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Appendices

1. Introduction

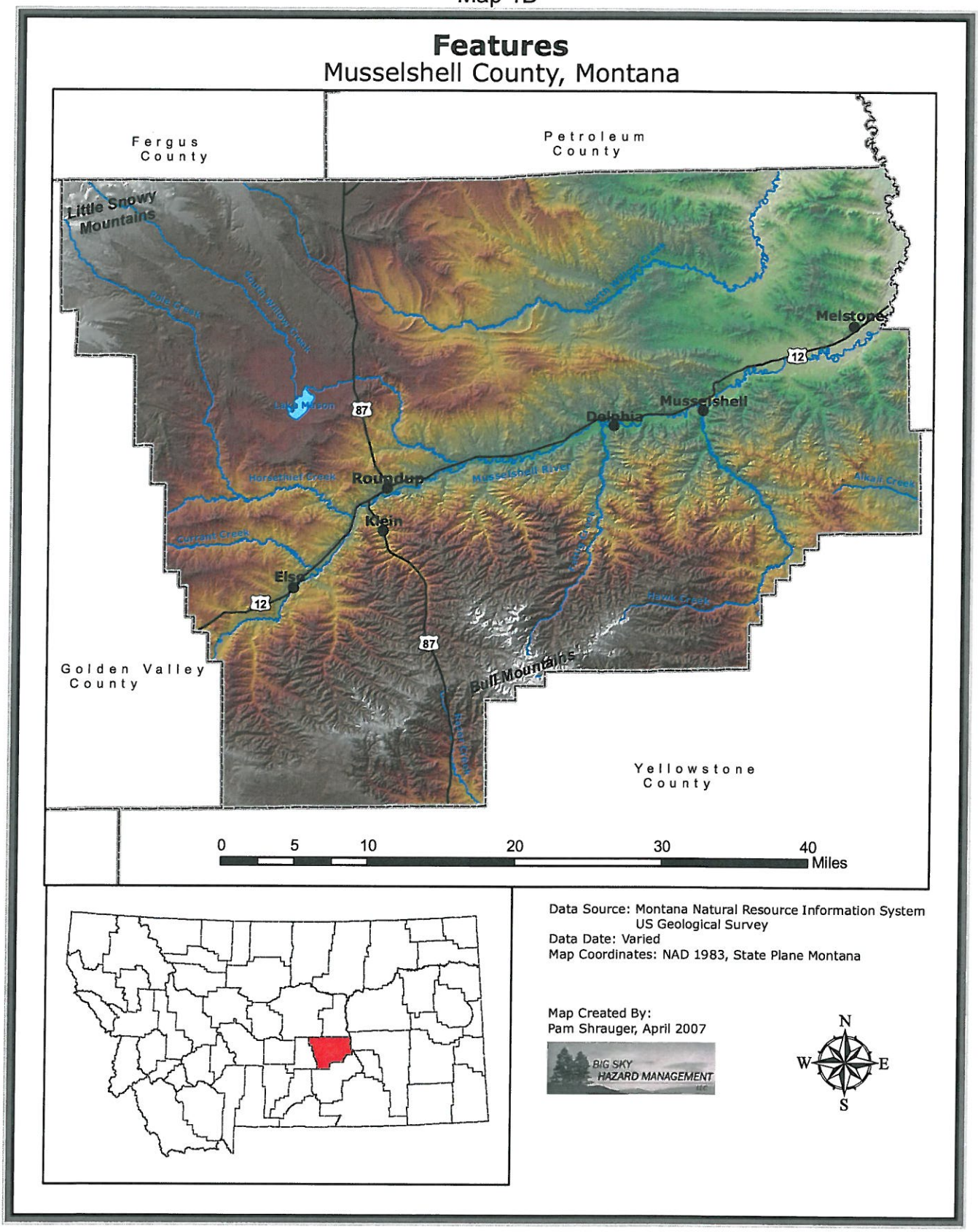
Musselshell County is located in east central Montana just north of Billings. Map 1B shows the major features in the county. Its economy is based primarily on agriculture, but it has had intermittent coal production, as a secondary economic activity, over the years. The 2005 population of the county was estimated at 4,497. Musselshell is a moderate sized county of some 1,867 square miles, but its population density is only 2.4 people per square mile, less then half of the state's average. The county seat is the City of Roundup with an estimated population of 1,916. The only other incorporated community in the county is the Town of Melstone with a population of 137. While the county has a relatively small population in itself, it is in close proximity to Billings, the most populous city in the state.

Musselshell County has a small tax base and its facilities and services are commensurate. As an effect of the county's geographic proximity to Billings, a market has developed for rural home sites, both primary and secondary, within its boundaries. The source of these building sites has come from the subdivision of ranches and other large land holdings. Most of these home sites are located in the southern portion of the county in areas that are currently in a state of being moderately to heavily forested. As will be discussed in the Risk Assessment, the mixture of structures within the mostly unmanaged ponderosa pine timber types has resulted in the proverbial "powder keg" situation for the county's limited structure and wildland fire protection services.

Historically, wildland fires were common in the pine ecosystems of Musselshell County. The effects of those fires have changed because of increased fuel loading and fire suppression activities. Today, there is still frequent lightning activity in the forested areas, and there are also new risks from the human activity on the subdivided parcels. Under high wind event conditions, fires have spread several miles in a few hours. Under such a scenario, some landowners are faced with potential loss of their structures and perhaps their lives. The firefighters responding to those areas are also at risk when they enter into fuel types where they could quickly be overrun by fast spreading crown and surface fires. Even in the absence of structures, the fire protection entities are challenged working in a fuel type noted for rapid and extreme fire behavior.

Photo 1A
Burnt Trees from the 2006 Majerus Fire

Map 1B


Features
Musselshell County, Montana
Fergus County
Petroleum County
Golden Valley County
Yellowstone County
Little Snowy Mountains
Big Snowy Mountains
Melstone
Musselshell
Delphia
Roundup
Klein
Elso
Lake Mason
Horsethief Creek
Currant Creek
Musselshell River
Alkali Creek
Hawk Creek
Bull Mountains
12
87
0 5 10 20 30 40
Miles
Data Source: Montana Natural Resource Information System
US Geological Survey
Data Date: Varied
Map Coordinates: NAD 1983, State Plane Montana
Map Created By:
Pam Shrauger, April 2007
BIG SKY HAZARD MANAGEMENT
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2. Plan Purpose, Authorities, and Objectives

The Musselshell County Fire Council recognizes that wildfires present serious challenges to the local fire departments and communities. Rather than wait until disaster strikes, Musselshell County can take proactive measures to prevent losses and lessen the impact from wildfires. Actions taken to reduce or eliminate the long-term risk from hazards are defined as mitigation. Disaster mitigation, or prevention, is an investment that can save lives and money.

The overarching purpose of this plan is to evaluate the current conditions, possible wildfire impacts, and potential actions that can be taken to lessen the impacts in Musselshell County with the ultimate goal of protecting life and property from wildfire. This plan serves as a Community Wildfire Protection Plan in accordance with the National Fire Plan and the associated 10-Year Strategy Implementation Plan and meets the requirements set forth by the National Interagency Fire Center.

The county had four principle objectives that they wished to achieve through the initial Strategic Fire Plan developed in 2003. These objectives were:

- Determine the most appropriate types of upgrades to their current structure and wildland fire fighting capabilities to meet future needs.
- Develop language for subdivision rules that would adequately deal with the anticipated fire problems expected from future growth associated with activities such as coal mining, power generation, or rural home construction.
- Find out what funding opportunities they may have for accomplishing needed fuel treatment work in those portions of the county where current conditions present an unacceptable risk to residents and firefighters.
- Educate the public about the types of risk they are assuming in building their homes in the wildland environment and possible mitigation measures they could take.

The new objectives for the 2007 revision of the Strategic Fire Plan to a Community Wildfire Protection Plan include:

- Meet the requirements of a Community Wildfire Protection Plan as outlined by the US Forest Service, US Bureau of Land Management, and Montana Department of Natural Resources and Conservation.
- Further detail the wildfire hazard in Musselshell County.
- Prioritize and promote cost-effective mitigation solutions.
- Support requests for grant funding.
- Provide a growth strategy for the fire departments based on hazards and responses.

3. Plan Development Process

Along with other counties in the State of Montana, Musselshell County was given the opportunity to acquire federal funds for the purpose of developing fire plans to deal with this emerging problem. In June of 2002, Musselshell County entered into a contract with Fire Logistics, Inc. to prepare a strategic fire plan for the county. The first edition of the plan was completed and adopted in October 2003. In 2006, Musselshell County decided to update the plan and modify it to meet the intent of the US Forest Service, US Bureau of Land Management, and Montana Department of Natural Resources and Conservation for a Community Wildfire Protection Plan. This update was funded by Musselshell County through a contract with Big Sky Hazard Management LLC.

Meetings with the Musselshell County Disaster & Emergency Services Coordinator and others representing a variety of firefighting agencies were held during the 2007 revision. Initial information was gathered through periodic contact with those knowledgeable on the Musselshell County wildfire hazard and tours of the hazard area. Press releases and notices submitted to the local newspaper offered the public opportunities to participate. Those interested were given an opportunity to comment on the draft plan from June 1, 2007 through July 1, 2007. Comments were integrated, where appropriate, into the plan throughout the review and development process. The Musselshell County Community Wildfire Protection Plan is a living, expandable document that will have new information added and changes made as needed.

4. Current Land Management Practices and Conditions

4.1 Land Use

Existing land uses play important roles in wildfire ignition, behavior, and impacts. Map 4.1B displays the existing land cover in Musselshell County. About 84% of the land in Musselshell County is privately owned, 9.3% is federal land, and 6.3% is state land. (Musselshell County, 2004) Map 4.1C shows the government land ownership in Musselshell County.

Approximately 50% of the county is currently in use as agricultural land. Most of the agricultural lands are tilled croplands and pastures. These lands have a relatively low fire potential. This is due to the type and quantity of the vegetative cover on them. They are also more likely to be located on gentler ground where access is usually available and resistance to fire control is light. These areas can burn readily in strong wind events, however. The primary exception is agricultural lands participating in the Conservation Reserve Program (CRP). The US Department of Agriculture (USDA) Farm Service Agency's Conservation Reserve Program (CRP) is a voluntary program available to agricultural producers to safeguard environmentally sensitive lands. Producers enrolled in CRP establish long-term, resource-conserving covers to improve the quality of water, control soil erosion, and enhance wildlife habitat. In return, the Farm Service Agency provides participants with rental payments and cost-share assistance. (Farm Service Agency, 2004) Although the CRP benefits the environment in many respects, CRP lands may increase the fuels available and therefore the wildfire risk in those areas. As of October 31, 2006, Musselshell County had 43,415 acres participating in the CRP. (Farm Service Agency, 2006)

Approximately 40% of the county is forested with a virtual monoculture of ponderosa pine. About half, or 221,101 acres, of the forested areas are privately owned. (Musselshell County, 2004) In most areas, there are many more trees per acre then there would have been historically. There are also more situations where continuous fuel exists from the ground to the crowns of mature trees. This results when too many seedlings survive and, because of intense competition for water and nutrients, form overcrowded pockets of spindly trees. These trees will survive to intermediate heights with many of them bent or broken by snow loads. This condition has occurred because of the absence of periodic, low intensity fires, which probably burned on a 10-15 year interval prior to European settlement. These fires kept the density of trees lower by selectively killing some of the thinly barked seedlings and smaller individual trees. The trees that did survive had a greater supply of nutrients and water to nourish them and were stronger and healthier. In the absence of the heavy fuel loadings now present, periodic low intensity fires would have had no significant impacts on the older trees that remained.

Commercial forestland does produce saleable timber, particularly in the Little Snowy and Bull Mountains, and is generally classified as low productivity, producing less than 50 cubic feet per acre per year. Decreasing or uncertain timber supplies from national forests and increased stumpage prices (prices per board foot) are contributing to increased timber harvesting on private lands across the state as a whole. The 1990's saw a dramatic rise in the harvesting of private acreage, in part due to the decreased availability of timber on federal lands and a short-term spike in timber prices. In 2001, private landowners in Musselshell County had more than 5 million board feet of lumber cut, down from 1999's 8.7 million board feet. In 1997, Musselshell County's

private land produced more than 16 million board feet of lumber, in 1994, more than 28 million, and in 1995, nearly 37 million board feet of lumber cut. (Musselshell County, 2004) Timber harvesting can both increase and decrease the wildfire hazard. Thinning, rather than clear cutting, leaves a viable forest that can sustain regular wildfires. Harvesting practices that leave behind large slash piles and dead fuels can contribute to increased fire dangers.

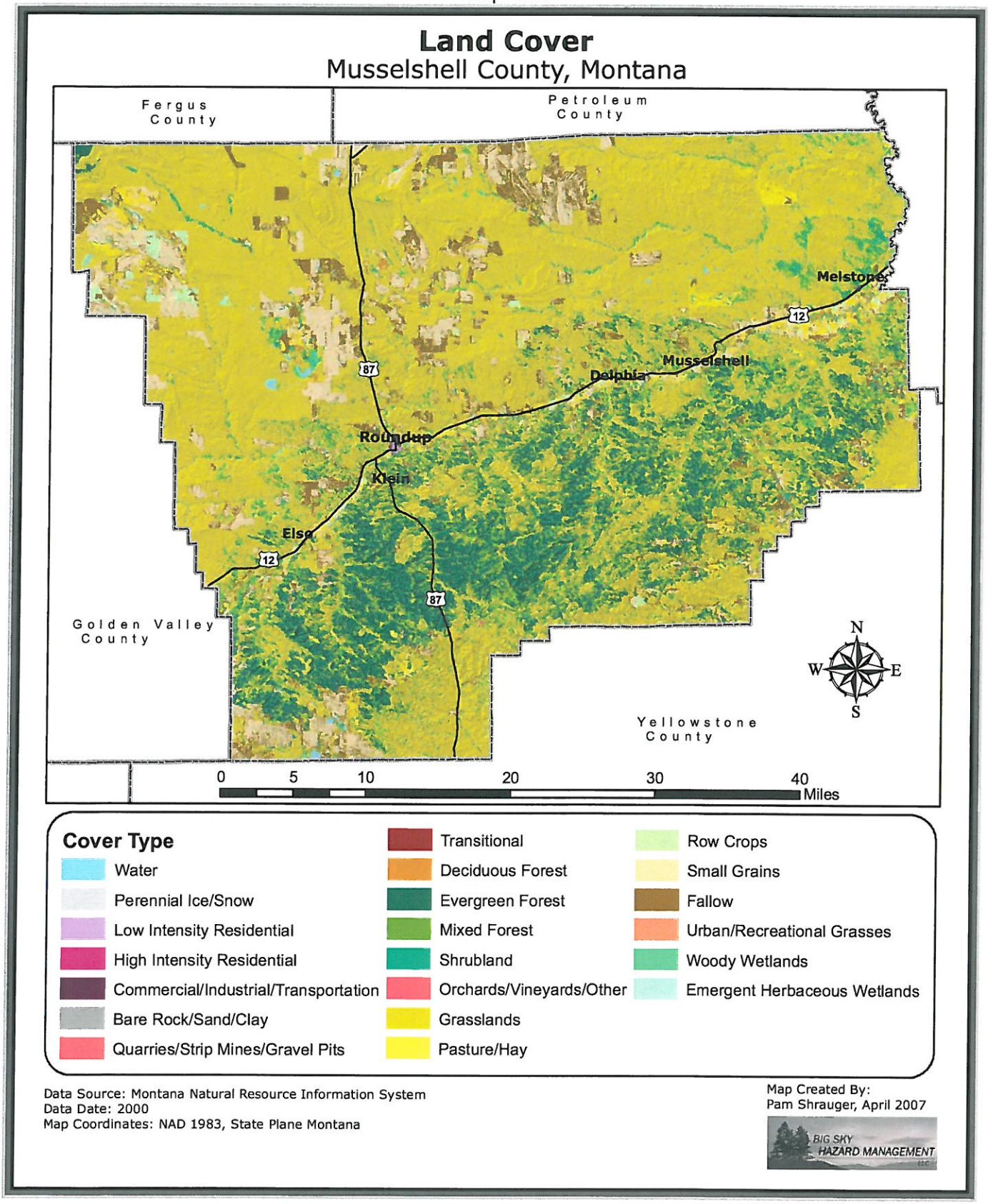
Photo 4.1A
Slash Pile in Southern Musselshell County

Grazing is a dominant land use in the county and occurs in both timbered lands and traditional agricultural lands. Some lands are heavily grazed and would not support a ground fire except under the most severe wind conditions. Others have been more moderately grazed but still present an effective barrier to wildland fire spread under most burning conditions. While grazing is generally a deterrent to the spread of wildfire, it also can prohibit the effective use of prescribed fire. This is particularly true on areas where tree encroachment is occurring. Without the fine grass fuels to carry the fire and to generate enough heat to kill the young trees, a grassland can, and often will be, converted to forested land.

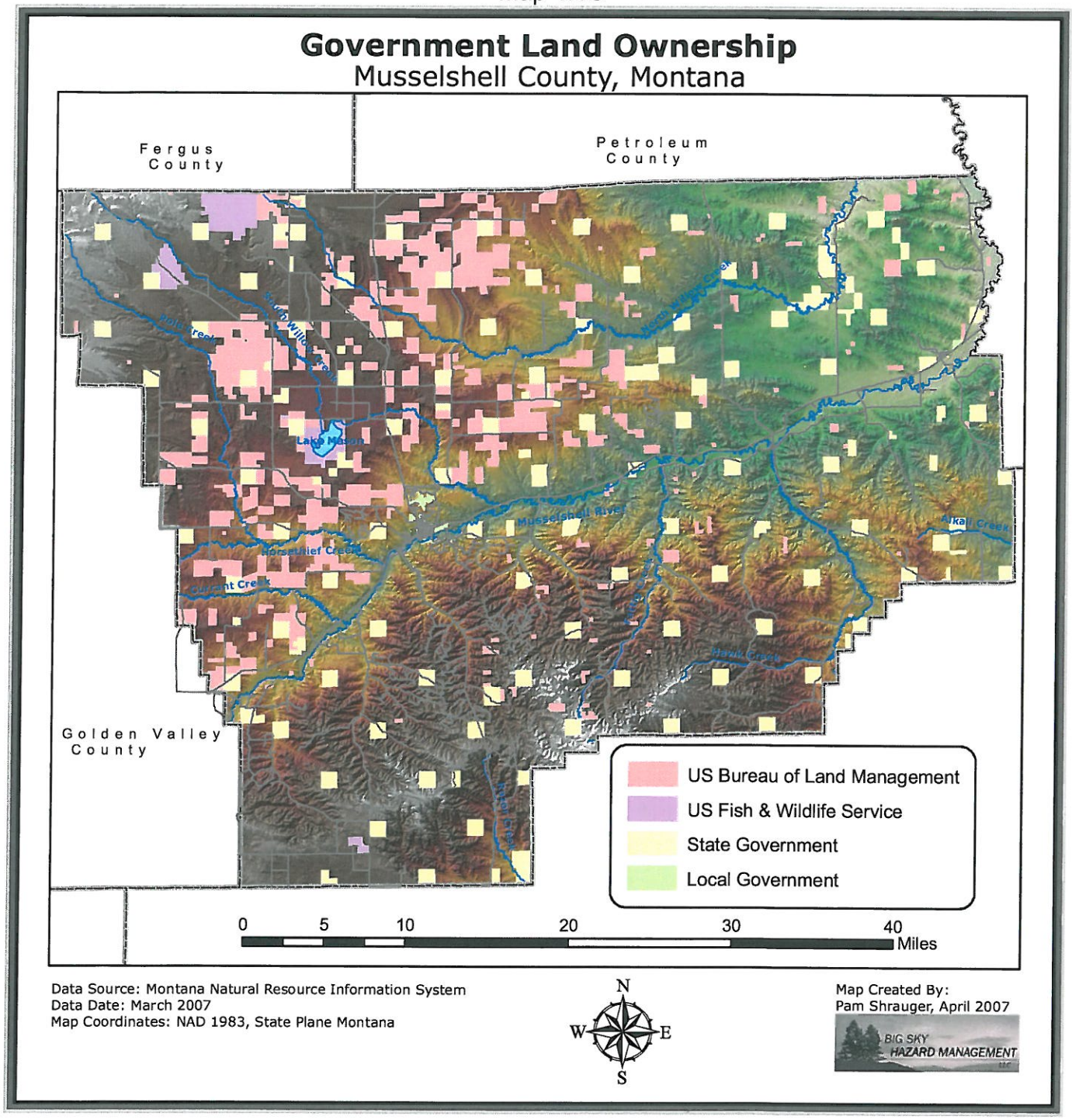
There are examples, within the county, where landowners have contracted for timber harvest or hazard reduction projects that have done an excellent job of mimicking nature and restoring timber stands to these more natural stocking levels. A wildland fire burning in those treated areas would have much less impact than a similar fire in an untreated area. There are also examples, unfortunately, where less ethical logging practices have occurred. In these areas where the stands were high graded and the slash left untreated, little has been achieved to alleviate the wildfire potential. Fires pose the most threat to the public and to the firefighter in this type of ecosystem. This is so mainly because of the quantity of energy released in the combustion process, the resistance to control of the fire, and the difficulty of observing the flaming front of the fire while engaged in fighting it. Structures that are not constructed of fire resistant materials and/or have not had adequate pretreatment of fuels around them, stand little chance of survival.

