CITY OF BOZEMAN

FOREST MANAGEMENT PLAN

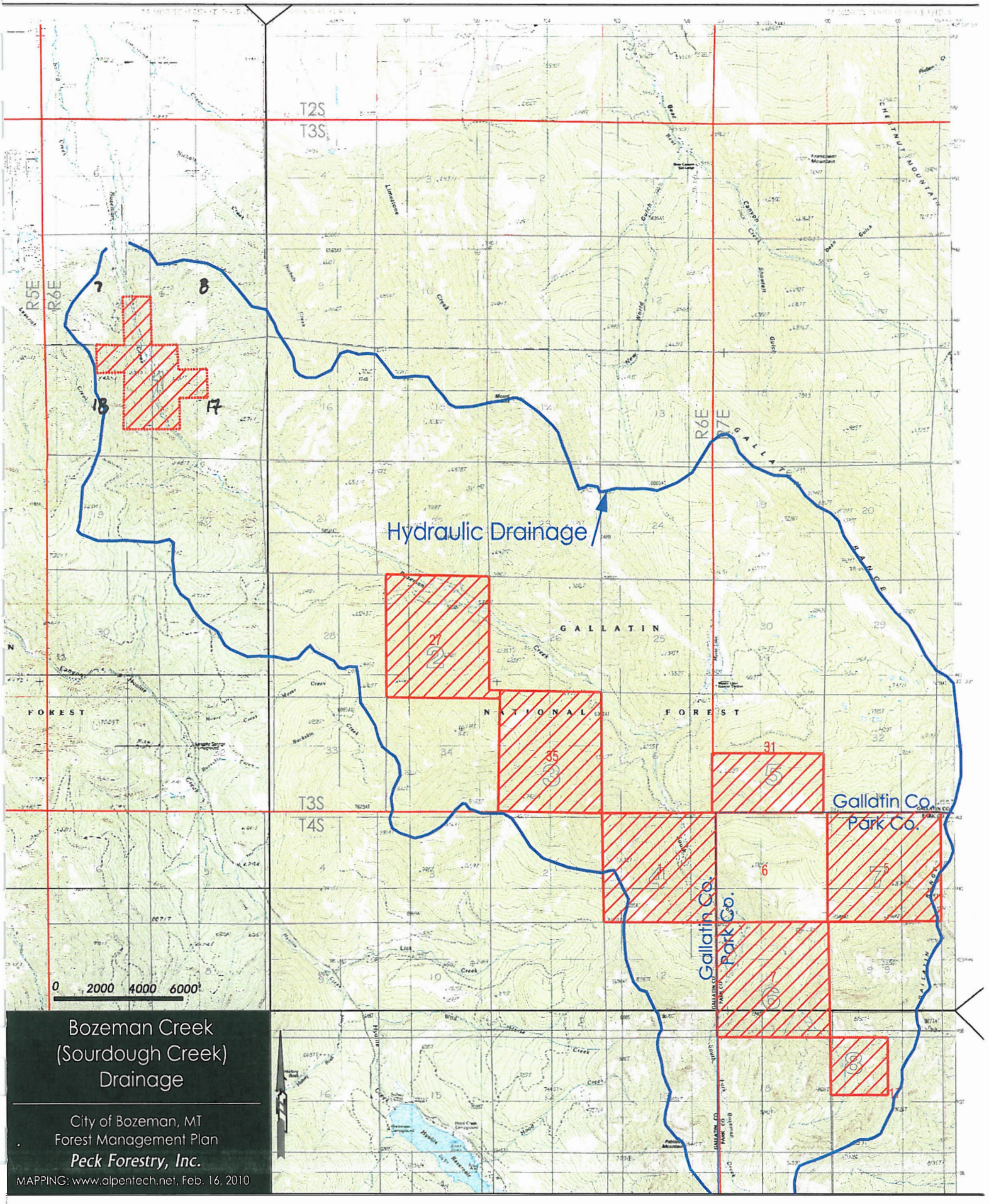
GALLATIN AND PARK COUNTIES, MONTANA

February 17, 2010

Prepared by:

Peck Forestry, Inc.
P.O. Box 238
Bozeman, MT. 59771
(406) 587-3790

TABLE OF CONTENTS



Bozeman Creek (Sourdough Creek) Drainage

City of Bozeman, MT
Forest Management Plan
Peck Forestry, Inc.
MAPPING: www.alpentech.net, Feb. 16, 2010

INTRODUCTION

The purpose of this Forest Management Plan (FMP) is to identify the timber resources of the City of Bozeman=s property within the Sourdough Creek drainage and to make recommendations based on the landowner=s goals.

The primary goal is to reduce the risk of a large catastrophic wildfire that would deposit large volumes of sediment in Sourdough Creek. Other goals within and outside this plan would include improving the forest health, soil and water conservation, wildlife habitat improvements and recreation.

