subtotal	**59.7386**	**0.0331**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	153.4734	8.2016	5.34
	Subtotal	**153.4734**	**8.2016**	
Communication	Facilities	0.2910	0.0165	5.67
	Subtotal	**0.2910**	**0.0165**	
	Total	**921.50**	**41.95**	

Appendix A: County Listing for the Region

Fremont,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado					
	Fremont	46,824	2,929	762	3,692
Total Region		**46,824**	**2,929**	**762**	**3,692**

Appendix E: MITIGATION IDEAS

Mitigation Strategy Action Ideas

The following ideas for mitigation actions were informed by two community surveys of the residents of Fremont County (225 participants). Additionally, some mitigation ideas were also taken from the current hazard mitigation plan and are denoted with blue text. This survey identified the priorities of community members and their input on ways to mitigate hazards in their neighborhoods, municipalities, and on their private properties.

- ***Multiple Hazards***
  - Provide necessary equipment for redundant communications for both responders and citizens
  - Improve response time to incidents and quicker re-entry after evacuations
  - Create public road maps with GIS for alternate routes if main routes are closed.
  - Provide adequate accommodations during hazard events. This should include food and water, medical care, and accommodations for domestic animals.
  - Provide support to groups with additional needs for evacuation, including the elderly and those with access and functional needs.
  - Ensure a fully stocked food bank, including water supply and dry goods
  - Ensure adequate back-up power sources and educate residents on obtaining a personal unit
  - Provide back-up power sources for County essential services and fueling facilities
  - Develop a Master Generator Plan for Lake County
  - Public education and outreach on preparedness - "Whole Community Preparedness"
  - Public Education & Information Program Development – collaborate with stakeholders
  - Develop multi-lingual Disaster Education public service announcements and educational videos
  - Develop a comprehensive public education program on the dangers of carbon monoxide during extended power outages
  - Develop and maintain the County's OEM natural hazards website
  - Promote collaboration between neighbors, the municipalities, and jurisdictions to assist in preparing area specific response and evacuation plans.
  - Support engagement of communities to build resilience and provide assistance with communal grant efforts to fund mitigation activities.
  - Create hazard warning systems and educate public on what this means for the community
  - Implement an Emergency Telephone Notification system and identify those who may need evacuation assistance in a specific registry
  - Develop enhanced Emergency Planning for Special Needs populations in EOP
  - Provide community assistance in evacuation drills for community businesses
  - Provide support for mitigation in hard to access areas
  - Provide support for community member mitigation efforts, especially those with minimized capacity to accomplish actions themselves
  - Provide support to community businesses in moving to remote work, if necessary
  - Work with County businesses to develop a Disaster Resistant Business Program
  - Build a storage bunker at the airport for permanent retention of all county information and necessary materials, hardware, and other things needed to help the county.
  - Reprioritize local government priorities around community preparedness– more input, initiative and funding
  - Create assessment for risk of industrial property development, including mining regulation, oil/gas explorations
  - Improve infrastructure

- Develop and begin to implement systematic process to evaluate and upgrade existing infrastructure
- Educate builders, developers, architects and engineers in techniques of disaster-resistant homebuilding
- Develop an improved critical facilities dataset to use in planning and mitigation efforts.
- Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.
- Enforce or initiate triggers guiding improvements to structures such as: (< 50% substantial damage/improvements)
- Provide redundancy for critical facilities
- Adopt Continuity of Operations Plans for all applicable hazards