The profitability of farming and ranching has decreased over the years, yet the value of land in Montana has steadily increased. As a result, agricultural land is being sold and converted to residential land use throughout many parts of the state, including Musselshell County. As of 2004, Musselshell County had approximately 1,900 tracts of subdivided land. About half of the tracts are less than 20 acres in size. Many of these tracts were subdivided prior to the adoption of subdivision review procedures. Most of the large tracts are 20 acres or larger due to statewide regulations enacted regarding community water and sewer requirements for subdivision of less than 20 acre tract sizes. (Musselshell County, 2004)

Map 4.1B


Land Cover
Musselshell County, Montana
Fergus County
Petroleum County
Golden Valley County
Yellowstone County
Melstone
Musselshell
Delphia
Roundup
Klein
Elso
12
87
N
W
E
S
0 5 10 20 30 40 Miles
Cover Type
Water
Perennial Ice/Snow
Low Intensity Residential
High Intensity Residential
Commercial/Industrial/Transportation
Bare Rock/Sand/Clay
Quarries/Strip Mines/Gravel Pits
Transitional
Deciduous Forest
Evergreen Forest
Mixed Forest
Shrubland
Orchards/Vineyards/Other
Grasslands
Pasture/Hay
Row Crops
Small Grains
Fallow
Urban/Recreational Grasses
Woody Wetlands
Emergent Herbaceous Wetlands
Data Source: Montana Natural Resource Information System
Data Date: 2000
Map Coordinates: NAD 1983, State Plane Montana
Map Created By:
Pam Shrauger, April 2007
BIG SKY HAZARD MANAGEMENT

Map 4.1C



The proliferation of subdivisions adds one of the most serious complications to fire protection in the county. The subdivided lots will eventually become developed and those developments will be subject to damage or destruction by fire since they are usually located in the forested environment where they are most vulnerable to a fire's effects. Often subdivision plans don't have adequate fire considerations or mitigations built into them to make them defensible in a

wildland fire situation. In addition, some landowners in existing subdivisions are not receptive to suggestions on how they could improve the defensibility and/or survivability of their property.

Photo 4.1D
Interface Setting

Some work has been done to reduce hazardous fuels in parts of the county. In 2004, the US Bureau of Land Management (BLM) conducted the Horsethief Hazard Fuels Reduction Project on 10,300 acres of BLM, state, and private lands west of Roundup.

There are signs of economic change in the county, which make this discussion more relevant. The Bull Mountain underground longwall coal mine reopened in 2004 and a railroad spur line to the mine is under construction through the southern part of the county. As of early 2007, a coal to liquids refinery that would convert coal to synthetic diesel fuel and a "clean coal" power plant are in the design and planning stages for the Bull Mountain Mine. Further development in the eastern part of the county could result in an open pit mine, another railroad spur line, and possibly another underground longwall mine. This economic development would bring thousands of new jobs to the area and would create a high demand for housing, particularly in the southern part of the county, over the next 5-10 years. This development would be in addition to the regular growth occurring in southern Musselshell County due to an expansion of the greater Billings area. This new development increases the need for wildfire mitigation to prevent the future loss of lives and property from wildfire.

4.2 Community Assets and Values

In addition to identifying and understanding the wildfire hazard, an important aspect of wildfire and mitigation planning is contemplating the effects wildfires may have on the community. To thoroughly consider the effects of the hazards on the community, the assets and values at risk must be first identified. Examples of community assets include the population, critical facilities, businesses, residences, critical infrastructure, natural resources, and the economy. The following sections identify the specific community assets and values.

4.2.1 Critical Facilities

During or following a disaster, some facilities become exceedingly important in protecting the safety of the population, the continuity of government, or the values of the community. Examples include those facilities vital to public safety such as law enforcement, fire services, and health services. Appendix C of the Musselshell County Pre-Disaster Mitigation Plan lists the critical facilities in the county. (Musselshell County, 2006)

4.2.2 Residences

Like critical facilities, structures such as residences are also vulnerable to wildfire. Based on 2000 US Census data, Musselshell County has 2,317 housing units, including 978 which are within the City of Roundup and 87 within the Town of Melstone. The median value of owner-occupied housing units is $54,600. Tables 4.2.2A, 4.2.2B, and 4.2.2C show additional data on housing units.

Table 4.2.2A 2000 US Census Housing Data on Structure Types

Units in Structure	Musselshell County TOTAL	City of Roundup	Town of Melstone	Unincorporated Areas of Musselshell County
1-unit, detached	1,659	735	46	878
1-unit, attached	37	8	4	25
2 units	31	30	1	--
3 or 4 units	43	43	--	--
5 to 9 units	28	28	--	--
10 to 19 units	20	20	--	--
Mobile home	473	109	33	331
Boat, RV, van, etc.	26	4	--	22

Source: Montana Department of Commerce, 2000.

Table 4.2.2B 2000 US Census Housing Data on Structure Ages

Year Structure Built	Musselshell County TOTAL	City of Roundup	Town of Melstone	Unincorporated Areas of Musselshell County
1999 to March 2000	43	1	--	42
1995 to 1998	152	25	2	125
1990 to 1994	102	22	--	80
1980 to 1989	274	67	10	197
1970 to 1979	486	126	28	332
1960 to 1969	180	52	9	119
1940 to 1959	372	236	10	126
1939 or earlier	708	448	25	235
TOTAL	2,317	978	87	1,252

Source: Montana Department of Commerce, 2000.

Table 4.2.2C 2000 US Census Housing Data on Structure Values

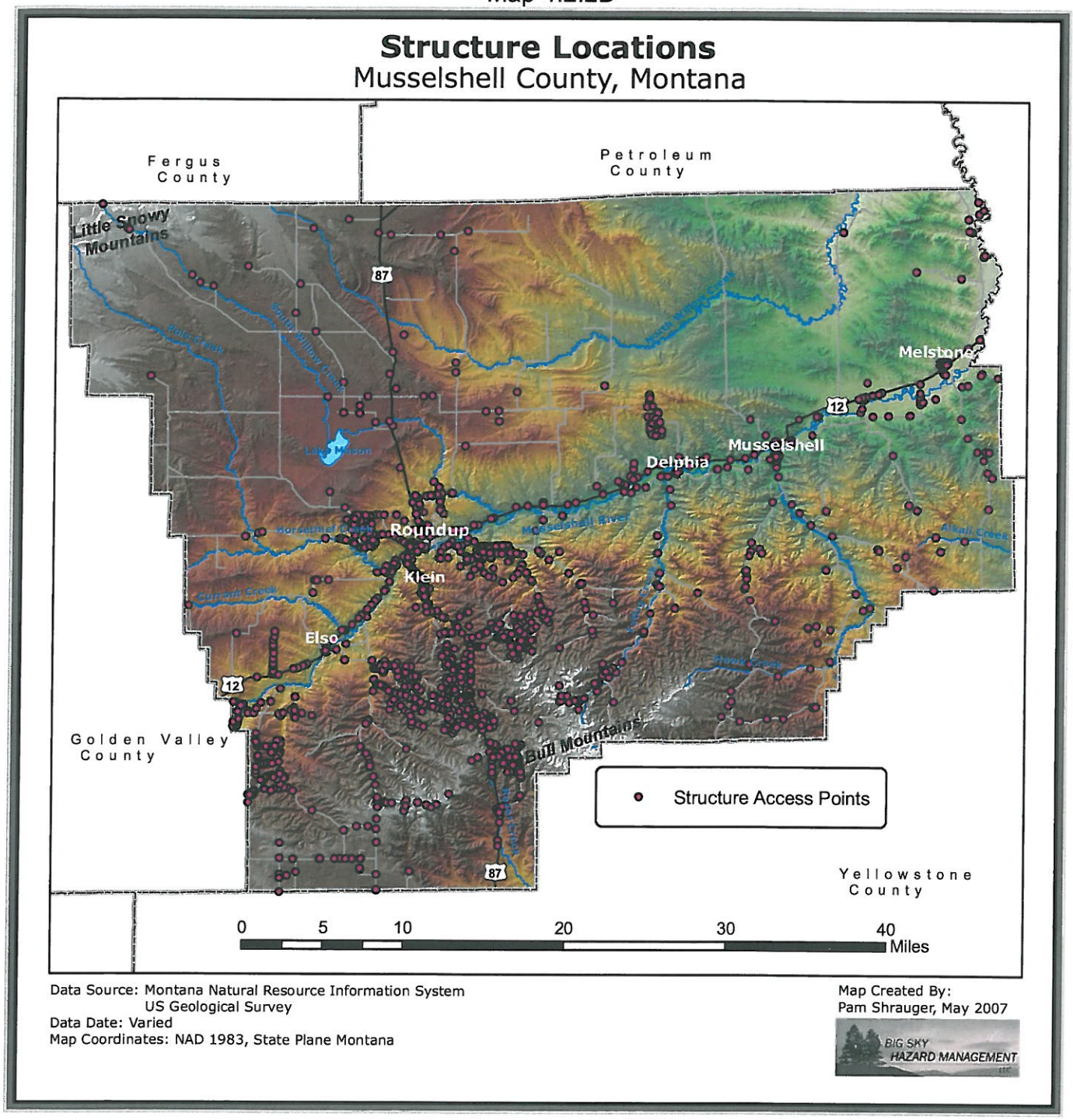
Value	Musselshell County TOTAL	City of Roundup	Town of Melstone	Unincorporated Areas of Musselshell County
Less than $50,000	45.2%	47.3%	59.1%	42.6%
$50,000 to $99,999	41.1%	44.8%	31.8%	38.9%
$100,000 to $149,999	8.4%	6.3%	9.1%	10.0%
$150,000 to $199,999	4.3%	1.7%	--	6.6%
$200,000 to $299,999	--	--	--	--
$300,000 to $499,999	1.2%	--	--	2.2%
MEDIAN	$54,600	$52,200	$33,000	approx. $57,976

Source: Montana Department of Commerce, 2000.

Using this census data, the total value of residential structures in 2000 in Musselshell County can be estimated at $126,508,200 (2,317 housing units * $54,600/unit). The value of the building stock in Roundup is estimated at $51,051,600, in Melstone at $2,871,000, and in unincorporated areas of Musselshell County at $72,585,952.

The majority of the increase in Musselshell County housing stock for the past decade has come from building on existing rural subdivision land. The availability and relative low price of rural acreages has attracted out of area buyers who in turn have constructed some very fine homes throughout Musselshell County. As more and more people reach retirement age this rural construction trend is expected to continue. As of 2004, Musselshell County had approximately 700 completely undeveloped subdivided tracts. (Musselshell County, 2004) Map 4.2.2D shows the approximate structure locations in the county.

Map 4.2.2D



4.2.3 Infrastructure

Utilities such as electricity, heating fuel, telephone, water, and sewer rely on established infrastructure to provide services. The providers of these services use a variety of systems to ensure consistent service in the county. Each of these services is important to daily life in Musselshell County, and in some cases, is critical to the protection of life and property. Often

regional electric infrastructure passes through wildland and non-irrigated agricultural areas. In particular, the electric substations and transmission lines are usually buffered by or overhang natural fuels. A wildfire could disrupt electricity should this infrastructure be damaged. Propane tanks also become hazardous infrastructure should a wildfire encroach on a structure. Temporary disruptions or low flows on the public water system may occur if large amounts of water are used to fight a fire, particularly during periods of drought or peak usage times. In most cases, the wildland areas lack adequate water infrastructure to support firefighting efforts.

Photo 4.2.3A
Propane Tank in the Wildland Urban Interface

Two major electric transmission lines extend from Roundup into Golden Valley County along the Musselshell River. Underground petroleum pipelines also traverse northern and western Musselshell County. Over 40% of the homes in Musselshell County are heated by propane and have a nearby tank that is refilled regularly by a local propane vendor.

In 2004, Musselshell County had a total of 696 road miles, including 99.4 miles classified as primary highway and maintained by Montana Department of Transportation. (Musselshell County, 2004) The major highways in the county include US Highway 12 that runs east-west through Roundup and US Highway 87 that runs north-south through Roundup. Most of the rural roads in the county are gravel. Many private roads also exist and some are in severe, almost impassible condition. Poorly maintained and narrow roads and driveways can present significant challenges for firefighting vehicles.

4.2.4 Population

As of 2000, the population of Musselshell County was 4,497 people. Of that population, 1,916 live within the City of Roundup and 137 live within the Town of Melstone. The median age is 43.2 years, compared to the state median of 37.5 years, with 17.5% of the population 65 years and older. In terms of education, of the population that is 25 years or older, 82.6% are at least high school graduates and 16.7% have a bachelor's degree. Table 4.2.4A shows the percentage of the civilian non-institutionalized population with disability status by age group.

Table 4.2.4A Disability Status of the Civilian Non-Institutionalized Population

Age Group	Total Population by Age Group	Percentage with a Disability
5 to 20 years	968	4.0%
21 to 64 years	2,507	18.9%
65 years and over	752	41.4%

Source: Montana Department of Commerce, 2000.

Understanding the limitations of those with special needs or disabilities becomes especially important during wildfires and other disasters. Many cannot evacuate on their own or require special equipment or medical supplies.

The population of Musselshell County hit a peak around 1920 with about 12,000 people. Over the course of about 60 years, the population steadily declined to about 3,700 in 1970. The population has generally increased since 1970 to the 2000 population of 4,497. Projections listed in the Musselshell County Growth Policy indicate slow increases in population reaching 5,000 by about 2012 and 5,500 by 2025. The estimated growth rate is approximately 23% over the next two decades. This growth is slightly lower than the rate expected for Montana statewide. (Musselshell County, 2004)

4.2.5 Economic, Ecologic, Historic, and Social Values

The economy of Musselshell County is driven by agriculture, natural resources, and educational, health, and social services. The agriculture and natural resources industries can be threatened by and damaged by wildfires, thus, jeopardizing the fragile economies. Table 4.2.5A shows economic statistics for the county.

Table 4.2.5A Economic Statistics

Category	Musselshell County
INCOME	
Median household income, 2003	$27,430
Per capita money income, 1999	$15,389
Persons below the poverty level, 2003	17.6%
WORKFORCE	
Population 16 years and over	3,595
Civilian Workforce, Employed	1,929 (53.7%)
Civilian Workforce, Unemployed	159 (4.4%)
Armed Forces	0 (0%)
Not in Labor Force	1,507 (41.9%)

Table 4.2.5A Economic Statistics (continued)

Category	Musselshell County
INDUSTRY/JOBS	
Agriculture, forestry, fishing, hunting, and mining	20.6%
Educational, health, and social services	20.4%
Retail trade	13.1%
Construction	11.4%
Other services (except public administration)	7.5%
Arts, entertainment, recreation, accommodation, and food services	6.1%
Public administration	5.2%
Other categories (less than 5%)	15.8%
CLASS OF WORKER	
Private wage and salary	59.5%
Self-employed not incorporated business	21.7%
Government	16.9%
Unpaid family workers	1.9%

Source: US Census Bureau, 2000.

In 2002, Musselshell County had 319 farms and 1,033,572 acres in farmland. As of January 1, 2006, Musselshell County had 39,000 head of cattle and calves and 5,700 head of sheep and lambs. (US Department of Agriculture, 2006) Table 4.2.5B demonstrates the types of crops planted and Table 4.2.5C shows the sales from agriculture.

Table 4.2.5B Acres Planted in 2005 in Musselshell County

Commodity	Planted	Production
Wheat	35,000 acres	876,000 bushels
Hay	34,500 acres	58,100 tons
Barley	9,000 acres	122,000 bushels
Oats	2,200 acres	33,000 bushels

Source: US Department of Agriculture, 2006.

Table 4.2.5C 2002 Market Value of Agricultural Production

	Musselshell County
Livestock Sales	$13,573,000
Crop Sales	$2,179,000
TOTAL	$15,752,000

Source: US Department of Agriculture, 2006.

The ecological, historical, and social values of Musselshell County each tie into the quality of life for residents and visitors. Without these values, lives and property may not be threatened, but the way of life and connections to history and the environment could be disrupted. These values can have deep emotional meaning and investment. Ecological values represent the relationship between organisms and their environment. For humans, these values include clean air, clean water, a sustainable way of life, and a healthy, natural environment including a diversity of species. Wildfires are part of a healthy ecosystem but often lead to losses in human values.

Historic values capture a piece of history and maintain a point in time. Historic values can include sites, buildings, documents, and other pieces that preserve times past and have value to people. Social values are often not fixed locations or can be quantified but are an important aspect of quality of life and interpersonal relationships. Examples of social values for many in Musselshell County include rodeos and county fairs. These gatherings promote community building and achievement. Other social values include freedom from tyranny, the ability to communicate with others, pride in making the world a better place, and friendships. The realm of social values is only limited by the human imagination and usually relates to how a person feels.

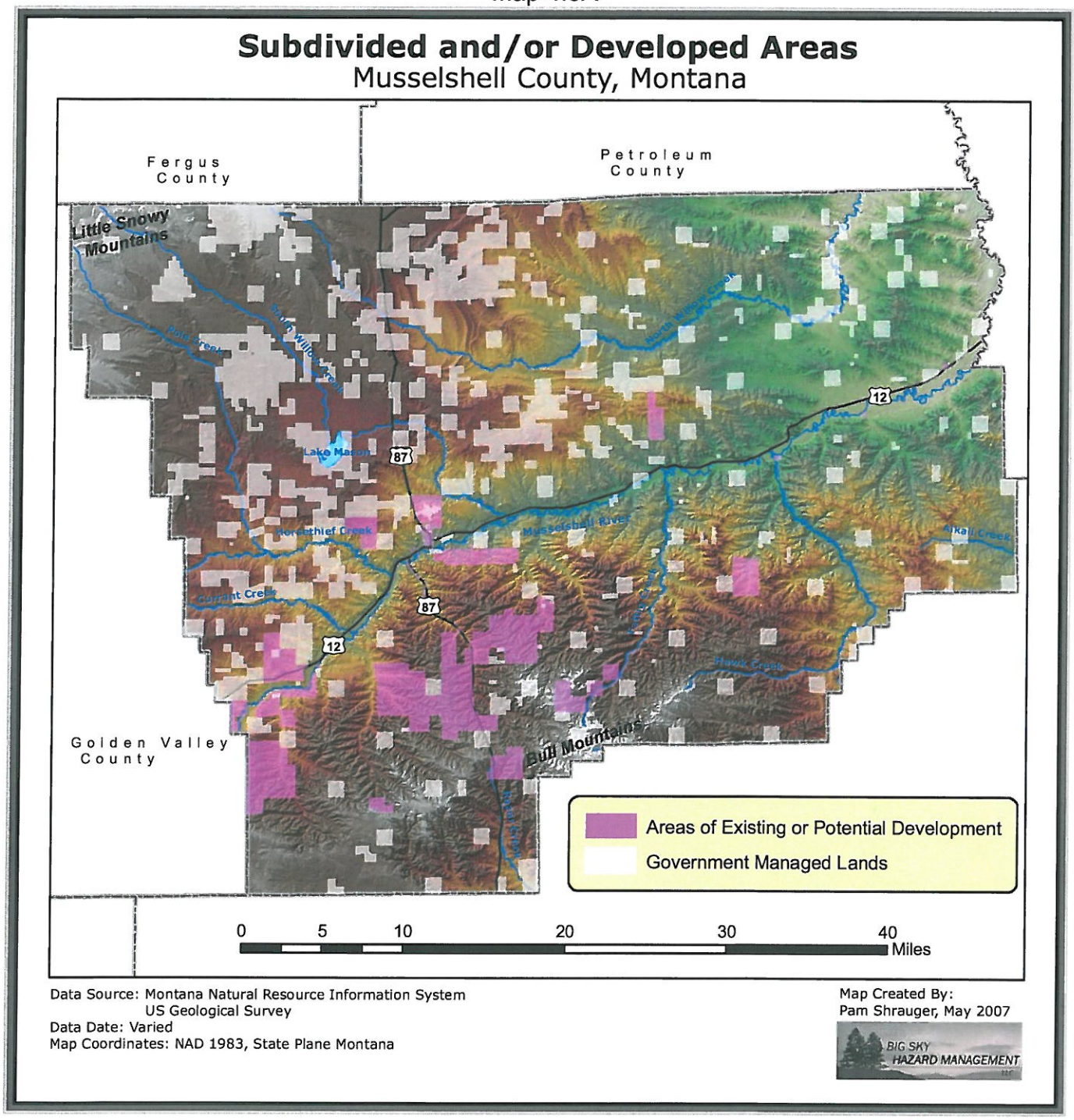
Wildfires can have an effect on all types of economic, ecologic, historic, and social values. Economically, rapidly moving wildfires can result in livestock, feed, crop, outbuilding, and fence losses. Natural resources such as timber can also be lost. Depending on the fire's location, historic losses can occur. Social values may be affected for those under evacuation orders and others supporting the firefighting effort. Fire restrictions may not allow campfires, hunting, and other recreational activities people often enjoy.