- **Dam Failure –**
  - Develop a Dam/Levee Public Education and Evacuation Plan for targeted areas of the community
  - Develop an outreach program aimed at identifying and assisting private dam owners with repairing or decommissioning at risk dams.
- **Debris Flow – no responses specific to debris flow**
- **Drought/Extreme Temperatures –**
  - Develop a public education on drought resistance
  - Identify alternative water supplies for time of drought. Mutual aid agreements with alternative suppliers.
  - Consider providing incentives to property owners that utilize drought resistant landscapes in the design of their homes.
  - Develop standards that require drought resistant landscapes on County and community owned facilities
  - Implement stormwater retention in regions ideally suited for groundwater recharges.
  - Develop a residential and local business program to modify plumbing systems - i.e., water saving kits
- **Earthquake**
  - Incorporate earthquakes in the Office of Emergency Management public outreach strategy.
  - Work with Colorado Geological to continue the study and analyze earthquakes related to appropriate levels of seismic safety in building codes and practices.
  - Further enhance seismic risk assessment to target high hazard buildings for mitigation opportunities.
  - Develop a post disaster action plan that includes a grant funding and debris removal components.
- **Flood**
  - Mitigation actions for flood prone areas north & south of Cañon City.
  - Mitigation actions for areas damaged by fires, erosion control
  - Improved storm water drainage by Cañon City.
  - Form a Stormwater Utility District for funding Stormwater projects

Mitigation Strategy Action Ideas

  - Provide maintenance and improvements to existing drainage channels and other pertinent storm drainage conveyances.
  - Clean out and make deeper the dry creek beds on 28 all the way to 69
  - Address flooding due to runoff stormwater, in general and on Tennessee
  - Implement flood containment structures, require designs/engineering to reduce flood risk
  - Improve infrastructure on county roads to minimize washout
  - Continued road maintenance for improved evacuation routes
  - Find alternative to gravel for road maintenance to avoid clogging drainage systems
  - Lidar mapping and signage for Arkansas River inundation zones
  - Education and assistance in homeowner responsibility to maintain ditches
  - Increase flood improvement projects
  - Construct a dam in Red Canyon to reduce floodplain
  - Provide stricter floodplain regulations along the Arkansas River corridor.
  - Consider establishing an administrative procedure or change in County/City codes for requiring builders to develop a site drainage plan ensuring "no adverse impact" when they apply for permits for new residential construction.
  - Complete GIS and other automated inventories for stormwater, problem drainage areas, DFIRM and other City assets.
  - Continue to update and revise Basin-wide Master Drainage Plans where changed conditions warrant
  - Evaluate repetitive loss properties and potential solutions to mitigate existing conditions.
  - Acquire and remove Repetitive Loss Properties and repeatedly flooded properties where the County's Repetitive Loss and master drainage plans identify acquisition to be the most cost effective and desirable mitigation measure
  - Continue National Flood Insurance Program (NFIP) and improve the County's Community Rating System (CRS) classification. Examine criteria and establish roles and responsibilities for completion.
  - Review compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.
  - Implement structural and non-structural flood mitigation measures for flood-prone properties, as recommended in the basin-wide master drainage plans
- **Landslide / Rockfall**
  - Landfall monitoring along Hwy 50
- **Pandemic**
  - Improve ability to test large amounts of the population with timely results
  - Improve ability to contact trace those with confirmed cases of the disease
  - Provide education and outreach to the community to improve compliance with public health orders
  - Monitor air pollution
- **Severe Winter Storm**
  - Removal / trimming of trees in rights of way
    - Address County and City responsibility in trimming and removing trees that present a risk to community members and private property.