4.3 Land Management Regulations and Policies

Remote, isolated, forested areas are becoming more popular places to live or to have a second home, as national trends show. Large tracts of privately owned forested areas are being subdivided and sold for residential development, particularly in southern Musselshell County. Current subdivision growth is at approximately 40 lots per year. Current in fill of existing lots is occurring at approximately 30 lots per year. Map 4.3A shows the areas of subdivision growth.

Regulating growth in these areas is a delicate balance between protecting private property rights and promoting public safety. Often, smart development is an inexpensive and effective way to reduce the impact of wildfires on the community. In the past, subdivisions and new development in Musselshell County have had few requirements. The results have been homes in locations that are very prone to intense wildfires that firefighters have had or will have difficulty in protecting because of access problems or serious safety concerns. Several Musselshell County planning documents adopted in recent years do more to protect homes, residents, and firefighters from wildfires. The details follow.

Map 4.3A



4.3.1 Musselshell County Subdivision Regulations, June 21, 2000

The Musselshell County Subdivision Regulations apply to all unincorporated areas of Musselshell County. If located within one mile of Roundup, the plans are submitted to the city for additional review. If the subdivision is partly in an incorporated community, both the city and the county review the plans. (1.1.4) The Subdivision Regulations apply to all divisions of land in which one

or more parcels are less than 160 acres, with some exemptions. To support state law (MCA 76-3-501), twelve "purposes" are promoted, one of which is, "The avoidance of danger or injury by reason of natural hazard or the lack of water, drainage, access, transportation or other public services." (1.1.3) Findings of Fact must weigh "effect on agriculture, agricultural water user facilities, local services, the natural environment, wildlife and wildlife habitat, and the public health and safety." (2.2.7)

Lands unsuitable for subdivision include potential hazard areas from "flooding, snow avalanches, rock falls, land slides, steep slopes in excess of 25 percent slope, high potential for wildfire, subsidence, high water table, polluted or non-potable water supply, high voltage lines, high pressure gas lines, aircraft or vehicular traffic hazards or congestion, or severe toxic or hazardous waste exposure; or because of unreasonable burdens on the general public such as requirements for the excessive expenditure of public funds, environmental degradation; or other features which may be detrimental to the health, safety, or general welfare of existing or future residents. These lands must not be subdivided for building or residential purposes unless the hazards are eliminated or will be mitigated by approved design and construction plans."

Several sections address the issues of building locations, water supply, and roadway design. The specific requirements are highlighted below.

All subdivisions must be planned, designed, constructed, and maintained so as to minimize the risk of fire and to permit the effective and efficient suppression of fires in order to protect persons, property, and forested areas. Subdivisions must be planned using the fire protection guidelines for wildland residential interface development, published jointly by the Department of State Lands and the Department of Justice. Measures include:

1. The placement of structures in such a manner so as to minimize the potential for flame spread and to permit efficient access for fire fighting equipment.
2. The presence of adequate fire fighting facilities on site, when required by the county commission.
3. An adequate water supply and water distribution system to fight fires on site, when required by the county commission,
4. The availability, through a fire protection district or other means, of fire protection services adequate to respond to fires that may occur within a subdivision.
5. Subdivisions containing high-density residential development (including motels, hotels, etc.), multi-family residences, mobile home parks, or recreational vehicle parks, which are located more than five (5) miles from a fire station, must establish a fire protection plan and coordinate it with the county fire chief.
6. Subdividers must coordinate the preliminary plat with the county fire chief.

(2.2.12.12)

Rural Lots – Each lot must contain a satisfactory building site that conforms to wildland residential interface practices. (2.2.12.2)

Excerpts from the Road Design Standards for Subdivisions (Table 2-1):

Minimum Design Standards	Minor Collector	Local Road	Homesite Road (year-round access only)
Minimum Roadway Width	24 feet	22 feet (20 feet for low impact minor subdivisions)	15 feet
Maximum Grades	10%	11%	12%
Curvature design speed maximum curve minimum radius	 30 mph 23 degrees 249 feet	 20 mph 53.5 degrees 107 feet	 100 feet
Cul-de-sacs/Turnarounds minimum outside road radius "T" turnaround straight backup length "T" turnaround inside turning radius "T" turnaround outside turning radius	 55 feet 30 feet 26 feet 38 feet	 55 feet 30 feet 26 feet 38 feet	Private driveways must provide adequate turn around provisions for emergency response vehicles or the emergency vehicle may not be able to respond all the way to the residence.
New Bridges width AASHO design load vertical clearance	 24 feet H-15 14.5 feet	 22 feet H-15 14.5 feet	 15 feet H-10 10 feet

Minimum plat approval covenant items include:

a. The formation and continuing operation of a land owner's association to provide for road maintenance and right-of-way weed control, or a continuing road maintenance agreement if allowed.

g. The requirement for the land owner's association (or maintenance agreement) to provide for filling and maintenance of the required, installed fire apparatus items (if any). (2.2.11.4)

If common property is to be deeded to a property owner's association, the covenants may include:

k. A fire protection plan when required by the county commission. (2.2.11.5)

High fire hazard areas include heads of draws, excessive slopes, dense fuel areas, limited access areas, or other hazardous wildfire components. For subdivisions proposed in areas subject to high wildfire hazard as determined by the county commission, the following standards apply:

1. Whenever possible, at least two entrance/exit roads or a widened access road must be provided to assure an adequate escape route for residents and access routes by fire fighting vehicles.
2. Road right-of-way must be cleared of slash.

3. Bridges must be built to a design load of 20 tons, and constructed of non-flammable materials.
4. Building sites must be prohibited on slopes greater than 25 percent and at the apex of "fire chimneys" (topographic features, usually drainageways or swales, which tend to funnel or otherwise concentrate fire toward the top of steep slopes).
5. Densities in areas of steep slopes or dense forest growth must be reduced through minimum lot standards as follows:

	Minimum Lot Size	
% Slope	Open Grass	Forest & Brush
0-10%	1 acre	2 acres
10-20%	2 acres	3 acres
20-25%	3 acres	4 acres
Over 25%	5 acres	not permitted

6. Open space, park land and recreation areas (including green belts, riding or hiking trails) should be located, where appropriate, to separate residences and other buildings from densely forested areas.
7. A minimum of one 4,000-gallon frost free cistern or year-round accessible dry fire hydrant capable of providing 4,000 gallons within a 2 hour period will be provided for each 20 lots or major areas served by a single access road, subject to approval by the county commission. The land owner association by-laws must include provisions for maintaining the hydrants and/or filling cisterns. Other subdivisions not meeting the above criteria must provide a sufficient water supply, or alternative, for effective fire protection to be approved by the county commission. Major subdivisions in areas that are not within 5 road miles of an existing fire station must also set aside a commission approved area of not less than 1 acre for a future fire station.

(2.2.12.13)

4.3.2 Musselshell County Growth Policy, January 2004

The Musselshell County Growth Policy serves as a guiding document for zoning regulations as required by state law. The plan recognizes and analyzes the expected future population growth, demand for single-family housing, and need for additional government services. The following goals and objectives are listed in the policy and relate to the wildfire hazard.

Goal: Maintain the best possible residential environment within Musselshell County.

- Objective: Insure adequate implementation and enforcement of existing subdivision regulations in the County.
- Objective: Protect the urban rural interface by enhancing fuel source reduction and noxious weed control in the County.

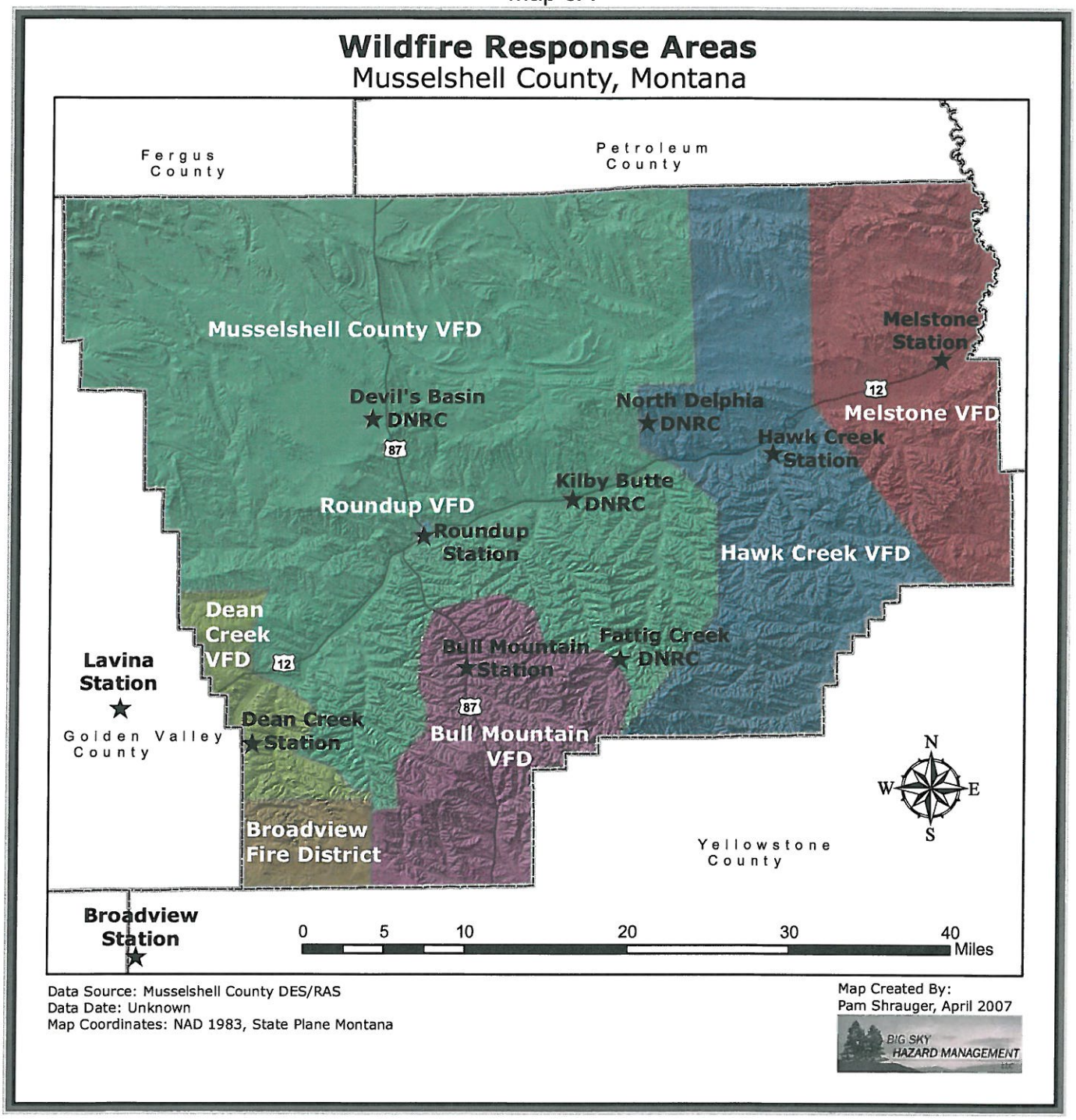
Goal: Utilize "Best Practices" approach to the design, construction, and management of infrastructure components to benefit the citizens of the County.

- Objective: Develop appropriate, coordinated, and cooperative program of disaster and emergency response, including law enforcement, fire protection, and ambulance services.
- Objective: Upgrade county roads as traffic counts and resources allow.

5. Fire Protection Capabilities

Musselshell County has eight fire protection organizations or groups providing a limited number of services. An outline of the different organizations and their capabilities follow. The information included in this outline came from a survey completed by the individual organizations in 2003 with updates in 2007. Map 5A shows the jurisdictional areas and fire stations.

Map 5A



5.1 Structural Fire Capabilities

National standards are being used as part of the analysis to clarify if a department actually has structural fire capability or not. Structural fire capability is defined as meeting the current National Fire Protection Association (NFPA) standards for equipment, personnel, and training.

Roundup Volunteer Fire Department (VFD) provides the only minimally NFPA-qualified structural fire protection services in Musselshell County. This service is limited by their single station location in Roundup, available equipment, financial limitations, and limited training opportunities. Roundup VFD will respond to structure fires outside the City of Roundup as a mutual aid request from other fire protection organizations.

The Roundup Volunteer Fire Department is equipped with two (2) structural fire engines with the newest being a 1981 model. Seating capacity of the engines, limited, out of date, and potentially unsafe personal protective equipment, limited training financial capability, and availability of personnel does not allow the department to meet national standards for personnel safety during a structure response. Roundup's location creates a "stand alone" situation for over one (1) hour before another fire department with structural capability could assist or cover a second structure fire response.

Other fire organizations, such as the Melstone Fire Department and the Hawk Creek Volunteer Fire Department, respond to structure fires but have extremely limited capabilities due to equipment limitations for structural response, lack of appropriate training, and personnel availability.

5.2 Wildland Fire Capabilities

Wildland fire response within Musselshell County is being provided by a number of different organizations. Some of these organizations meet the criteria established by the State of Montana for official fire protection entities and others do not meet any criteria.

- Bull Mountain Volunteer Fire Department provides wildland fire response and limited structural protection from an approaching wildland fire.
- Dean Creek Volunteer Fire Department provides only wildland fire response.
- Hawk Creek Volunteer Fire Department is located in Musselshell. They provide wildland fire response, emergency medical services response, and limited structural protection from an approaching wildland fire.
- Melstone Fire Department provides wildland fire response, emergency medical services response, rescue response, limited structural response, and limited hazardous materials response.
- Musselshell County Volunteer Fire Department provides wildland fire response, limited structural response, motor vehicle accident response, oil field fire response, and limited rescue and hazardous materials response.

- Roundup Volunteer Fire Department provides structure fire response, emergency medical services response, rescue response, motor vehicle accident response, and limited hazardous materials response. The City of Roundup has an Insurance Services Organization (ISO) rating of 5.

- Montana Department of Natural Resources and Conservation (DNRC) can provide additional wildland fire response capability through the county co-op program. Musselshell County is within the Southern Land Office of the Montana DNRC's geographic area. This provides additional resources from Billings through the Air Tanker Base, DNRC's Rotor Wing section, and the US Bureau of Land Management's (BLM) office. During the established fire season and dependent upon prior assignment, these resources may not be available.

- US Bureau of Land Management (BLM) manages fires on BLM lands. Initial fire attack for Musselshell County comes from the Billings Field Office. Under the Billings Field Office Fire Management Plan, northern Musselshell County is within the "Sage and Grasslands" Fire Management Unit (FMU) and the southern part of Musselshell County is within the "Musselshell" Fire Management Unit (FMU). An objective for both fire management units is, "Fires are suppressed at a minimum cost, considering firefighter and public safety, benefits, and values to be protected, consistent with resource objectives." Part of the BLM's fire management strategy for these units is, "The appropriate management response to wildland fire within the Sage and Grasslands/Musselshell FMU would generally be aggressive fire suppression." (US Bureau of Land Management, 2004)

Table 5.2A shows the apparatus in the county.

Table 5.2A Musselshell County Fire Apparatus

Department	Vehicles
Bull Mountain Volunteer Fire Department	- three (3) Type 6 Engines - one (1) Type 3 Water Tender - one (1) Type 2 Water Tender
Dean Creek Volunteer Fire Department	- two (2) Type 3 Engines - two (2) Type 6 Engines
Hawk Creek Volunteer Fire Department	- two (2) Type 6 Engines - one (1) Type 3 Water Tender - one (1) Quick Response Unit
Melstone Volunteer Fire Department	- two (2) Type 3 Engines that have limited structural capability - four (4) Type 6 Engines - two (2) Type 3 Water Tenders - one (1) Quick Response Unit

Table 5.2A Musselshell County Fire Apparatus (continued)

Department	Vehicles
Musselshell County Volunteer Fire Department	- one (1) Type 2 Structure Engine - two (2) Type 3 Engines that have structural capability - one (1) Type 6 Engine - one (1) Type 2 Water Tender - one (1) Type 3 Water Tender - one (1) Type 3 Water Tender at North Delphia - one (1) Motor Vehicle Crash Response Vehicle - one (1) Command Unit
Roundup Volunteer Fire Department	- two (2) Type 2 Structure Engines
Montana Department of Natural Resources and Conservation (DNRC)	- one (1) Type 6 Engine at Devil's Basin - one (1) Type 6 Engine at Kilby Butte - one (1) Type 6 Engine at North Delphia

Musselshell County has a mutual aid agreement between all the fire protection entities within the county along with separate agreements with Yellowstone, Fergus, Rosebud, Petroleum and Golden Valley Counties. Many of these agreements have not been updated since the late 1980's. The county also has a mutual aid agreement with the Montana Department of Natural Resources and Conservation and a Reciprocal Fire Agreement with the US Bureau of Land Management.

5.3 Other Local Resources

Emergency Dispatch

All emergency calls, including fire calls, are dispatched through the dispatch center, staffed 24 hours per day, in the county sheriff's office. Two sirens, one at the sheriff's office and one at the fire station, provide emergency alert capabilities for the City of Roundup. Public safety communications have four repeater sites in the county at Melstone, Hawk Creek, Roundup, and Bull Mountain/Dean Creek. (Musselshell County, 2004)

Law Enforcement

The primary law enforcement agency in the county is the Musselshell County Sheriff's Department. The department has seven officers, including the sheriff, and seven fully equipped patrol cars. The department provides law enforcement protection to the City of Roundup through a contract. Montana Highway Patrol also has two officers stationed in Roundup. Montana Fish, Wildlife, and Parks also has officers that provide law enforcement. (Musselshell County, 2004)

Emergency Medical Services

The Musselshell County Ambulance Service has three ambulances and responds to emergency medical calls throughout the county. The Melstone and Hawk Creek Fire Departments have Quick Response Units that can provide emergency medical services until the ambulance arrives or they can meet up with them. (Musselshell County, 2004)

Disaster & Emergency Services
Emergency management for the county, mitigation, preparedness, response, and recovery, is provided by a full-time position. This office also coordinates planning, rural addressing, and other countywide emergency coordination issues. Disaster & Emergency Services maintains the Musselshell County Disaster and Emergency Coordination Plan.

Public Health
Musselshell County is part of a six-county health district with Petroleum, Fergus, Judith Basin, Wheatland, and Golden Valley Counties. The district office is in Lewistown. The public health district addresses issues related to public health, disease, and sanitation.

Road Department
Musselshell County has a staff of five employees and five motor graders to maintain approximately 600 miles of road. These graders can be used during wildfires to help contain the fire.