Mitigation Strategy Action Ideas

    - Zoning and planning to enforce mitigation of tree maintenance
  - Education about not using heaters inside.
- **Subsidence / Sinkhole**
  - Research the applicability of establishing an administrative procedure or change in County codes for requiring builders to check for expansive soils when they apply for permits for new residential construction and for using foundations that mitigate expansive soil damages when in a moderate or high-risk area.
- **Thunderstorm (Hail, Lightning)**
  - Install Lightning Warning & Alert Systems in public recreation areas
  - Install lightning rods on public structures
- **Tornado**
  - Removal / trimming of trees
    - County and City responsibility in trimming and removing trees that present a risk to community members and property.
  - Develop a model SafeRoom project for a Mobile Home Park
  - Develop a SafeRoom plan for County/Community facilities
  - Individual SafeRoom rebate program
  - Educate residents, building professionals and SafeRoom vendors on the ICC/NSSA "Standard for the Design and Construction of Storm Shelters" and consider incorporating into current regulatory measures
  - Develop a program which encourages residents to trim or remove trees that could affect power lines
  - Develop a program which encourages residents to obtain a NOAA weather radio.
  - Secure emergency generators (or alternative power sources) for all critical and vital facilities
  - Develop a program which encourages residents to be prepared including generators, 72-hour self-sufficiency kits, NOAA radios, etc.
  - Support programs such as "Tree Watch" that proactively manage problem areas by use of selective removal of hazardous trees, tree replacement, etc.
  - Establish and enforce building codes that require all roofs to withstand high wind loads
  - Modify land use and environmental regulations to support vegetation management activities that improve reliability in utility corridors
  - Modify landscape and other ordinances to encourage appropriate planting near overhead power, cable, and phone lines
- **Wildfire**
  - Fuel mitigation, thinning, removal of beetle kill, modification of wildland fuels, etc.
  - Removal / trimming of trees
    - County and City responsibility in trimming and removing trees that present a risk to community members and property.
  - Develop a program to assist property owners who are unable to complete mitigation actions sufficiently on their own.
  - Create free mowing program for areas that pose fire risk
  - Assist community members in creating neighborhood mitigation action plans and applying for grant funding as a community

Mitigation Strategy Action Ideas

- Increase equipment and personnel for wildfire crews, especially air support and suppression
- Facilitate controlled grazing on public lands to prevent overgrowth
- Increase number of Fire Wise and Ready, Set, Go communities
- Projects to put utilities underground to reduce fire damage risk
- Research the availability of use of possible weapons of mass destruction funds available to enhance fire capability in High Risk areas.
- Update building codes to require the use of fire-retardant building materials in high fire hazard areas
- Require Higher regulatory standards - such as a prohibition on combustible roof materials
- Continue to develop partnerships with other organizations to implement wildfire mitigation plans and other hazard reduction programs.
- Complete and maintain a Community Wildfire Protection Plan including the assessment of parcels identified in the Wildland Urban Interface.
- Work with Colorado Forestry Association and Department of Natural Resources to review zoning and ordinances to identify areas to include wildfire mitigation principles.
- Investigate the status of and need to create additional emergency vehicle access in high hazard areas

Wildlife – Vehicle Collisions

- Develop a program to manage deer population (culling)

Appendix F: FEMA APPROVAL & ADOPTIONS

Appendix G: MEETING ATTENDANCE

Kick off Meeting Fremont County Hazard Mitigation Plan – June 18 2020

Attendees:

Sunny Bryant	Christe Coleman
Mykel Kroll – EM	Mark Thompson
Sean Garrett	Connie Gjelsness
City of Canon City	Adam Lancaster
Dwayne McFall	Wyatt Sanders

Fremont County Hazard Mitigation Plan Risk Assessment Meeting

Location: Canon City & Webinar | Date: Wednesday September 30, 2020 – 2:00-4:00 PM

Name	Title	Organization	E-Mail	Present	Miles / Drive Time
Adam Lancaster	City Engineer	Canon City	atlancaster@canoncity.org		
Adrian Washington	Emergency Manager	Custer County	adiran@custercountygov.com		
Ashley Smith	Mayor	Canon City	ashley.smith@canoncity.org		
Bob Hartzman	Water Superintendent	Canon City	bwhartzman@canoncity.org		
Brenda Jackson	County Attorney	Fremont County	Brenda.jackson@fremontco.com		
Christe Coleman	South Region Field Manager	DHSEM	Christe.coleman@state.co.us	X	
Connie Gjelfness	Town Clerk	Rockvale	townofrockvale@gmail.com	X (virtual)	
Dan Witt	Manager Electric Operations	Black Hills Corp.	dan.witt@blackhillscorp.com		
Danni Taylor	Town Clerk	Coal Creek	townofcoalcreek@bresnan.net		

Name	Title	Organization	E-Mail	Present	Miles / Drive Time
Dave DelVecchio	Fire Chief	Canon City Area Fire Protection District	ddelvecchio@canonfire.org		
Debbie Bell	County Commissioner (Chairwoman)	Fremont County	Debbie.bell@fremontco.com		
Dwayne McFall	County Commissioner	Fremont County	Dwayne.mcfall@fremontco.com	**X**	
James Wade	District Manager	Park Center Water District	wadepctp@hotmail.com		
Jeff Blue	District Manager	Fremont Sanitation District	jblue@fsd.co		
Jerry Farringer	Project Support	Williamsburg	jefarringer@gmail.com		
Keith Berry	County GIS	Fremont County	keith.berry@fremontco.com	**X**	
Mark Thompson	Mitigation Planning Specialist	DHSEM	Markw.thompson@state.co.us	**X (virtual)**	
Matthew Sheldon	County Engineer	Fremont County	matthew.sheldon@fremontco.com		
Mike Patterson	City Manager	Florence	mike.patterson@florencecolorado.org		
Mykel Kroll	Director of Emergency Management	Fremont County	mykel.kroll@fremontco.com	**X**	

Name	Title	Organization	E-Mail	Present	Miles / Drive Time
Patricia Gavelda	Mitigation Section Planning Team Supervisor	DHSEM	patricia.gavelda@state.co.us		
Renee Bolkema	Town Clerk	Brookside	townhallbrookside@bresnan.net		
Richard Atkins	Emergency Manager	Chaffee County	ratkins@chaffeecounty.org		
Rusty Huddle	Operations Supervisor	ATMOS Engery	Rusty.Huddle@atmosenergy.com		
Ryan Stevens	City Administrator	Canon City	erstevens@canoncity.org		
Sean Garrett	County Planning and Zoning	Fremont County	sean.garrett@fremontco.com	X	
Sunny Bryant	County Manager	Fremont County	Sunny.bryant@fremontco.com	X	
Tamara Wagner	Interim Police Chief	Canon City	ttwagner@canoncity.org		
Tim Payne	County Commissioner	Fremont County	Tim.payne@fremontco.com		
Tony Adamic	DOT Director	Fremont County	tony.adamic@fremontco.com	X	
Tony Falgien	Streets Superintendent	Canon City	alfalgien@canoncity.org		

Name	Title	Organization	E-Mail	Present	Miles / Drive Time
Wade Broadhead	City Planner	Florence	wade@florencecolorado.org		
Wyatt Sanders	County Building Department/Flood Plain Administrator	Fremont County	wyatt.sanders@fremontco.com		
	Emergency Manager (gstanley@parkco.com)	Park County			
	Emergency Manager	El Paso County	lonnieinzer@elpaso.com		
	Emergency Manager	Pueblo County	bradleyc@pueblocounty.us		
	Emergency Manager	Saguache County	rwoelz@saguachecounty-co.gov		
	Emergency Manager	Teller County	angelld@co.teller.co.us		
	Town Clerk	Williamsburg	clerk@williamsburgcolorado.com		
Michael Garner	Consultant	Synergy Disaster Recovery	mgarner@synergydisasterrecovery.com	X	
McKenzie Parrot	Consultant	Synergy Disaster Recovery	mparrot@synergydisasterrecovery.com	X	

Fremont County Hazard Mitigation Plan Mitigation Strategy Meeting

Location: Webinar | Date: Tuesday December 8th, 2020, 2020 – 2:30-4:00 PM

Name	Title	Organization	E-Mail	Present	Miles / Drive Time
Adam Lancaster	City Engineer	Canon City	atlancaster@canoncity.org	X	
Adrian Washington	Emergency Manager	Custer County	adrian@custercountygov.com	X	
Ashley Smith	Mayor	Canon City	ashley.smith@canoncity.org		
Bob Hartzman	Water Superintendent	Canon City	bwhartzman@canoncity.org		
Brenda Jackson	County Attorney	Fremont County	Brenda.jackson@fremontco.com		
Christe Coleman	South Region Field Manager	DHSEM	Christe.coleman@state.co.us	X	
Connie Gjelfness	Town Clerk	Rockvale	townofrockvale@gmail.com		
Dan Witt	Manager Electric Operations	Black Hills Corp.	dan.witt@blackhillscorp.com		
Danni Taylor	Town Clerk	Coal Creek	townofcoalcreek@bresnan.net		