5.4 Community Awareness

Community awareness of the wildfire hazard can play a big role in individuals' preparedness and mitigation activities. In Musselshell County, local officials believe the communities' awareness of the wildfire hazard is decent, as publications have been mailed to residents and wildfires generally receive a lot of media attention; however, very few people take action or believe it won't happen to them. A wildfire mitigation program for fuels reductions has been going on for years, but the 25% match of the grants often requires community involvement that is difficult to get. The county wildfire season is declared as January 1-December 31, so residents are required to get burn permits year round.

The National Weather Service issues several products to alert for significant wildfire potential or hazards. These include:

- Fire Weather Watch: A fire weather watch is issued when Red Flag conditions (see below) are expected in the next 24 to 72 hours.
- Red Flag Warning: A red flag warning is issued when Red Flag criteria are expected within the next 12 to 24 hours. A Red Flag event is defined as weather conditions that could sustain extensive wildfire activity and meet one or more of the following criteria in conjunction with "Very High" or "Extreme" fire danger:
  - Sustained surface winds, or frequent gusts, of 25 mph or higher
  - Unusually hot, dry conditions (relative humidities less than 20%)
  - Dry thunderstorm activity forecast during an extremely dry period
  - Anytime the forecaster foresees a change in weather that would result in a significant increase in fire danger. For example, very strong winds associated with a cold front even though the rangeland fire danger index is below the "Very High" threshold.
- Fire Warning: A fire warning may be issued by local officials when a spreading wildfire or structure fire threatens a populated area. Information in the warning may include a call to evacuate areas in the fire's path, as recommended by officials according to state law or local ordinance.

- Dense Smoke Advisory: Dense smoke advisories are issued when widespread or localized smoke is expected to reduce visibilities to ¼ mile or less.

(National Weather Service, 2006a)

6. Risk Assessment

6.1 Fire History

Recorded fire history for Musselshell County began as European settlement advanced into Montana in the last half of the nineteenth century. With the building of the Milwaukee Railroad through Roundup, ranches, homesteads, and mining became prominent features within the county. Available timber located adjacent to the rail line was harvested for ties and building materials. This harvest was very extensive and removed most of the available mature timber.

Photo 6.1A
Roundup in 1910

Photo 6.1B
Roundup in 2002

As settlement of the county continued, fire suppression of all wildland fires was considered the norm by settlers protecting their property and croplands. A policy of fire suppression continued through the twentieth century as the new stands of ponderosa pine matured and a natural buildup of dead and down fuels began to accumulate.

In 1984, an example of what wildland fire can do in a mature stand of ponderosa pine with significant accumulations of dead and down fuel was displayed as the **Hawk Creek Fire** burned 178,621 acres, nearly 280 square miles, over a six-day period at the end of August. Forty-four homes were destroyed along with 240 million board feet of timber.

Photo 6.1C
A Building Foundation following the Hawk Creek Fire of 1984

During the following eighteen years, Musselshell County has continued to experience a series of large fire events, beginning with the **Corey Flat Fire** south of Musselshell in August 1988 (3,500 acres), **Burnt Shed Fire** north of Musselshell in September 1998 (5,500 acres), **Fishel Creek Complex** near Musselshell in July 1999 (33,000 acres and 7 structures), the **Average Bad Day Fire** south of Roundup in July 2000 (4,000 acres and 10 structures), the **Musselshell Complex** east of Roundup in August 2003 (1,630 acres), and the **Majerus Fire** south of Roundup in July 2006 (1,100 acres and 3 structures). All but one of these fires was a stand replacement fire and collectively they burned a total of about 49,000 acres and 20 structures. The one exception was the Average Bad Day Fire that started within the perimeter of the Hawk Creek Fire. This fire was a cleansing fire that removed the dead and down fuels created by the Hawk Creek Fire. Map 6.1D shows the approximate locations of the larger wildland fires in Musselshell County since 1986.

Map 6.1D

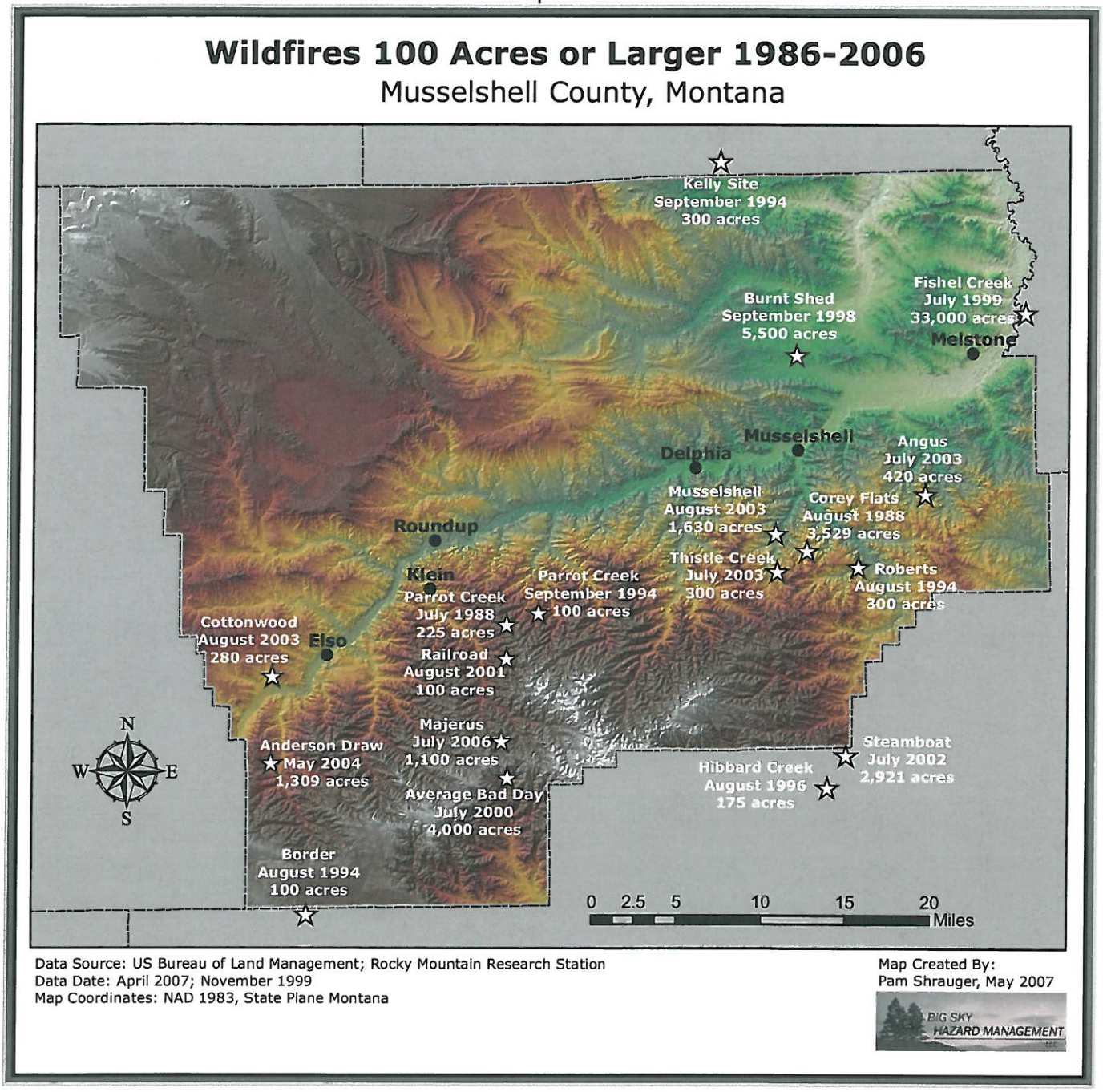


Figure 6.1E shows the perimeter of the Hawk Creek fire and Table 6.1F summarizes wildfires of 1,000 acres or more in Musselshell County.

Figure 6.1E

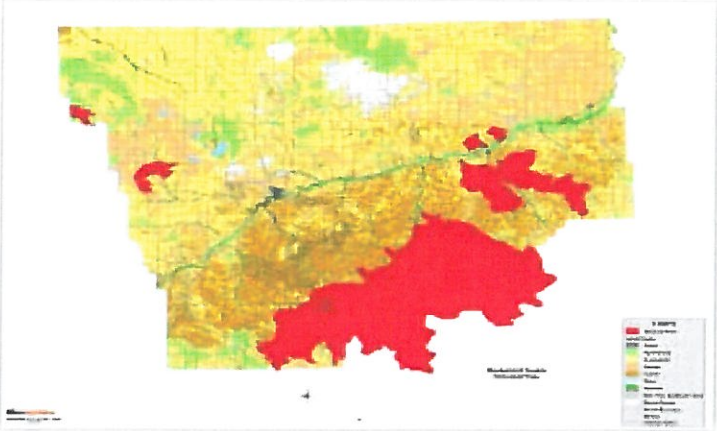


Table 6.1F Musselshell County Wildfire History of Fires Burning more than 1,000 Acres

Fire Name	Date	Location	Size	Direct Losses	Other Impacts	Estimated Losses	Estimated Firefighting Costs
Hawk Creek Fire FEMA FMA #2049	Aug. 1984	South of Roundup	178,621 acres	44 homes, 240 million board feet of timber		Unknown	Unknown
Corey Flat Fire	Aug. 1988	South of Musselshell	3,500 acres			Unknown	Unknown
Burnt Shed Fire	Sep. 1998	5 miles north of Musselshell	5,500 acres		Cabins threatened	$35,000	$50,000
Fishel Creek Complex, 11 fires, FEMA FMA #2266	Jul. 1999	35 miles northeast of Roundup	33,000 acres	1 residence, 3 cabins, 3 outbuildings, and several thousand acres of rangeland	Musselshell and ranches threatened, Highway 12 closed	$70,000	$595,000
Average Bad Day Fire	Jul. 2000	10 miles south of Roundup	4,000 acres	2 outbuildings, 1 garage, 7 unoccupied trailers		$100,000	Unknown
Steamboat Fire	Jul. 2002	40 miles northeast of Billings	2,921 acres		Burned nearly 3,000 acres in 6 hours	Unknown	Unknown
Musselshell Complex, 5 fires	Aug. 2003	10-30 miles east of Roundup	1,630 acres		One residence threatened	Unknown	$130,000
Anderson Draw	May 2004	9 miles east of Lavina	1,309 acres		Structures threatened	Unknown	Unknown
Majerus Fire	Jul. 2006	10 miles south of Roundup	1,100 acres	3 structures	Residences threatened, Highway 87 closed	Unknown	$300,000
TOTALS			231,581 acres	64 structures plus timber and rangeland		More than $205,000	More than $1,075,000

Source: Center for International Disaster Information, 2007.

Photo 6.1G
Homesite Burned by the 2006 Majerus Fire

Outside the ponderosa pine timber communities, both grassland and sagebrush fires have burned in Musselshell County during the same time period. These are not as well documented as large fires burning in the timber communities. However, as European settlement and homesteading increased within the county, grazing from cattle and sheep modified these fuel complexes to the extent that the size of fires in this grass and sagebrush ecosystem has been significantly reduced.

6.2 Fire Ecology

A method of placing various forest and grassland habitat types into fire groups is commonly used to determine the response of vegetation (primarily trees) to fire and the successional path certain species take during succession. Fire groups describe the natural role of fire following a sequence from low to high elevation vegetative categories. (Fischer and Clayton, 1983) They paint an average picture of fire intensities and frequencies, and describe the natural role of fire prior to active suppression efforts. Fire groups correlate directly to Pfister's Forest Habitat Types of Montana (1977), in how they respond to fire disturbance, and are grouped in this analysis based on vegetation similarities.

Warm, dry ponderosa pine habitat types:
Fire group two consists of ponderosa pine stands with predominantly grass undergrowth. These habitats may exist as a fire maintained grassland and will support limber pine, Rocky Mountain juniper, and Douglas fir as isolated trees or clusters of trees. In some habitat types, juniper may be a minor climax species. Sites are typically hot, dry, south and west-facing slopes at low elevations, forming the lower timberline in the area. Slopes are often steep with poorly developed soils. Extensive stands also occur on flats and rolling topography at the lowest elevation of forest distribution. Moisture stress is a critical factor for plant growth during the summer months.

Downed and dead fuel loads in this fire group are often light if fire has maintained the stand. If fire has been absent from the stand, the amount of dead and down material increases significantly over time.

Photo 6.2A
Heavy Fuels

The large fuels usually account for 75% or more of the total fuel load. These large fuels result from the downfall of dead trees that were unsuccessful competitors in dense stands, from deadfall following a fire, and damage caused by wind, snow, and timber removal.

Live fuels often contribute to the fire hazard in this fire group. Dense ponderosa pine understories often develop beneath scattered overstory trees. Fires that start in such timber stands often burn vigorously in the crowns of the understory trees. Consequently, fast spreading severe fires are a result, despite relatively light downed and dead fuel loadings.

Photo 6.2B
Pine Stand
Regeneration

The role of fire in this group is threefold:

- To maintain grasslands: Grassland areas capable of supporting juniper and ponderosa pine may remain treeless through frequent burning.

- To maintain open pine stands: The open condition is perpetuated by periodic fires that reduce the number of seedlings, remove the dense understory of saplings or pole sized trees, or thin the overstory trees.

- To encourage ponderosa pine regeneration: Fire exposes mineral soil, reduces seedling-damaging cutworm populations, reduces competing vegetation, and increases nutrient availability. Depending on the seed crop, weather, and continuity of the seedbed, regeneration may appear as dense stands, separated thickets, or scattered individuals. Periodic fire can create uneven-age stands comprised of various even aged groups. Severe fires will result in a predominantly even aged stand.

Photo 6.2C
Fire Effects

Natural fire frequencies in forests adjacent to grasslands were at fairly short intervals, according to numerous fire history studies conducted in the ponderosa pine forest types throughout the western United States. These studies have shown fire to be a frequent event, occurring at intervals from 5

to 25 years and a mean fire-free average of 6 to 12 years for fires occurring in small stands of 50-100 acres. (Gruell, G. 1982; Weaver, H. 1967; Weaver, H. 1959)

Successful fire control during the 20th century has undoubtedly affected this ponderosa pine group. A primary effect is the increase of two-storied stands on numerous sites within Musselshell County, where the understory is a dense stand of pole-sized or larger trees. When fire suppression eventually fails in such stands, large, severe fires often result. Another effect of fire suppression is the increase in the acreage covered by ponderosa pine stands as a result of successful juniper and ponderosa pine invasion of formerly fire-maintained grasslands. In hot dry areas where natural regeneration is extremely slow or non-existent, the effects of fire suppression have been minimal.

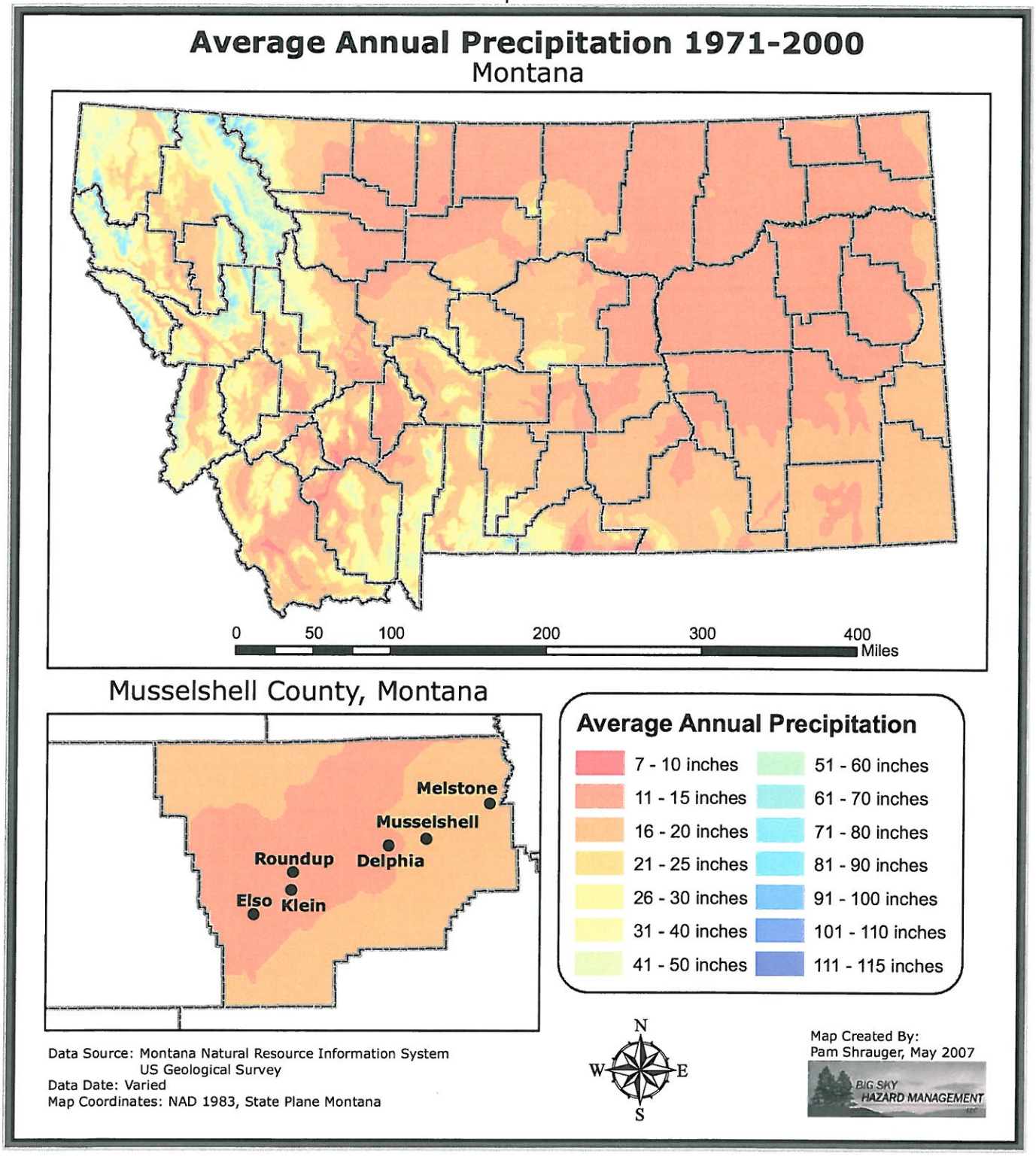
6.3 Climate and Weather

Climate in Musselshell County and central Montana is classified as Middle Latitude Steppe. This semiarid region is characterized by low rainfall, low humidity, clear skies, and relatively large annual and daily temperature changes.

About one-third of the annual precipitation in Musselshell County falls during May and June. The period of least precipitation is November through February. The Roundup weather observing station averages 12.37 inches of precipitation annually. The lowest annual precipitation was 5.03 inches in 1931 and the highest was 21.81 inches in 1978. Heavy snows, from 6 to 12 inches, can occur during the winter. Snow seldom accumulates to great depths because of thawing from strong west-to-southwest downslope Chinook winds. Thunderstorms typically occur about 30 days per year, usually from May through September. These storms are accompanied by strong, gusty winds and occasional hail. Upslope fog and low clouds, accompanied by east and northeast winds, are common during the colder two-thirds of the year with an occasional occurrence during the warmest months. Map 6.3A depicts the average annual precipitation for the State of Montana during the years of 1961 through 1990.

Moisture regimes can be defined in terms of storm tracks which generally move across the county from southwest to northeast. Any significant moisture associated with these storm tracks has often been depleted prior to reaching the northern half of the county, but the higher elevations in the Bull Mountains promote the orographic lifting that provides more moisture to this forested area. Lightning associated with these storms can contribute to a significant number of fire starts along the storm's path. During the summer months, the increased sun angle leads to stronger warming and drying of the earth's surface. As the air warms and rises, cumulus clouds can develop. The dry air at the surface contributes to high-based clouds, and the moisture associated with these building cumulus clouds rarely hits the ground. This phenomenon is called virga, rain that evaporates before reaching the ground. In some of the stronger cells, gusty downdrafts can be produced and are often accompanied by dry lightning.