Name	Title	Organization	E-Mail	Present	Miles / Drive Time
Dave DelVecchio	Fire Chief	Canon City Area Fire Protection District	ddelvecchio@canonfire.org		
Debbie Bell	County Commissioner (Chairwoman)	Fremont County	Debbie.bell@fremontco.com		
Dwayne McFall	County Commissioner	Fremont County	Dwayne.mcfall@fremontco.com	X	
James Wade	District Manager	Park Center Water District	wadepctp@hotmail.com		
Jeff Blue	District Manager	Fremont Sanitation District	jblue@fsd.co		
Jerry Farringer	Project Support	Williamsburg	jefarringer@gmail.com		
Keith Berry	County GIS	Fremont County	keith.berry@fremontco.com	X	
Mark Thompson	Mitigation Planning Specialist	DHSEM	Markw.thompson@state.co.us	X	
Matthew Sheldon	County Engineer	Fremont County	matthew.sheldon@fremontco.com		
Mike Patterson	City Manager	Florence	mike.patterson@florencecolorado.org		
Mykel Kroll	Director of Emergency Management	Fremont County	mykel.kroll@fremontco.com	X	

Name	Title	Organization	E-Mail	Present	Miles / Drive Time
Patricia Gavelda	Mitigation Section Planning Team Supervisor	DHSEM	patricia.gavelda@state.co.us	X	
Renee Bolkema	Town Clerk	Brookside	townhallbrookside@bresnan.net	X	
Richard Atkins	Emergency Manager	Chaffee County	ratkins@chaffeecounty.org	X	
Rusty Huddle	Operations Supervisor	ATMOS Energy	Rusty.Huddle@atmosenergy.com		
Ryan Stevens	City Administrator	Canon City	erstevens@canoncity.org		
Sean Garrett	County Planning and Zoning	Fremont County	sean.garrett@fremontco.com	X	
Sunny Bryant	County Manager	Fremont County	Sunny.bryant@fremontco.com	X	
Tamara Wagner	Interim Police Chief	Canon City	ttwagner@canoncity.org	X	
Tim Payne	County Commissioner	Fremont County	Tim.payne@fremontco.com		
Tony Adamic	DOT Director	Fremont County	tony.adamic@fremontco.com		
Tony Falgien	Streets Superintendent	Canon City	alfalgien@canoncity.org		

Name	Title	Organization	E-Mail	Present	Miles / Drive Time
Wade Broadhead	City Planner	Florence	wade@florencecolorado.org		
Wyatt Sanders	County Building Department/Flood Plain Administrator	Fremont County	wyatt.sanders@fremontco.com		
	Emergency Manager (gstanley@parkco.com)	Park County			
	Emergency Manager	El Paso County	lonnieinzer@elpaso.com		
Chuck Bradley	Emergency Manager	Pueblo County	bradleyc@pueblocounty.us	X	
	Emergency Manager	Saguache County	rwoelz@saguachecounty-co.gov		
Becky Frank	Emergency Manager	Teller County	frankr@co.teller.co.us	X	
	Town Clerk	Williamsburg	clerk@williamsburgcolorado.com		
Michael Garner	**Consultant**	Synergy Disaster Recovery	mgarner@synergydisasterrecovery.com	X	
McKenzie Parrot	**Consultant**	Synergy Disaster Recovery	mparrot@synergydisasterrecovery.com		
Caitlin Langmead	**Consultant**	Synergy Disaster Recovery	clangmead@synergydisasterrecovery.com	X	

Name	Title	Organization	E-Mail	Present	Miles / Drive Time
Katie Rosenquist		Brookside		X	