Map 6.3A


Average Annual Precipitation 1971-2000
Montana
0
50
100
200
300
400
Miles
Musselshell County, Montana
Melstone
Musselshell
Roundup
Delphia
Elso
Klein
Average Annual Precipitation
7 - 10 inches
11 - 15 inches
16 - 20 inches
21 - 25 inches
26 - 30 inches
31 - 40 inches
41 - 50 inches
51 - 60 inches
61 - 70 inches
71 - 80 inches
81 - 90 inches
91 - 100 inches
101 - 110 inches
111 - 115 inches
N
W
E
S
Data Source: Montana Natural Resource Information System
US Geological Survey
Data Date: Varied
Map Coordinates: NAD 1983, State Plane Montana
Map Created By:
Pam Shrauger, May 2007
BIG SKY
HAZARD MANAGEMENT

Periods of drought often affect Musselshell County. Extreme droughts, such as the 1930's Dust Bowl, has a 2% probability of occurring each decade, or once every 500 years. Severe droughts, such as the one that occurred in the 1950's, have a 20% chance of occurring each decade, or once every 50 years. (National Oceanic and Atmospheric Administration, 2003) Significant wildfires do not always correlate with annual precipitation deficiencies. For example, the 1998 and 1999 wildfires occurred during years when annual precipitation was higher than average, 13.48 and 13.86 inches, respectively. Other factors, such as when the precipitation falls, the absorption of the precipitation, and longer term averages, likely play important roles. The years 2000 through 2004, as a whole, were only 75% of normal.

Long-term drought poses another significant challenge because of its effect on current vegetative conditions (i.e., reduction in live fuel moisture content). Fire records for Musselshell County indicate that wildland fire suppression actions are effective when the energy release component (ERC) is below the 97th percentile. When the ERC is above the 97th percentile, wildland fire suppression actions are historically not effective.

Seasonal changes can influence fire behavior as well. The winter months of December through February are generally non-fire months, but snow accumulations can be a key factor in potential fire activity for any given summer. Spring seasons (April through June) are generally moist months with low fire frequencies. The ignitions that do occur result in mostly low intensity fires. Minor fire activity can occur in early spring prior to green-up conditions. As the season turns to summer, grasses and shrubs begin to lose their live fuel moisture, down fuels begin to dry, and fire conditions normally peak by August. Late fall conditions in November mark the transition into winter, but again, dry cold frontal passages, frost-killed fuels, and the lack of snow pack can lead to conditions of rapid fire growth and high intensity fire behavior during wind events.

Despite wet winters and other favorable factors, summer weather can dramatically change what looks to be a quiet wildfire season into a busy one. Montana summers can quickly turn extreme with extended dry periods, very low humidities, dry thunderstorms, and gusty winds. Much depends on the summertime subtropical high pressure ridge, also called the Bermuda High, over the Atlantic Ocean. Shifts in the high pressure ridge dictate the path of the upper level jet stream and the amount of moisture of over central Montana. When the Bermuda High extends into the Central Plains, it can direct just enough moisture from the southwest to produce dry thunderstorms. Local high pressure systems positioned over Montana can lead to weeks without rain. High pressure creates subsidence, or sinking air, that dries the atmosphere. This subsidence does two things; it brings very warm temperatures (90-105°F) to the area, and it lowers the relative humidities. This lower relative humidity begins to dry the fuels of all size classes (1 hour, 10 hour, 100 hour, 1000 and 1000 hour plus time lag fuels). The 1-100 hour time lag fuels will show evidence of drying within 3-5 days. The 1000 hours fuels will take significantly longer to dry, usually in the 3-5 weeks range.

Climate, such as the typical semiarid conditions or long-term drought, is not the only atmospheric player in wildfires. Real-time weather also plays an important role. Weather directly affects fire behavior, with wind being the major influencing factor. Generally, winds in this area prevail out of the southwest, and can be moderate to strong, depending on the elevation and aspect. Southwest facing slopes are more exposed to the prevailing wind, which relates to increased fire behavior

activity. Fires generally spread from southwest to northeast. During calm days, fire spread will be dictated by topographic configuration and local upslope-downslope winds. During strong wind events, fire spread will be dictated by wind direction, and the winds will override the effects of the topographic features.

The fire history for Musselshell County in 1984, 1988, 1998, and 1999 were years of significant large fire growth. In reviewing these four years, a correlation can be drawn to the month of August. In three of the four years, large fires occurred in late August, with the exception of 1999, when conditions for large fire growth developed by late July. A review of the fire history for Musselshell County for these years showed the following correlations:

- Average maximum daily temperature of 87 degrees.
- Average wind speed was 8.5 mph consistently from the west northwest. Wind gusts from 20-30 mph were common and often exceeded 40 mph and reached as high as 61 mph. These gusty winds were most common during the time frame from 8/23-8/31.
- August is consistently the driest month with weather records showing poor nighttime relative humidity recovery. During the daylight hours, the relative humidity begins to drop substantially beginning at 0900 and remains low until 2100. These lows bottom with percentages in the lower teens around 1700-1800. The time frame from 8/23-8/31 consistently remains the time period with the lowest relative humidity and poorest humidity recovery. In reviewing the weather history, these are also the days in the month where relative humidities remained low for the entire twenty-four hour period.
- Moisture events did occur in August, but were limited in location, content, and duration. The remnants of these events kept the maximum relative humidity high in that particular area for a period of seven days.
- ERC's were recorded above the 90th percentile for the months of August and September.
- Conifer stands contributed to large fire spread, where high fire intensities did not allow for aggressive initial attack or fire suppression with ground forces due to safety concerns.

The correlations of these weather factors will be used in the Fire Behavior section. An average of these factors will be used to make fire behavior projections (using BehavePlus software) for the county.

6.4 Fire Behavior

As described earlier, wildland fire has been a dominant force in shaping the landscape. Fire activity is directly related to available fuels, fuel moisture content, topography, climate, and existing weather factors.

Significant wildland fires have the following fire behavior characteristics:

- Wildland fires will be either wind or plume-dominated.

- Wildland fires begin as ground based fires, but become crown fires as they move through the ladder fuels into the crowns.

On-site or available fuels are produced either through natural processes (minus natural fire events) or through timber management practices. Vegetation inventory indicates that the forested areas of Musselshell County are a mix of age classes with the dominant age class in the 70-120 year range.

A fire behavior-modeling program, BehavePlus, uses 12 distinct fuel models, a predetermined ignition point, pre-existing fuel conditions, and on-site weather factors to help predict fire behavior, including flame length, rate of fire spread, spotting distances, and fire size. Using this data, a Fire Behavior Analyst can determine the direction the fire will spread and its probable size. Also using this information, a landowner, homeowners' association, developer, or the county can make decisions as to where they might implement cost-effective fuel treatments.

Fire behavior fuel models are divided into four categories: grass models, brush models, timber models, and slash models. One grass model, one brush model, and one timber model represent this project area. The fuel models consist primarily of model 10, ponderosa pine stands.

Potential fire behavior for Musselshell County can be understood by reviewing the fire behavior observed from the Hawk Creek Fire. Large fire activity from 1988, 1998, 1999, 2000, 2003, and 2006 burned in the same fuel model and under similar weather conditions. Remaining ponderosa pine stands that presently exist in the county remain vulnerable to a stand replacement fire with the potential for significant risk to people, property, and resources.

The Hawk Creek Fire burned 178,621 acres over a six-day period in August 1984. The majority of the drainages in the Hawk Creek Fire experienced high-intensity stand replacement fire behavior.

Photo 6.4A
Hawk Creek Fire Scar

The weather conditions and fire behavior displayed the following common characteristics:

- Winds were blowing at 10 mph plus, eight of nine days from 8/23-31.
- Winds blew out of the west at a steady 10 mph, with gusts of 23-31 mph.
- High daily temperatures ranged from 88-92 degrees.
- Minimum relative humidities ranged from 10-12% and humidity recovery from 36-58%.
- Most of the fire activity was wind dominated.
- High rates of spread were common with the fire traveling in excess of several miles per hour during the initial run.
- Long distance spotting contributed to fire spread.

The continuous stands of multi-storied ponderosa pine provided an excellent fuel bed for large fire growth. There were virtually no natural fuel breaks to help slow down the fire or to provide anchor points for the suppression crews. The old decadent stands of mixed conifers, in conjunction with the heavy ground fuels, provided a continuous fuel bed for the fire to burn through. The only breaks in the area were the low elevation meadows where the grass had been heavily grazed by livestock. These became ineffective due to the long distance spotting that occurred and even the grazed meadows eventually became involved with fire.

Similar seasonal timing and weather conditions were present during the ignition of the fires in 1988, 1998, 1999, 2000, 2003, and 2006. The location of the ignition and the nature of the

adjacent fuel bed were the prominent reasons these fires did not achieve the size of the Hawk Creek Fire.

Large fire growth can be expected to come from two distinct categories. The first, as described previously, will come from climatic conditions that the county experiences as a normal course of seasonal drying. Generally, this seasonal drying trend begins in July and depending on the severity of the fire season, large fire growth can occur thru November. The timeframe for this category can generally be predicted and staffed for.

The second large fire category will be the result of high wind events that can only be sometimes predicted in the short term and can occur well beyond the months of late summer and fall. The months that display potential for this type of fire are not limited, except during the time period when seasonal green up is occurring. The impact of this type of event will be dependent on available fuels and long term drying. Wind events cannot always be accurately predicted, and depending on the duration of the event, any given fire ignition can be expected to have a significant impact on the county.

The ignition component is a critical issue in the high wind event scenario. Basically, by controlling ignition sources through a strong fire prevention program and burn permit enforcement, the county has the ability to mitigate the potential for large wind-driven wildland fire events.

Two fire behavior projections were developed using climate data from the National Oceanic & Atmospheric Administration for Musselshell County.

The first BehavePlus run represents a wildland fire, started at 1500 during a mid-summer scenario, using the following inputs:

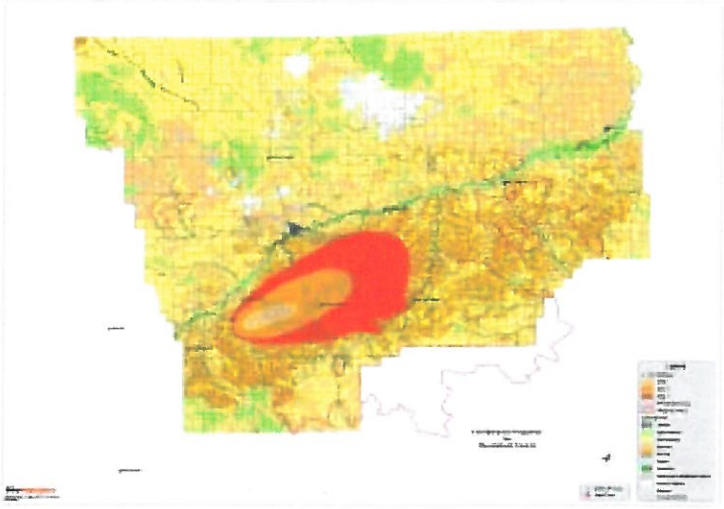
- Temperature: 88 degrees
- Relative Humidity: 15%
- Dew Point: 35 degrees
- 20 Foot Wind Speed: 15 mph
- 1 Hour Fuels: 4%
- 10 Hour Fuels: 7%
- 100 Hour Fuels: 11%
- Live Woody: 75%

A fire starting in late August under these weather conditions during the mid-afternoon in mature ponderosa pine stands will closely resemble those stands located south of Roundup. The ignition is the result of a lightning strike and is located mid-slope on a westerly aspect.

Within an hour of ignition, the fire will have exceeded present initial attack capabilities and will be moving to the east northeast spotting up to ½ of a mile ahead of the main fire with a probability of ignition for spots being 79%. If initial attack is not successful, the fire will continue to burn through the night due to the poor humidity recovery (<35%). In the early morning hours, the fire's growth will slow. By this time, the fire has been burning actively for fifteen hours. If the ignition was located on the western side of the county, the fire would have reached and burned through a

number of the developed subdivisions located south of Roundup during the first burning period as shown in Figure 6.4B

Figure 6.4B



On the second day, the fire will become active by 1000 hours as the relative humidity drops below 20%. This will occur with or without any significant wind. As this activity takes place, several smoke columns will form and in time become one column. Spotting will become pronounced from ½ to 1 mile ahead of the fire front. Without wind, available fuels will influence the fire spread.

On day three, expect similar burning conditions to occur. This fire will continue to burn and will stop when either the fuel or weather conditions change to the point that suppression forces can become effective. The resulting burn pattern of this fire will closely resemble the Hawk Creek Fire. This type of fire can be extremely lethal and will threaten life, property, and natural resources.

The second run is a wildland fire that would be started at 1500 hours during a fall scenario using the following inputs:

- Temperature: 45 degrees
- Relative Humidity: 18%
- Dew Point: 4 degrees
- 20 Foot Wind Speed: 40 mph
- 1 Hour Fuels: 4%
- 10 Hour Fuels: 8%
- 100 Hour Fuels: 11%
- Live Woody: 100%

The run uses a lower air temperature, but a higher wind speed, which corresponds to a cold frontal passage. The other inputs will remain the same as the summer run with the exception of the shading value, which will increase due to the angle of the sun.

This fire will burn in the same pattern as the mid-summer run, with the following exceptions:

- The fire will drop to the ground and remain as a ground fire once the wind event is over.
- Free burning conditions will generally not be present.
- Due to the increase in wind, spotting distances increase from 1/2 mile to 3/5 mile.
- Probability of ignition will drop to 65% due to the colder fuel temperatures.

This fire scenario is probably more dangerous to life and property due to its unexpected timing.

6.5 Ignition Risks

All fires must start with an ignition. If no ignitions occurred, the county wouldn't have a wildfire problem. The truth, however, is that fire ignitions can occur for a wide variety of reasons. The most common ignition source is lightning. Lightning ground strikes, with or without rain, can easily produce enough heat to start a fire. Lightning develops when ice particles in a cloud move around, colliding with other particles. These collisions cause a separation of electrical charges. Positively charged ice particles rise to the top of the cloud and negatively charged ones fall to the middle and lower sections of the cloud. The negative charges at the base of the cloud attract positive charges at the surface of the Earth. Invisible to the human eye, the negatively charged area of the cloud sends a charge called a stepped leader toward the ground. Once it gets close enough, a channel develops between the cloud and the ground. Lightning is the electrical transfer through this channel. The channel rapidly heats to 50,000 degrees Fahrenheit and contains approximately 100 million electrical volts. The rapid expansion of the heated air causes thunder. (National Weather Service, 2006b) Lightning strikes can occur anywhere in the county.

Humans can also create fire ignitions in wildland areas with campfires, cigarettes, ranch equipment, controlled burns, railroads, unsupervised children, fireworks, or intentionally, in the case of arson. Most of the wildfires in Musselshell County have been started by lightning, however, the human factors are always possible. Events, such as fireworks activities during the Fourth of July, can increase the ignition risks.

6.6 Related Hazards

6.6.1 Smoke

Directly related to wildfires is smoke. Smoke can affect many more people than the fire itself. Those nearby or downwind may not feel the direct impacts of the fire, but given the appropriate atmospheric conditions, may experience negative impacts from the particulate matter in the air. Smoke from wildfires may lead to unhealthy air conditions affecting those with respiratory problems and otherwise healthy people. The Montana Department of Environmental Quality (DEQ) monitors air quality during wildfires, issuing daily statements and categorizing the air quality for the larger cities across the state. When the air quality is especially poor, the public may be advised to spend less time outside and to close doors and windows. Smoke can also severely reduce visibilities and lead to road closures and aircraft diversions.

6.6.2 Flash Floods

Counter intuitively, wildfires can increase the probability of flash floods and landslides. Destroyed vegetation and seared soils cannot absorb water as readily. Runoff, particularly on steep slopes, occurs rapidly and can flood normally dry areas. Debris flows, such as mudslides, landslides, and erosion, also become more likely without vegetation, particularly roots, holding the soils and rocks in place. Post-fire debris flows are particularly hazardous because they can occur with little warning, can exert great impulsive loads on objects in their paths, can strip vegetation, block drainage ways, damage structures, and endanger human life. (US Geological Survey, 2007)

6.7 Future Development

A wildfire hazard generally exists anywhere in Musselshell County whether or not the area is developed, with the exception of urban areas like Roundup were wildland fuels are less prevalent. Fires can burn through many parts of the county without causing damage to homes or businesses. The problems arise with the wildfire coincides with human development and values. Many areas already have homes, infrastructure, and resources. A limited number of mitigation activities can reduce the risks to these areas. The future vulnerabilities, in addition to the existing ones, depend on the extent, location, and type of future development that occurs in the county. In many cases, such development will add to the vulnerabilities and put more pressure on firefighting agencies. Future development will add to the number of resources needed to protect structures and infrastructure from wildfires. Without proportional increases to firefighting resources, future development will likely lead to more losses during wildfires.

6.7.1 Natural Resource Extraction Industries

The extraction of natural resources, namely coal, in Musselshell County is an important economic element. The Bull Mountain Coal Mine is an underground longwall coal mine in southern Musselshell that has been producing coal since 2004. A railroad spur line is being built to allow for the transportation of the coal by rail. This new railroad is a new wildfire ignition risk, particularly in the southern part of the county. A coal to liquids refinery that would convert coal to synthetic diesel fuel and a "clean coal" power plant are in the design and planning stages for the Bull Mountain Mine. Further development in the eastern part of the county could result in an open pit mine, another railroad spur line, and possibly another underground longwall mine. This development is an additional asset that would need to be protected in a wildfire and presents new ignition risks.

The Bull Mountain Volunteer Fire Department currently responds to incidents in area of the mine but does not have the personnel, equipment, apparatus, facilities, or training to adequately deliver service to this type of facility. Since this railroad and mine will greatly strain emergency services in the entire county, significant changes will be needed by the Bull Mountain Fire Department to provide basic services to the mine as well as their existing customers. Coal mines require protection for the structures, equipment, transportation vehicles, operational level hazardous materials response, emergency medical response, and some special rescue/extrication capability.

The railroad that is going to transport the coal will create additional protection issues including wildland fires from the trains, crossing accidents with vehicles, hazardous materials releases,

special rescue issues concerning large/heavy equipment, and a new alternative transportation source that is uncommon for the responders in this area.

6.7.2 Subdivision Growth

If history is any indication, along with the continued movement of the population outside towns and cities, Musselshell County shall continue to see considerable new subdivisions. Existing subdivisions will become completely developed and additional lots for development will become necessary if this trend continues. Current subdivision growth is at approximately 40 lots per year. Current in fill of existing lots is occurring at approximately 30 lots per year. It can be assumed that this trend will continue and possibly increase in the future, particularly if the fuels plant and additional mines are developed and create a significant number of new jobs.

The county's growth policy and subdivision regulations are the only existing avenues to manage local growth. Local government agencies that will be tasked to provide services for these areas need to participate in the subdivision review process and voice their infrastructure and mitigation requirements associated with this subdivision growth.

6.7.3 Expectations of Service

The people moving into Musselshell County have their own expectations of service levels. Normally, the expectation of service is derived from the services received by the new resident at their previous community. These service levels may include but are not limited to the following:

- Full service delivery emergency services organization to include wildland fire response, structure fire response, motor vehicle accident rescue, car fire response, emergency medical response, and possibly hazardous materials response, special rescue response, oil field fire response, etc.
- Response time – quick, shortly after hanging up the phone.
- Professional well trained personnel, with adequate equipment and apparatus.
- The ability to acquire fire insurance at reasonable rates.

Many of these expectations cannot be met in the rural areas due to a small tax base over a large area resulting in volunteer fire departments with aging equipment, apparatus, and limited training. For service delivery to match expectations, either significant modifications, including substantial tax increases, must be made or public expectations need to become more realistic.

6.8 Vulnerable Areas

Any part of Musselshell County that has vegetation has some probability of wildfire. The key to reducing wildfire losses, however, is to identify the wildland-urban interface areas in the county. The highest hazard areas will have a high probability of significant wildfires. These areas include regions with timber and other significant fuels built up. Additionally, the interface areas, by definition, have human development such as structures or infrastructure. It is also important to identify wildland areas that could see development in the future. Therefore, the entire county is

defined as the wildland-urban interface, based on the potential for future development in most areas and the abundance of fuels, timber, hardwoods, and grasses.

The following characterizations can help prioritize where protection capability should be improved and where fuel treatments could be most effective.

- Extreme Risk Areas - These are areas where wildland fire is highly undesirable. A fire has the potential to cause major property damage or resource loss, will result in major suppression costs, and will create an extreme risk to firefighters. Fire suppression actions will be aggressive, and the acreage burned will be kept as small as possible within these areas. Prevention will also be emphasized to keep the numbers of person-caused ignitions to a minimum.

  These areas are characterized as those densely forested areas where structures are located or planned, and where the current fuel conditions are significantly more hazardous than they would be in a healthy and appropriately stocked stand.

- High Risk Areas -These are areas where wildland fire is undesirable under current fuel conditions. Like Extreme Risk Areas, fuel conditions are hazardous and fire suppression actions will be aggressive in order to keep fires small. Again, fire prevention will be emphasized in these areas.

  Although wildland fire under current conditions is unacceptable, appropriate fuel treatment measures may permit some restoration of the fire adapted landscape over time. Once this condition is reached, fire intensities and long term damage from wildland fires will be reduced and a prescribed fire could be used periodically to maintain a healthier ecosystem which would be less prone to a catastrophic wildfire. Generally, these areas have moderate terrain and scattered forested areas.

- Moderate Risk Areas - These are areas where prescribed fire can be returned immediately to the fire adapted landscape without significant negative effects. A prescribed fire should be used regularly to maintain the desirable conditions already present. Suppression of wildfires can be made with consideration of the lowest suppression costs and resource loss. It may not always result in minimizing the burned area.

Map 6.8A shows the risk areas based on their proximity to hazardous fuels and access problems and Table 6.8B approximates the number of structures in each category by jurisdiction. Map 6.8C shows the undeveloped but subdivided parcels of land by hazard level to demonstrate the potential for future development in hazardous areas. Table 6.8D approximates the number of undeveloped, subdivided parcels in each category by jurisdiction.

Map 6.8A

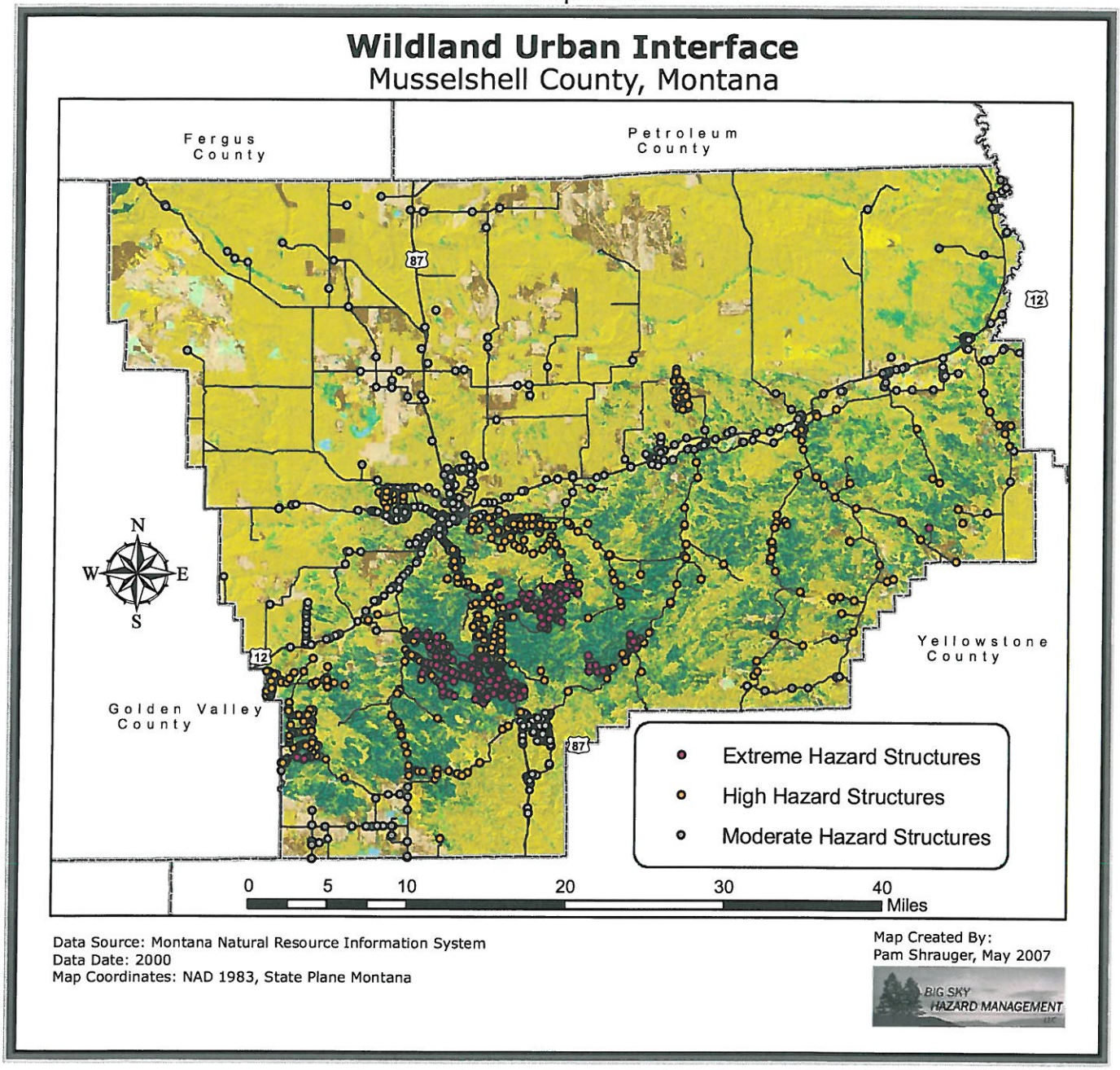


Table 6.8B Wildland Urban Interface by Wildfire Jurisdiction

Department	Extreme Hazard	High Hazard	Moderate Hazard
Broadview	0 structures	1 structure	26 structures
Bull Mountain	230 structures	168 structures	124 structures
Dean Creek	6 structures	109 structures	3 structures
Hawk Creek	1 structure	141 structures	32 structures
Melstone	0 structures	12 structures	158 structures
Musselshell	63 structures	343 structures	434 structures
TOTAL	300 structures	774 structures	777 structures

Map 6.8C

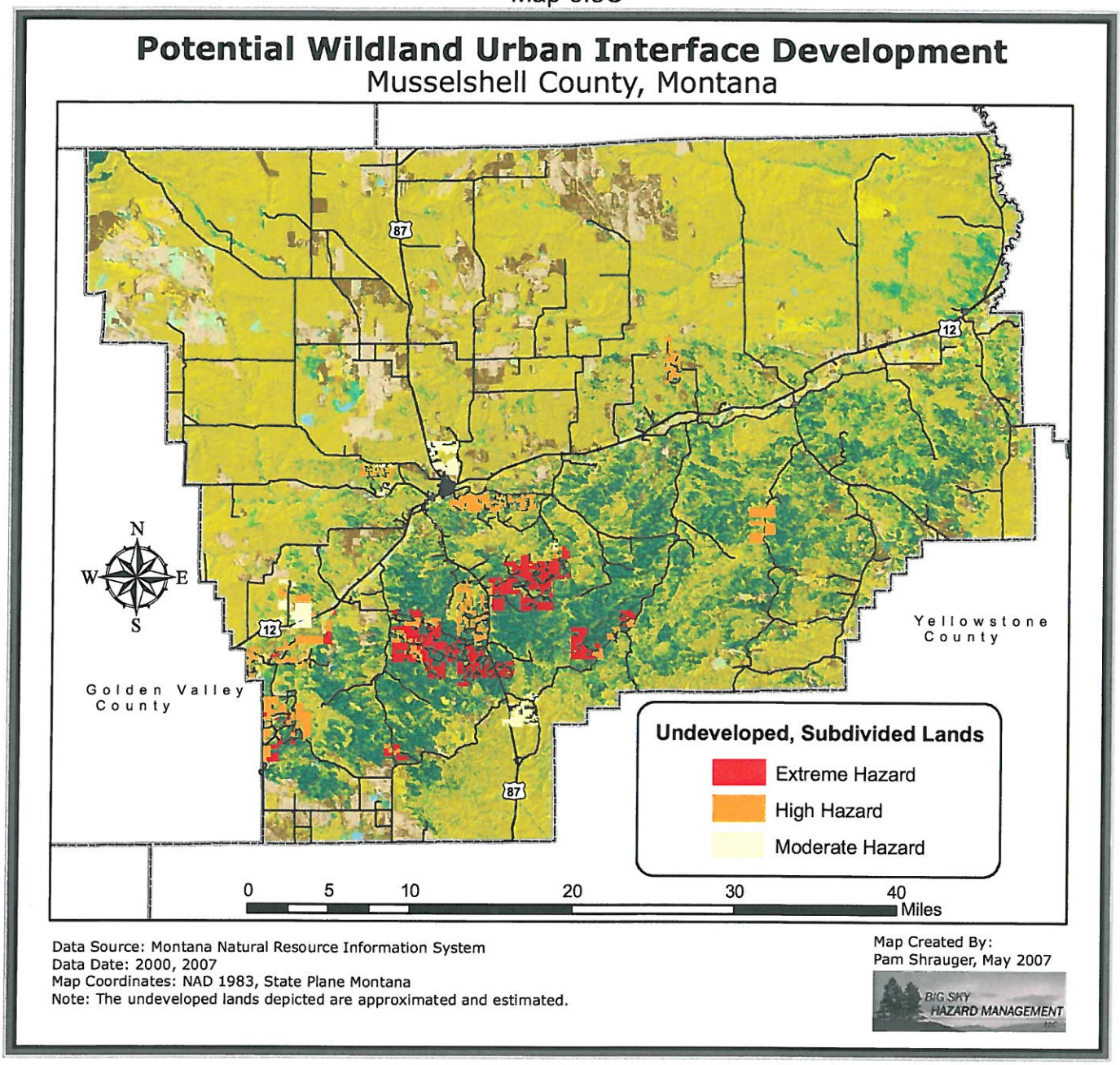


Table 6.8D Undeveloped, Subdivided Parcels by Wildfire Jurisdiction

Department	Extreme Hazard	High Hazard	Moderate Hazard
Broadview	5 parcels	2 parcels	0 parcels
Bull Mountain	318 parcels	103 parcels	71 parcels
Dean Creek	14 parcels	64 parcels	0 parcels
Hawk Creek	0 parcels	121 parcels	0 parcels
Melstone	0 parcels	0 parcels	68 parcels
Musselshell	135 parcels	368 parcels	153 parcels
TOTAL	472 parcels	658 parcels	292 parcels

Critical facilities and infrastructure can also be at risk during wildfires. Perhaps the most vulnerable are communications towers, electric transmission lines and substations, oil and gas fields, pipeline terminals, and bunk storage tanks located in wildland areas. Musselshell County has an abundance of these types of critical facilities and infrastructure. Rural fire stations and schools may also be at risk if adequate defensible space is not provided. Community infrastructure such as pumping stations and sewer lagoons could be threatened by wildfires in the area. Generally, critical facilities and infrastructure located with the City of Roundup are buffered by urban development and are not particularly at risk from wildfires.

6.9 Risk Assessment Summary

The following are findings for Musselshell County as they relate to the county's fire history and present day fuel complex.

- The stands of mature ponderosa pine are at "High to Extreme Risk" for an ignition due to the lack of fire playing its natural role in the forest type. These forested areas will continue to deteriorate unless they are either treated by timber harvest or some other type of fuels mitigation project. In lieu of a conscious effort to improve timber stand conditions, they will be recycled through a stand replacement wildland fire.
- Without significant improvements to the fire suppression delivery system, the county will be unable to safely and effectively respond to large wildland fires.
- Subdivision development and occupancy of homes in the wildland-urban interface without mitigation of the adjacent wildland fuel hazard has further complicated the fire suppression capability of the rural fire organizations.
- Few geographic areas have the potential for extreme fire behavior on an annual basis as does Musselshell County.

Musselshell County will face some serious fire protection challenges, if the status quo is maintained, on its wildlands and wildland urban interface in the coming years.

Years of fire protection have led to unnatural fuel accumulations in many of the ponderosa pine stands in the county. It is a problem that is ongoing to this day as wood biomass continues to accumulate in the forest. In addition, areas that were void of trees are being forested by the prolific pine species. In pre-settlement times, the frequent and free burning lightning fires occurring in summer and fall would have consumed this excess biomass and kept the tree encroachment from invading grasslands. It would also have thinned the stands of trees to a lower number of stems per acre. Now, in the absence of those frequent, low intensity fires, a very flammable environment has been created. Unless some other form of treatment takes place, the problems will only get worse for the county in its responsibility for providing fire protection.

Within older subdivisions, fuel management, adequate access roads, rural water supply, and survivable space have not been adequately considered.

One significant problem is the protection of the structures currently in place, as well as those anticipated to be built in the future as the economic and recreational bases of the county expand.

There are some 1,900 tracts of subdivided land totaling over 65,000 acres at present in the county, many of which are undeveloped. This number will most certainly rise as the demand increases. These subdivisions have created a wildland urban interface problem whether they are within the grasslands or timbered areas.

Photo 6.9A
Interface Setting

Current funding is not adequate for the fire protection organizations to provide basic service to an expanding population.

The existing number of structure protection apparatus in the county is not adequate to meet existing needs when the wildlands are not at risk to burn. When they are at risk to burn, which can be virtually any month of the year, there is no chance that the current capability can keep pace with the potential need. Financial constraints also limit the amount of training that can be brought to the volunteer firefighters.

Firefighter safety should never be compromised.

Musselshell County and the fire service organizations need to ensure the safety of their firefighters. Thorough situational awareness on the part of the firefighter is a must, yet it is difficult to judge that awareness among the various volunteer firefighters in the county. The prospects to gain this awareness are uncommon as training opportunities and out of county dispatches are infrequent. Those who have witnessed a Hawk Creek Fire will appreciate what can happen and those who have dealt primarily with routine small fires probably will not. This is not meant as an aspersion on the volunteers but as an observation made by those who have survived decades of fighting wildland fires under a wide range of weather and fuel conditions and are surprised by nothing when it comes to violent fire behavior. There are fuel and topographic conditions in some areas of

the county where, when wildlands are at risk to burn, firefighters respond to structure fires at great personal risk to themselves and their equipment.

Structural firefighting response needs to be significantly improved to provide a minimum level of safety to responders and the public. Structural response capability needs to be provided to the entire county, with a higher level of service delivery developed in the southern end of the county.

Fire response needs to be appropriate for the potential fire conditions.

The next challenge occurs when county volunteer firefighters are called upon to respond to a wildland fire. These responses are limited to that period of the year when the wildlands are capable of supporting an active fire. As stated earlier, this could occur during virtually any month of the year but it is most often the case from July through October. If the wind is not blowing and the ERC indices are at normal levels, the response should proceed more or less routinely. Rates of spread should be low to moderate, and those firefighters that have had wildland firefighting training would be expected to contain a fire without much problem.

If the wind is blowing or the ERC indices are high, they may encounter some difficulty, depending on the fuel type and terrain. Many areas in the county now have fuel loadings that are outside their natural range of variability. The heavier the fuel type, the greater the fire intensity, and the greater the resistance to control a fire is. The greater the resistance to control, the more firefighters are needed, and the higher the level of leadership and training is required.

If both strong winds and high ERC's are being experienced, as stated previously about structure fires, there is little chance of success, and indeed there is a high probability of a burn over by one or more of the county's apparatus and personnel. Chief officers need the leadership skills, training, and experience to evaluate the potential fire and fuel conditions and alter strategy and tactics to ensure firefighter safety and effectiveness.

Agricultural lands must also be considered wildfire hazard areas.

Grazing and other agricultural practices provide a diverse fuel complex in portions of the county that are a solely grass and brush field or a combination of each. These practices provide a fuel break system that allow for continuous success in wildland fire suppression. Grazing removes fine fuels and acts to retard fire spread. Grazed areas can provide anchor points for fire suppression and safety zones for firefighter safety.

Timber harvests using best management practices designed by a certified consulting forester can be utilized as a site conversion tool. This practice will shift land management use from timber production toward a combination of forage and timber management.

Conservation Reserve Program (CRP) lands, because of the accumulation of fine fuels, will promote more rapid fire spread and higher intensity fires. CRP lands may also contribute to the eventual encroachment of unwanted tree species due to the lack of active management of the land.

7. Mitigation Strategy

Hazard mitigation, as defined by the Disaster Mitigation Act of 2000, is any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. Studies on hazard mitigation show that, on average, for each dollar spent on mitigation, society saves an average of four dollars in avoided future losses. (Multihazard Mitigation Council, 2005)

The development of a wildfire mitigation strategy allows Musselshell County to create a vision for preventing future wildfire losses, establish a common set of mitigation goals, prioritize actions, and evaluate the success of such actions. The Musselshell County Wildfire Mitigation Strategy is based on the recommendations by local officials and the results of public meetings for the county's all-hazard Pre-Disaster Mitigation Plan.

Rather than wait until a wildfire occurs, Musselshell County has developed this strategy to move in a more proactive direction for wildfire mitigation. All losses cannot be entirely mitigated, however, some actions can be taken, as funding and opportunities arise, that may reduce the impacts of wildfires, thus, saving lives and property.

7.1 Goals, Objectives, and Actions

Goal 1: Reduce the potential impacts of wildfires to people and property before the wildfire occurs.

Objective 1.1: Reduce fuels and improve firefighting conditions around existing homes, outbuildings, and roadways.

Project 1.1.1: Subdivision-wide Fuels Mitigation

- Conduct door-to-door property evaluations.
- Provide financial incentives to homeowners to reduce the fuel loadings around homes and improvements. Treatments may include, but are not limited to, prescribed burning, timber harvest, hand piling and burning, machine piling and burning, chipping, grazing, and firewood gathering.
- Consider using roads, including private roads, as fuel breaks. If justifiable, fuels mitigation, ingress/egress, and road conditions should be addressed.
- Continue to pursue and effectively utilize existing funding opportunities for fuel treatments.
- Strategically conduct fuels modification projects to create a landscape-scale fuel break system.

Project 1.1.2: Public Land Fuels Mitigation

- Encourage land management agencies, including local municipalities, to maintain healthy fuels on public lands, particularly on public lands adjacent to private lands.
- Coordinate local fuel mitigation activities with state and federal projects.

Project 1.1.3: Rural Water Tanks and Dry Hydrants

- Install water tanks and dry hydrants in rural areas.
- Maintain fire department connections to the water tanks and dry hydrants.

Objective 1.2: Minimize the wildfire hazard in new subdivisions and developments.

Project 1.2.1: Subdivision Regulations

- Further define "wildland residential interface practices."
- Add language to the county subdivision regulations requiring adequate defensible space around structures.
- Require covenants to have provisions for maintaining defensible space.
- Require covenants to have provisions for maintaining private roadways and driveways.
- Require approval by the local fire chief on all subdivisions.
- Continue and update the subdivision impact fee.

Photo 7.1A
Road in the Wildland Urban Interface

Project 1.2.2: Industrial Growth

- Establish requirements for new industrial facilities such as mines, railroads, and power generation facilities that minimize the probability of industry-related fire ignitions.
- Establish requirements for commercial facilities to maintain adequate fire suppression capabilities, fire department access, and defensible space.

Project 1.2.3: Land Use Permits

- Require land use permits for new construction in the county.
- Establish wildfire mitigation requirements for single housing construction similar to that of subdivisions.

Photo 7.1B
FireWise Home

Objective 1.3: Increase individual responsibility for wildfire mitigation.

Project 1.3.1: Insurance Premiums

- Encourage insurance companies to reduce premiums on buildings that have the following features (and increase premiums on those that don't, if necessary): fire sprinklers, defensible space, fire-resistant construction materials, adequate access, and sufficient water supply (NFPA 1141 minimum).

Goal 2: Increase the preparedness of the fire departments and the communities for wildfires.

Objective 2.1: Develop an organizational structure for the fire departments that is adequately funded, sustainable, and maximizes fire suppression capabilities.

Project 2.1.1 County Fire Service Area

- Establish a county fire service area in unincorporated areas of Musselshell County.
- Determine an acceptable fee (for example, $100/house) to fund the fire service area.
- Hire a full-time, paid fire chief to coordinate fire service area activities such as volunteer recruitment and retention, subdivision reviews, budgeting, training, and equipment maintenance.
- Maintain fire stations throughout the county at existing locations and expand to new locations when funding, volunteer availability, and service demand allows.

Objective 2.2: Continuously increase the training of volunteer firefighters.

Project 2.2.1: Comprehensive Training Program

- Establish long-term training goals for the fire departments, including a focus on structure protection during wildfires and current NFPA standards.
- Develop annual training programs that fit volunteers' schedules.
- Encourage BLM and DNRC to hold training earlier in the season to accommodate early season fires.
- Promote train-the-trainer courses so more training can be done locally.

Objective 2.3: Provide wildfire outreach and education to the maximum number of residents and visitors.

Project 2.3.1: Interface Education

- Educate residents through subdivision meetings and door-to-door efforts regarding the types of risk they were assuming in building their homes in the wildland environment and possible mitigation measures they could take.
- Once enough interest is generated, bring in a reputable speaker to present a series of discussion forums that local groups could attend to learn more about living in a forested and/or fire environment.
- Develop a demonstration area illustrating positive examples of forest stewardship, defensible space, fuel breaks, and FireWise concepts.
- Obtain the DNRC training DVD on wildland firefighting and risk reduction for distribution to ranchers and homeowners.

Project 2.3.2: Fire Restrictions and Closures

- Tier fire prevention activities to the fire danger rating, including restrictions and closure criteria.
- Educate residents during the burn permit application process.
- Implement significant local media outreach and signage during periods of fire restrictions and closures.

Objective 2.4: Increase local hazard knowledge and awareness through information and planning.

Project 2.4.1: Historic Fire Database

- Create a centralized, countywide database of historic wildfires including information on start date and time, end date and time, location, size, cause, fuels, weather conditions, and damages.

Project 2.4.2: Community Mapping

- Using GIS technology, map the locations of water storage, potential staging areas, driveways, and structures.
- Produce maps that can be distributed to local, state, and federal firefighting crews.

Goal 3: Increase the response capabilities of the local fire departments.

Objective 3.1: Increase the local abilities to manage increasingly complex wildfires.

Project 3.1.1: Type III Incident Management Team
- Create a Musselshell County Type III Incident Management Team
- Identify potential team members.
- Train volunteer firefighters in the various Incident Management Team positions.

Objective 3.2: Purchase vehicles and equipment that improve firefighting safety and efficiency.

Project 3.2.1: Vehicle and Equipment Needs Analysis
- Conduct a survey and needs analysis for each of the departments regarding their current and anticipated future wildland fire vehicle and equipment needs.
- Use capital improvements planning and grant funding to fulfill the needs.

Project 3.2.2: Type 3 Engines
- Purchase more Type 3 wildland fire engines (500 gallon capacity with a pumping capacity of 120 gallons per minute at 250 psi).

Objective 3.3: Increase the efficiency and organization of a large-scale evacuation.

Project 3.3.1: Evacuation Plan
- Create a comprehensive evacuation plan for systematically evacuating people in harm's way.
- Develop evacuation notification procedures and materials.
- Ensure the road infrastructure is adequate to handle in-person notifications and evacuations.
- Coordinate with the American Red Cross regarding evacuation centers and evacuee contact information.
- Establish re-entry procedures.

Objective 3.4: Ensure adequate numbers of volunteer firefighters are available to fight wildfires.

Project 3.4.1: Volunteer Retention
- Explore incentives to retain volunteer firefighters such as retirement benefits, health and fitness programs, and other possibilities.

7.2 Implementation

Each of the proposed projects has value, however, time and financial constraints do not permit all of the proposed actions to be implemented immediately. By prioritizing the actions, the most critical, cost effective projects can be achieved in the short term. The prioritization of the projects serves as a guide for choosing and funding projects, however, depending on the funding sources and political dynamics, some actions may be best achieved outside the priorities established here.

To ensure that community goals and other factors are taken into account when prioritizing projects, a prioritization model that uses the following factors has been developed: Cost, Staff Time, Feasibility, Public Safety, Firefighter Safety, Property Benefit, Values Benefit, Annual Maintenance, and Hazard Level.

Cost considers the direct expenses associated with the project such as material and contractor expenses. *Staff time* evaluates the amount of time needed by a local government employee to complete or coordinate the project. *Feasibility* assesses the political, social, and/or environmental ramifications of the project and the likelihood such a project would proceed through permitting and public review processes. *Public safety* considers the possible prevention of deaths and injuries of the general public through the project's implementation. *Firefighter safety* considers the possible prevention of firefighter deaths and injuries through the project's implementation. *Property benefit* estimates the reduction of property losses, including structures and infrastructure, through the project's implementation. *Values benefit* considers the economic, ecologic, historic, and social benefits of the project. It also considers other less quantifiable benefits that may be attributable to the project. *Annual maintenance* rates the amount of work required to keep the mitigation measure effective and useful. *Hazard level* is based on the degree of wildfire hazard in the area being addressed by the project.

Each of the factors can be ranked qualitatively for each of the projects. The methods used to assign a category and the associated score can be generally defined as shown in Table 7.2A. The highest possible score is 33. Some factors have a greater range than others, thus indicating a higher weighting. These weightings allow for appropriate prioritization of the project. More specifically, 15 of 33 points account for benefits (public safety, firefighter safety, property benefit, and values benefit), 11 of 33 points account for direct and indirect costs (cost, staff time, and annual maintenance), 4 of 33 points account for the hazard level, and 3 of 33 points account for project feasibility.

Table 7.2B lists the projects and their associated scores. The scoring can be refined as more specific projects and details are developed.

Table 7.2A Prioritization Criteria

Factor	Threshold	Rating	Score
Cost *Range: 1-5*	Little to no direct expenses	Low	5
	Less than $5,000	Low-Moderate	4
	$5,000-$25,000	Moderate	3
	$25,001-$100,000	Moderate-High	2
	Greater than $100,000	High	1
Staff Time *Range: 1-3*	Less than 10 hours of staff time	Low	3
	10-40 hours of staff time	Moderate	2
	Greater than 40 hours of staff time	High	1
Feasibility *Range: 1-3*	Positive support for the project	High	3
	Neutral support for the project	Moderate	2
	Negative support for the project	Low	1
Public Safety *Range: 1-4*	Potential to reduce more than 20 casualties	Very High	4
	Potential to reduce 6-20 casualties	High	3
	Potential to reduce 1-5 casualties	Moderate	2
	No potential to reduce casualties	Low	1
Firefighter Safety *Range: 1-4*	Potential to reduce more than 20 casualties	Very High	4
	Potential to reduce 6-20 casualties	High	3
	Potential to reduce 1-5 casualties	Moderate	2
	No potential to reduce casualties	Low	1
Property Benefit *Range: 1-4*	Potential to reduce losses to more than 20 buildings or severe damages to infrastructure	Very High	4
	Potential to reduce losses to 6-20 buildings or substantial damages to infrastructure	High	3
	Potential to reduce losses to 1-5 buildings or slight damages to infrastructure	Moderate	2
	No potential to reduce property losses	Low	1
Values Benefit *Range: 1-3*	Provides significant benefits to economic, ecologic, historic, social, or other values	High	3
	Provides some benefits to economic, ecologic, historic, social, or other values	Moderate	2
	No or very little benefit to economic, ecologic, historic, social, or other values	Low	1
Annual Maintenance *Range: 1-3*	Requires very little or no maintenance	Low	3
	Requires less than 10 hours per year	Moderate	2
	Requires more than 10 hours per year	High	1
Hazard Rating *Range: 1-4*	Extreme Hazard	Extreme	4
	High Hazard	High	3
	Moderate Hazard	Moderate	2
	Low Hazard	Low	1

Table 7.2B Mitigation Project Scores

	Cost	Staff Time	Feasibility	Public Safety	Firefighter Safety	Property Benefit	Values Benefit	Maintenance	Hazard Rating	TOTAL SCORE
Project 1.2.1: Subdivision Regulations	5	2	2	4	4	4	2	2	4	29
Project 1.2.3: Land Use Permits	5	2	2	4	4	4	2	2	4	29
Project 2.3.2: Fire Restrictions and Closures	5	2	3	3	3	3	2	2	4	27
Project 1.2.2: Industrial Growth	5	2	2	3	3	3	2	2	4	26
Project 1.3.1: Insurance Premiums	5	1	2	3	3	3	1	3	4	25
Project 1.1.1: Subdivision-wide Fuels Mitigation	2	1	2	4	4	4	2	1	4	24
Project 1.1.3: Rural Water Tanks and Dry Hydrants	2	1	2	4	4	4	2	1	4	24
Project 2.2.1: Comprehensive Training Program	3	1	3	3	4	3	2	1	4	24
Project 2.3.1: Interface Education	3	2	3	4	3	3	1	1	4	24
Project 3.1.1: Type III Incident Management Team	4	1	3	3	4	3	1	1	4	24
Project 3.3.1: Evacuation Plan	5	1	3	4	3	1	1	2	4	24
Project 1.1.2: Public Land Fuels Mitigation	2	3	2	3	3	3	2	1	4	23
Project 2.1.1 County Fire Service Area	4	1	2	2	3	2	1	3	4	22
Project 2.4.2: Community Mapping	3	2	3	1	3	3	1	2	4	22
Project 3.4.1: Volunteer Retention	3	2	3	2	3	2	1	2	4	22
Project 2.4.1: Historic Fire Database	4	2	2	1	1	1	3	2	4	20
Project 3.2.1: Vehicle and Equipment Needs Analysis	1	2	3	2	2	2	1	2	4	19
Project 3.2.2: Type 3 Engines	1	2	3	2	2	2	1	2	4	19

Photo 7.2C
Existing Slash Pile

Funding for wildfire mitigation projects exists from a multitude of sources. Some sources may be specifically designed for wildfire mitigation activities, while others may have another overarching purpose that certain activities may qualify for. Most funding sources are recurring through legislation or government support. Some, however, may be from an isolated instance of financial support. Whenever possible, creative financing is encouraged. Often, additional funding sources are found through working with other agencies and businesses to identify common or complementary goals and objectives. Table 7.2D shows the programs available to Musselshell County directly or as a sub-applicant. This list of potential funding sources is certainly not all inclusive. Many opportunities for mitigation funding exist both in the public and private sectors such as foundations and philanthropic organizations.

Table 7.2D Wildfire Mitigation Funding Sources

Name	Description	Managing Agencies
AmeriCorps	Provides funding for volunteers to serve communities, including disaster prevention.	▪ Corporation for National & Community Service
Assistance to Firefighters Grants	Provides funding for fire prevention and safety activities and firefighting equipment and vehicles.	▪ US Department of Homeland Security
Community Facilities Grant Program	Provides assistance to rural areas and towns to construct, enlarge, or improve essential community facilities and purchase equipment.	▪ US Department of Agriculture, Rural Development
Economic Development Administration (EDA) Grants and Investments	Invests and provides grants for community construction projects, including mitigation activities.	▪ US Economic Development Administration
Federal Excess Personal Property (FEPP) Program	Makes long-term loans of federal firefighting equipment from the US Forest Service.	▪ Montana Department of Natural Resources and Conservation ▪ US Forest Service
Firefighting Property Program	Provides excess US Department of Defense equipment for firefighting purposes.	▪ Montana Department of Natural Resources and Conservation ▪ US Department of Defense
Fireman's Fund Heritage Program	Provides funding for equipment, fire prevention tools, firefighter training, fire safety education, and community emergency response programs.	▪ Fireman's Fund Insurance Company

Table 7.2D Wildfire Mitigation Funding Sources (continued)

Name	Description	Managing Agencies
Forest Land Enhancement Program (FLEP)	Promotes sustainable forest management practices on non-industrial private forest lands suitable for growing trees.	▪ Montana Department of Natural Resources and Conservation ▪ US Forest Service
Hazard Mitigation Grant Program (HMGP)	Provides post-disaster mitigation funding.	▪ Montana Disaster & Emergency Services ▪ FEMA – Region VIII
Hazardous Fuels Mitigation Program	Provides funding for the reduction of hazardous wildland fuels.	▪ US Bureau of Land Management
Individual Assistance (IA)	Following a disaster, funds can be used to mitigate hazards when repairing individual and family homes.	▪ Montana Disaster & Emergency Services ▪ FEMA – Region VIII
National Fire Plan (NFP)	Provides funding for pre-disaster wildfire mitigation.	▪ Montana Department of Natural Resources and Conservation ▪ US Forest Service
PPL Montana Community Fund	Provides grants to Montana organizations in the areas of education, environment, and economic development.	▪ PPL Montana
Pre-Disaster Mitigation Competitive Grants (PDMC)	Provides grants through a competitive process for specific mitigation projects, including planning.	▪ Montana Disaster & Emergency Services ▪ FEMA – Region VIII
Ready Reserve Program	Provides funding for basic and advanced wildland firefighter training.	▪ US Bureau of Land Management
Rural Development Grants	Provides grants and loans for infrastructure and public safety development and enhancement in rural areas.	▪ US Department of Agriculture, Rural Development
Rural Fire Assistance Grant (RFA)	Funds fire mitigation activities in rural communities.	▪ National Interagency Fire Center
SBA Pre-Disaster Mitigation Loan Program	Provides low-interest loans to small businesses for mitigation projects.	▪ US Small Business Administration (SBA)
Volunteer Fire Assistance Grant (VFA)	Provides assistance to organize, train, and equip rural and volunteer fire departments to prevent and suppress fires.	▪ Montana Department of Natural Resources and Conservation ▪ US Forest Service

A critical component of any wildfire protection program is the implementation of projects. Table 7.2E shows the projects with the responsible stakeholders and the implementation timeframe. The timeframes are defined as follows:

- Ongoing: to be implemented as soon as possible and sustained
- Short-term: to be implemented in the next 0-12 months
- Mid-term: to be implemented in the next 1-3 years
- Long-term: to be implemented in the next 3-5 years

Table 7.2E Project Implementation

Project	Responsible Stakeholder(s)	Timeframe
Project 1.2.1: Subdivision Regulations	County Commissioners Fire Departments	Short-term
Project 1.2.3: Land Use Permits	County Commissioners Fire Departments	Short-term
Project 2.3.2: Fire Restrictions and Closures	County Commissioners Fire Departments DNRC BLM	Ongoing
Project 1.2.2: Industrial Growth	County Commissioners Fire Departments	Short-term
Project 1.3.1: Insurance Premiums	Insurance Companies Fire Departments	Mid-term
Project 1.1.1: Subdivision-wide Fuels Mitigation	Fire Departments DNRC BLM	Ongoing
Project 1.1.3: Rural Water Tanks and Dry Hydrants	Fire Departments Homeowners	Mid-term
Project 2.2.1: Comprehensive Training Program	Fire Departments DNRC BLM	Ongoing
Project 2.3.1: Interface Education	Fire Departments Homeowners	Short-term
Project 3.1.1: Type III Incident Management Team	Fire Departments	Short-term
Project 3.3.1: Evacuation Plan	Sheriff's Office Fire Departments DES	Short-term
Project 1.1.2: Public Land Fuels Mitigation	BLM DNRC	Ongoing
Project 2.1.1 County Fire Service Area	Fire Departments County Commissioners	Mid-term
Project 2.4.2: Community Mapping	DES/RAS Fire Departments	Mid-term
Project 3.4.1: Volunteer Retention	Fire Departments	Ongoing

Table 7.2E Project Implementation (continued)

Project	Responsible Stakeholder(s)	Timeframe
Project 2.4.1: Historic Fire Database	Fire Departments DES/RAS	Ongoing
Project 3.2.1: Vehicle and Equipment Needs Analysis	Fire Departments	Long-term
Project 3.2.2: Type 3 Engines	Fire Departments	Long-term

7.3 Projected Fire Department Growth

Community and fire department growth continues to be an ongoing issue in Musselshell County. With a large percentage of privately owned land, particularly privately owned forested land, the potential for development in wildland urban interface areas is very high. Some areas have already been subdivided, as shown in Table 7.3A and others remain as large parcels but could be subdivided in the future.

Table 7.3A Estimated Structures and Undeveloped, Subdivided Parcels by Fire Department

Department	Existing Structures*	Undeveloped, Subdivided Parcels*	Land Area within Musselshell County
Broadview	27 structures	7 parcels	45 square miles
Bull Mountain	522 structures	492 parcels	178 square miles
Dean Creek	118 structures	78 parcels	60 square miles
Hawk Creek	174 structures	121 parcels	336 square miles
Melstone	170 structures	68 parcels	232 square miles
Musselshell	840 structures	656 parcels	1,016 square miles
Roundup	N/A	N/A	1 square mile
TOTAL	1,851 structures	1,422 parcels	1,868 square miles

*Note: this does not include the City of Roundup

As the communities grow, so will the fire departments. Community growth usually results in the following for fire departments:

- Increased call volumes and incidents
- Higher public expectations of the services provided
- Greater need for more volunteers
- Greater need for more and higher grade equipment
- Greater need for more stations
- Greater need for more fire department administrative staff

Currently, each department receives its funding from the county through rural fire protection statutes. An analysis was done by Fire Logistics in 2003 regarding the most appropriate organizational structure for a countywide fire department. According to the analysis, the county may be operating outside the scope of the rural fire protection statutes. The analysis recommends that the County Commissioners consult with the County Attorney regarding the fire protection issues and use the rural fire district organizational structure or a combination of the fire

service area and rural fire protection, if a fire service area has bonding authority. Restructuring the fire protection organizational structure appears to be necessary for the county to reasonably provide structural and wildland fire protection, plus additional all hazard emergency services. Details of the analysis can be found in Appendix D.

8. Plan Maintenance Procedures

An important aspect of any useable plan is the maintenance and upkeep of the document. To facilitate and ensure the plan will remain viable for Musselshell County for many years, the plan maintenance responsibilities lie with the Musselshell County Disaster and Emergency Services Coordinator. An evaluation of the plan will be conducted annually during a Musselshell County Fire Council meeting. As wildfires occur, projects are completed, and hazard information is improved, the Musselshell County Community Wildfire Protection Plan will need to be updated. To facilitate the update process, annual updates are recommended with major revisions occurring every five years. Table 8A shows the schedule of plan updates.

Table 8A Schedule of Plan Updates

Plan Section	Annually	Every 5 Years
Introduction		X
Plan Purpose, Authorities, and Objectives		X
Plan Development Process		X
Land Use		X
Critical Facilities		X
Residences		X
Infrastructure		X
Population		X
Economic, Ecologic, Historic, and Social Values		X
Land Management Regulations and Policies	X	X
Fire Protection Capabilities	X	X
Fire History	X	X
Fire Ecology		X
Climate and Weather		X
Fire Behavior		X
Ignition Risks	X	X
Related Hazards		X
Future Development	X	X
Vulnerable Areas		X
Risk Assessment Summary		X
Goals, Objectives, and Actions	X	X
Implementation	X	X
Projected Fire Department Growth		X
Plan Maintenance Procedures		X
Appendices	X	X

Written comments for consideration during the plan updates may be submitted by the public to Musselshell County Disaster and Emergency Services at:

Musselshell County Disaster and Emergency Services
506 Main
Roundup, MT 59072

Appendices

A. References

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B. Acronyms

AASHO – American Association of State Highway Officials
BLM – Bureau of Land Management
CRP – Conservation Reserve Program
CWPP – Community Wildfire Protection Plan
DEQ – Department of Environmental Quality
DES – Disaster and Emergency Services
DNRC – Department of Natural Resources and Conservation
EDA – Economic Development Administration
ERC – Energy Release Component
FEMA – Federal Emergency Management Agency
FEPP – Federal Excess Personal Property
FLEP – Forest Land Enhancement Program
FMA – Fire Management Assistance
FMU – Fire Management Unit
FSA – Fire Service Area
HMGP – Hazard Mitigation Grant Program
IA – Individual Assistance
ISO – Insurance Services Organization
MCA – Montana Code Annotated
NAD – North American Datum
NFP – National Fire Plan
NFPA – National Fire Protection Association
PDM – Pre-Disaster Mitigation
PDMC – Pre-Disaster Mitigation Competitive
RAS – Rural Addressing System
RFA – Rural Fire Assistance
SBA – Small Business Administration
USDA – United States Department of Agriculture
USFS – United States Forest Service
VFA – Volunteer Fire Assistance
VFD – Volunteer Fire Department

C. Glossary

The glossary contains definitions of terms used in this report and related to wildfire.

AERIAL FUELS:

All live and dead vegetation located in the forest canopy or above surface fuels, including tree branches, twigs and cones, snags, moss, and high brush.

ANCHOR POINT:

An advantageous location, usually a barrier to fire spread from which to start constructing fireline. Used to minimize the chance of being flanked by the fire while the line is being constructed.

ASPECT:

Aspect is the direction toward which a slope faces.

BACKING FIRE:

Used to specify fire set to spread against the wind or down slope. Also called back-burn.

BARRIER:

Any obstruction to the spread of fire. Typically, an area or strip devoid of flammable fuel.

BEHAVE:

A system of interactive computer programs for modeling fuel and fire behavior that consists of two systems: BURN and FUEL.

BLOW-UP:

A sudden increase in fire intensity or rate of spread strong enough to prevent direct control or to upset control plans. Blow-ups are often accompanied by violent convection and may have other characteristics of a fire storm.

BRUSH:

A collective term that refers to stands of vegetation dominated by shrubby, woody plants, or low growing trees, usually of a type undesirable for livestock or timber management.

BURNING CONDITIONS:

Burning Conditions is the state of the combined factors of the environment that affect fire behavior in a specified fuel type.

BURNING OUT:

Setting fire inside a control line to consume fuel between the edge of the fire and the control line.

BURNING PERIOD:

That part of each 24-hour period when fires will spread most rapidly, typically from 10:00 a.m. to sundown.

CANOPY:

The Canopy is the uppermost spreading, branch layer of vegetation.

CHAIN:

A unit of linear measurement equal to 66 feet.

CLOSURE:

Legal restriction of specified activities such as smoking, camping or entry that might cause fires in a given area.

COLD TRAILING:

A method of controlling a partly dead fire edge by carefully inspecting and feeling with the hand to detect any heat, digging out every live spot and lining any live edge.

CONDITION OF VEGETATION:

A stage of growth or degree of flammability of vegetation that forms part of a fuel complex. Herbaceous stage is at times used when referring to herbaceous vegetation alone. In grass areas, minimum qualitative distinctions for stages of annual growth are usually green, curing, and dry or cured.

CONTROL LINE:

An inclusive term for all constructed or natural fire barriers and treated fire edge used to control a fire.

CREEPING FIRE:

Creeping fire is a fire burning with a low flame and spreading slowly.

CROWN FIRES:

Crown Fires or Crowning is the uncontrolled movement of a wildfire spreading through tree crowns or shrubs more or less independently from the surface fire. Sometimes crown fires are classed as either running or dependent, to distinguish the degree of independence from the surface fire.

CURING:

Drying and browning of herbaceous vegetation or slash.

DEAD FUELS:

Dead Fuels are fuels with no living tissue in which moisture content is governed almost entirely by atmospheric moisture (relative humidity and precipitation), dry-bulb temperature, and solar radiation.

DEBRIS BURNING:

A fire set for the purpose of clearing land or for rubbish, garbage, range, stubble, or meadow burning.

DEFENSIBLE SPACE:

An area either natural or manmade where material capable of causing a fire to spread has been treated, cleared, reduced, or changed to act as a barrier between an advancing wildland fire and the loss to life, property, or resources. In practice, "defensible space" is defined as an area a minimum of 30 feet around a structure that is cleared of flammable brush or vegetation.

DETECTION:

The act or system of discovering and locating fires.

DIRECT ATTACK:

Any treatment of burning fuel, e.g., by wetting, smothering or chemically quenching the fire or by physically separating the burning from unburned fuel.

DRY LIGHTNING STORM:

A lightning storm with negligible precipitation reaching the ground.

DUFF:

The partly decomposed organic material lying below the litter layer of freshly fallen twigs, needles, and leaves and immediately above the mineral soil.

ENERGY RELEASE COMPONENT (ERC):

The computed total heat released per unit area (British thermal units per square foot) within the fire front at the head of a moving fire.

ESCAPED FIRE:

A fire which has exceeded initial attack capabilities.

EXTREME FIRE BEHAVIOR:

"Extreme" implies a level of fire behavior characteristics that ordinarily precludes methods of direct control action. One or more of the following is usually involved: high rate of spread, prolific crowning and/or spotting, presence of fire whirls, and/or a strong convection column. Predictability is difficult because such fires often exercise some degree of influence on their environment and behave erratically, sometimes dangerously.

FINE FUELS:

Fine Fuels are fast-drying dead or cured fuels, generally characterized by a comparatively high surface area-to-volume ratio, which are less than ¼ inch in diameter and have a time lag of one hour or less. These fuels (grass, leaves, needles, etc.) ignite readily and are consumed rapidly by fire when dry.

FIRE BEHAVIOR:

Fire Behavior is the manner in which a fire reacts to the influences of fuel, weather and topography

FIRE BEHAVIOR ANALYST:

The Fire Behavior Analyst is responsible to the Planning Section Chief for establishing a weather data collection system and for developing fire behavior predictions based on fire history, fuel, weather and topography.

FIREBREAK:

A natural or constructed barrier utilized to stop or check fires that may occur or to provide a control line from which to work. Sometimes called a fire line.

FIRE CONTROL:

All activities to protect wildland from fire.

FIRE DANGER:

Resultant of both constant and variable fire danger factors, which affect ignition, spread and difficulty of control of fires and the damage they cause.

FIRE EFFECTS:

The physical, biological and ecological impact of a fire on the environment.

FIRE GROUP:

A vegetation classification system combining fire frequency information, fire ecology, and habitat types. There are 11 fire groups.

FIRE INTENSITY:

Fire Intensity is a general term used to measure the fire in BTU's or flame length to determine control difficulty and the heat energy released by a fire.

FIRELINE:

The part of a control line that is scraped or dug to mineral soil.

FIRE PERIMETER:

The fire Perimeter is the entire outer edge or boundary of a fire.

FIRE SEASON:

1) Period(s) of the year during which wildland fires are likely to occur, spread, and affect resource values sufficient to warrant organized fire management activities.

2) A legally enacted time during which burning activities are regulated by State or Local authority.

FIRE SUPPRESSION:

Fire Suppression is to stop or slow fire spread in order to contain and extinguish all fire.

FIRE WEATHER:

Fire Weather is weather conditions that influence fire ignition, behavior and suppression.

FLAME HEIGHT:

Flame Height is the average maximum vertical extension of flames at the leading edge of the fire front. Occasional flashes that rise above the general level of flames are not considered. This distance is less than the flame length if flames are tilted due to wind or slope.

FLAME LENGTH:

Flame Length is the distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface); an indicator of fire intensity.

FLASH FUELS:

Fuels such as grass, leaves, draped pine needles, fern, tree moss and some kinds of slash that ignite readily and are consumed rapidly when dry. Flash fuels can also be called fine fuels.

FORB:

A Forb is a plant with soft, rather than permanent woody stem, that is not a grass or grass-like plant.

FOREST FUELS:

Forest Fuels are vegetative material, living and dead, found in the wildland environment that contributes to the overall fire hazard.

FUEL:

Fuel is any combustible material which includes vegetation, such as grass, leaves, ground litter, plants, shrubs, and trees that feed a fire.

FUEL BED:

A Fuel Bed is an array of fuels usually constructed with specific loading, depth and particle size to meet experimental requirements; also commonly used to describe the fuel composition in natural settings.

FUELBREAK:

An area, strategically located for fighting anticipated fires, where the native vegetation has been modified or replaced so that fires burning into it can be more easily controlled.

FUEL LOADING:

Fuel loading is the amount of fuel present and expressed quantitatively in terms of weight of fuel per unit area.

FUEL MODEL:

Fuel Model is a simulated fuel complex (or combination of vegetation types) for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified.

FUEL MODIFICATION:

A method, or methods, of modifying a fuel load by reducing the amount of flammable vegetation or altering the type of vegetation to reduce the fuel load.

FUEL MOISTURE CONTENT:

The Fuel Moisture Content is the quantity of moisture in fuel expressed as a percentage of the weight when thoroughly dried at 212 degrees Fahrenheit.

FUEL REDUCTION:

Fuel Reduction is the manipulation, including combustion, or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control.

FUEL TYPE:

Fuel Type is an identifiable association of fuel elements of a distinctive species, form, size, arrangement, or other characteristics that will cause a predictable rate of fire spread or difficulty of control under specified weather conditions.

GREEN BELT:

The Green Belt is an area adjacent to a suburban home cleared of all dead and dying vegetative material and replaced with living, green vegetation which is essentially non-flammable.

GROUND FIRE:

Ground fire is fire that consumes the organic material beneath the surface litter of the forest floor, e.g., a peat fire.

GROUND FUEL:

Ground Fuel is all combustible materials below the surface litter, including duff, tree or shrub roots, punky wood, peat, and sawdust that normally support a glowing combustion without flame.

HAZARD REDUCTION:

A Hazard Reduction is any treatment of a hazard that reduces the threat of ignition and fire intensity or rate of spread.

HEAD FIRE:

A fire spreading or set to spread with the wind or up slope.

HEAVY FUELS:

Fuels of large diameter such as snags, logs, large limb wood that ignite and are consumed more slowly than flash fuels.

HOTSPOT:

A particularly active part of the fire.

INCIDENT COMMAND POST:

The location from which all fire operations are directed.

INDIRECT ATTACK:

A method of suppression in which the control line is located along natural firebreaks, favorable breaks in topography or at a considerable distance from the fire and the intervening fuel is burned out.

INITIAL ATTACK:

Initial Attack is the actions taken by the first resources to arrive at a wildfire to protect lives and property, and to prevent further extension of the fire.

LADDER FUELS:

Ladder Fuels are forest vegetation situated at different heights and close enough together to allow a surface fire to become a potential crown fire.

LITTER:

The Litter is the top layer of the forest, scrubland, or grassland floor, directly above the fermentation layer. It is composed of loose debris of dead sticks, branches, twigs, and recently fallen leaves or needles and little is altered in structure by decomposition.

LIVE FUELS:

These fuels consist of living plants, such as trees, grasses, and shrubs, in which the seasonal moisture content cycle is controlled largely by internal physiological mechanisms, rather than by external weather influences.

MOPUP:

The act of making a fire safe after it is controlled, such as extinguishing or removing burning material along or near the control line, felling snags and trenching logs to prevent rolling.

NATURAL BARRIER:

A Natural Barrier is a naturally occurring obstruction to the spread of a fire.

OROGRAPHIC

Where the flow of air is forced up and over barriers such as mountains.

PRESCRIBED FIRE:

Controlled application of fire to wildland fuels in either their natural or modified state, under specified environmental conditions which allow the fire to be confined to a predetermined area and at the same time to produce the intensity of heat and rate of spread required to attain planned resource management objectives.

PREVENTION:

Activities directed at reducing the number of fires that start, including public education, law enforcement, personal contact and reduction of fuel hazards.

PROBABILITY OF IGNITION

Indicates the probability of a firebrand producing a fire that will require suppression action. The higher the ignition component, the greater the chance that a fire will start. High temperature and low humidity are the major contributors to a high ignition component.

RATE OF SPREAD:

The Rate of Spread is the relative activity of a fire in extending its horizontal dimensions. It is expressed as a rate of increase of the total perimeter of the fire. As the rate of forward spread of the fire front, or as rate of increase in area, depending on the intended use of the information. Usually it is expressed in chains or acres per hour for a specific period in the fire's history.

RELATIVE HUMIDITY:

Relative Humidity is the ratio of the amount of moisture in the air, to the maximum amount of moisture that air would contain if it were saturated. It is the ratio of the actual vapor pressure to the saturated vapor pressure.

RESISTANCE TO CONTROL:

The relative difficulty of constructing and holding a control line as affected by resistance to line construction and by fire behavior.

RETARDANT:

An approved chemical liquid or foam that retards the combustion process when applied to fuel.

RISK:

The chance of a fire starting as determined by the pressure and activity of causative agents.

SLASH:

Slash is the debris left after logging, pruning, thinning or brush cutting: This includes logs, chips, bark, branches, stumps and broken understory trees or brush.

SPOT FIRE:

A Spot Fire is a fire ignited outside the perimeter of the main fire by flying sparks or embers.

SPOTTING:

Spotting is the behavior of a fire producing sparks or embers that are carried by the wind and start new fires beyond the zone of direct ignition by the main fire.

STRUCTURE FIRE:

A structure fire is a fire originating in and burning any part or all of any building, shelter, or other structures.

SUBSIDENCE

A sinking or downward motion of air over a broad area. This results in the warming and drying of air by compression. It is often used to imply the opposite of atmospheric convection.

SUPPRESSION:

All the work of extinguishing or confining a fire beginning with its discovery.

SURFACE FIRE:

A Surface Fire is a fire that burns surface litter, other loose debris of the forest floor, and small vegetation.

SURFACE FUELS:

Surface Fuels are loose surface litter on the soil surface, normally consisting of fallen leaves or needles, twigs, bark, cones, and small branches that have not yet decayed enough to lose their identity. This also includes grasses, forbs, low and medium shrubs, tree seedlings, heavier branch wood, downed logs, and stumps interspersed with or partially replacing the litter.

THINNING:

Thinning is a selective cutting of trees to improve the remaining forest stand, by removing trees of poor vigor or by reducing tree density.

TORCHING:

Torching is the ignition and flare-up of a tree or small group of trees, usually from bottom to top.

UNCONTROLLED FIRE:

An uncontrolled fire is any fire with an uncontained perimeter which threatens to destroy life, property, or natural resources.

UNDERBURN:

An underburn is a fire that consumes surface fuels but not the crowns of the overstory.

VALUES-AT-RISK:

Values-At-Risk is the physical and non-physical elements of the environment that may be adversely affected by fire.

WILDLAND FIRE:

A Wildland Fire is any non-structure fire, other than prescribed fire, that occurs in the wildland.

WILDLAND URBAN INTERFACE:

Wildland Urban Interface is the line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.

D. Organizational Structure Legal Analysis

2.1 INTRODUCTION

2.1.1 Fire Logistics, Inc. has been retained by Musselshell County to provide an analysis of the various approaches to organizing fire protection for the residents of the county. Fire Logistics, Inc. researched the available options, determined the county's objectives, evaluated the pros and cons of each approach, and recommended a selected approach to the county.

2.2 AVAILABLE OPTIONS

2.2.1 There are 4 options available for the county to follow to organize fire protection in the county:

(1) Rural Fire Districts
(2) Rural Fire Protection
(3) Fire Service Areas
(4) Multi-jurisdictional Service Districts

2.3 COUNTY OBJECTIVES

2.3.1 Musselshell County's objectives to organize their fire protection in the county are:

(1) Determine the best organizational structure for the Musselshell Fire Protection Agency.

(2) Determine the existing capability and service provided by the existing fire service providers.

(3) Provide a vision of the future fire protection system in Musselshell County.

(4) Develop a plan to implement the recommended fire protection system.

2.4 PROS & CONS

2.4.1 The advantages and disadvantages to each method of providing fire protection to the citizens of Musselshell County are detailed below:

2.4.2 Rural Fire Districts

Pros

- Equitability between taxpayers
- Tax levied on improvements & land
- Trustees govern FD affairs
- Trustees establish budget
- Can issue bonds
- Can have a capital improvement fund

Cons

- Most difficult to form
- Tax levied on improvements & land
- 51% freeholders & 51% land mass

2.4.3 Rural Fire Protection

Pros
- Administered by BOCC
- Tax levy on all property
- Focus is wildland fire protection

Cons
- Statutes confusing
- Administered by BOCC

2.4.4 Fire Service Area

Pros
- Easiest to form
- Charter establishes services
- Fee on structures
- Fee can be adjusted yearly
- Trustees establish budget
- Pledge income to secure debt

Cons
- Not equitable to all fee payers
- Renters can't vote
- Structure fire - no wildland
- Wildland fire service needs to be solved
- BOCC sets fees, not Board of Trustees
- BOCC can change charter

2.4.5 Multi-jurisdictional Service District

Pros
- Established by inter-local agreement
- Can provide multiple services
- Restriction on tax levied on agricultural property

Cons
- 15% of resident property owners
- Administered through inter-local agreement

2.5 ANALYSIS

2.5.1 Of the four available methodologies to provide fire protection to Musselshell County, the multi-jurisdictional service district approach (MCA 7-11-11) can most easily be discarded because it is likely not appropriate for use in Musselshell County unless the Board of County Commissioners want to create a jurisdiction that extends into other counties. Even if that was the County's desire, consolidating rural fire districts is also an option for a jurisdiction that crosses county lines.

2.5.2 The remaining three options, which are viable options for providing fire protection to the County, are:

(1) Rural Fire Districts
(2) Rural Fire Protection, and
(3) Fire Service Areas

2.5.2.1 Rural Fire District

2.5.2.1.1 A Rural Fire District (RFD) (MCA 7-33-21) is the most difficult method of fire protection service delivery to form. A petition to create the RFD must be signed by 51% of the freeholders who own 51% of the land to be incorporated in the RFD boundary.

2.5.2.1.2 While difficult to form, the RFD is probably the most equitable form of fire protection, i.e., the owner of a property pays the same levy of taxes on his or her property. So the owner of a significantly more valuable home pays a commensurate amount of taxes for the fire protection provided to the home.

2.5.2.1.3 The RFD is managed by a Board of Trustees, who establish the budget, levels of service, and request that the Board of County Commissioners establish a mil levy to support the budget of the RFD within the constraints of the statutes.

2.5.2.1.4 A RFD has bonding authority for buying and maintaining fire protection facilities, including real property, and apparatus including emergency response apparatus for the district.

2.5.2.1.5 RFD's were impacted by HB 124 (The Big Bill) in that some revenues, such as motor vehicle taxes, state reimbursements, etc., were affected. A RFD needs to ensure that the county distributes its share of those funds.

2.5.2.1.6 A RFD can provide all risk emergency services, i.e., emergency medical services, hazardous materials response, wildland fire, structural fire, confined space rescue service, etc.

2.5.2.2 Rural Fire Protection

2.5.2.2.1 Musselshell County is already providing fire protection services under the Rural Fire Protection statutes. (MCA 7-33-22) However, the purpose of these statutes is the protection of conservation of range, farm, and forest resources and prevention of soil erosion.

2.5.2.2.2 Provision of all risk emergency services under these statutes may not be allowed and the county may be operating outside the scope of the statute. The County Attorney should be consulted as to the legality of providing all risk emergency services under these statutes.

2.5.2.2.3 These statutes are very confusing! One needs to refer to the fire protection statutes prior to the re-codification to get a true understanding of the intent of the rural fire protection statutes (See 11-2001 - 2031 R.C.M.).

2.5.2.2.4 Fire protection if provided under these statutes is administered by the Board of County Commissioners through the County Fire Warden. There is no provision to appoint or elect a Board of Trustees.

2.5.2.2.5 Funding for rural fire protection is provided by a levy on the property in the county for the purpose of funding fire protection.

2.5.2.3 Fire Service Area

2.5.2.3.1 The Fire Service Area (FSA) (MCA 7-33-24) is the easiest form of fire protection to create. It simply requires a petition of 30 signatures of owners of real property in the proposed service area. Based on the testimony during the public hearing, the Board of County Commissioners may establish different boundaries, establish a different fee schedule, change the

kinds, types, or level of service, or change the manner in which the FSA will provide services to its residents.

2.5.2.3.2 It is entirely possible that after a FSA is formed, a group of 30 owners can petition the Board of County Commissioners to change the kinds, types and levels of service provided by the FSA and it could occur in spite of the desires of the elected Board of Trustees.

2.5.2.3.3 A FSA is funded by a fee upon structures within the boundaries of the FSA. Most FSA's in the state today range from flat fees per structure to fees per use of the structure. If the FSA approach is taken, significant care should be taken to establish a realistic fee structure based on the needs of the FSA.

2.5.2.3.4 A FSA's funding structure creates an inequity between service demands and amount paid for service. If this same fee per resident structure is used the owner of a 12,000 square foot trophy home pays the same rate as the first time home buyer that has a 1,200 square foot home. The revenue to fund a FSA is based on the fee per structure, so it is interpreted that a FSA is a structural fire department only. Provision of wildland fire services are typically provided through the rural fire protection statutes. A confusing approach!

2.5.2.3.5 A FSA can pledge its income to secure a debt, however, it doesn't appear that a FSA has bonding authority. The County Attorney should be consulted as to his or her opinion whether the bonding authority from the rural fire district statutes can be applied to a FSA.

2.6 RECOMMENDATIONS

2.6.1 Based on our analysis we would recommend that the Board of County Commissioners:

(1) Consult with the County Attorney about the issues raised in this report.

(2) Use the rural fire district as the selected methodology for providing fire and emergency services to the county, if bonding authority is only available to a rural fire district.

(3) Use a combination of the fire service area and the rural fire protection to provide both structural and wildland fire protection to the residents of Musselshell County.

E. Meeting Attendance Records

F. Plan Adoption Documentation

G. Activities Completed