Sourdough Creek is a source of water to the city of Bozeman, Montana. The City=s ownership contains large areas of overmature timber. The objective is to thin the timberlands not to eliminate fire completely, but to allow a fire, whether started intentionally or naturally to burn without the risk of an abundant amount of sediment clogging the filtering capacity of the City=s water treatment facility.

Timber prices have substantially declined in the last few years. Harvesting timber in a way to improve forest health, breakup the continuous crown cover and reduce the risk of a catastrophic fire by conventional equipment or helicopter was profitable in the past and it is not in today=s market.

LOCATION

The City of Bozeman=s property is located within the Sourdough Creek drainage approximately 8 miles south of Bozeman, Montana and is legally described below:

Gallatin County, Montana:

Township 3 South, Range 6 East, P.M.M.

Section 7:	E1/2SE1/4
Section 17:	W1/2NW1/4, SE1/4NW1/4, NW1/4SW1/4
Section 18:	N1/2NE1/4, SE1/4NE1/4, NE1/4SE1/4
Section 27:	All
Section 35:	All

Township 4 South, Range 6 East, P.M.M.

Section 1:	All

Township 3 South, Range 7 East, P.M.M.

Section 31:	S1/2

Park County, Montana

Township 4 South, Range 7 East, P.M.M.

Section 5:	All
Section 7:	All
Section 17:	NW1/4

HISTORY

The Sourdough Creek drainage has been used as a watershed for supplying the city of Bozeman a water source from early 1900's. A road was constructed up the drainage to help facilitate the improvements to the dam of Mystic Lake in the late 1950's. The road was also used as a main haul road of forest products from the logging that has occurred in the drainage. The Bozeman Watershed Council described in detail, the history of the drainage in it=s 2004 Watershed Assessment and is a good reference.

An emphasis is made in regard to an event in the spring of 1988. A powerful storm came through this drainage and surrounding areas that had wide scale impacts. The storm fell as dry snow on the upper elevations, wet snow at the mid elevation and as rain on the lower end. There were high winds after the storm that blew a large number of trees over in the wet snow zones. This blowdown contributed a large amount of fuel to the understory and significantly effects the management of these stands today.

CURRENT USES

Current uses include recreation activities such as hiking, biking, skiing, snowshoeing, hunting, fishing and general sight seeing. The drainage is an important supply of water to the city of Bozeman. There have been limited timber harvesting activities in the last ten years.

RESOURCE ASSESSMENT

General Conditions

The City of Bozeman owns approximately 4000 acres scattered throughout ten sections. The property is checkerboard within the larger USDA Forest Service ownership. There are approximately 10 miles separating the lowest section in the northern part of the drainage to the upper section in the southern end. Elevations range from 5300 to 8800. In recent years the forest stands have suffered from two forest pests.

The mountain pine beetle (Dendroctonus ponderosae) attacks and kills lodgepole and whitebark pine trees. The bark beetles have the capability of causing widespread mortality to the pine trees in the drainage. Most of the activity the last few years has been on the lower end and this year has seen a lot more activity on the upper end. The mountain pine beetle is not new to the drainage.

The last infestation occurred in the late 1970's to early 1980's. The majority of these trees killed have blown over and have contributed to the fuel loading that exist today.

The spruce budworm (Choristoneura occidentalis) defoliates Douglas fir, englemann spruce and subalpine fir trees. The defoliation does not kill the tree in the first year, but with repeated years of defoliation the trees will start to die. This is the second major year the spruce budworm has been in the drainage. The drier southern site seems to be hit the hardest with some tops of the trees being killed, especially the younger, understory trees. Trees that do get weaken from repeated defoliation by the budworm tend to be highly susceptible to attack from the Douglas fir beetle, which will kill the tree. At this time very little signs of the Douglas Fir beetle have been observed.

Timber

The two dominant trees species within the drainage are Douglas Fir (Pseudotsuga menziesii) and lodgepole pine(Pinus contorta). There are smaller amounts of englemann spruce (Picea engelmannii), subalpine fir (Abies lasiocarpa), whitebark pine (Pinus albicaulis) and limber pine(Pinus flexilis). The whitebark and the limber pine are the only non commercial species. The lodgepole pine stands are on the wetter, cooler slopes and the Douglas fir are located on the drier, warmer slopes.

The drainage receives a considerable amount of rainfall and as a result the trees grow very well. Ages of the trees exceed 100 years old and the majority are in the 150 year old range. In general, the forest stands are well stocked with the average basal area in the range of 200 square feet/ acre. Board foot volumes per acre are high with the majority of the stands exceeding 12 Thousand Board Feet (MBF) acre and some as high as 20 MBF/acre. Approximately 30% of the gross timber volume is dead and close to half of this dead timber is on the ground and unmerchantable from a sawlog or houselog stand point. Subalpine fir/ Huckleberry is the dominant habitat type.

Roads

The main road in the drainage was built in 1958 to assist in the reconstruction of the Mystic Lake dam. The road continued up the South Fork to access lands that were logged in the 1970's. There is also a road that connects to the Hyalite drainage. All of these roads are in relatively good shape and very little work is required for them to be used as haul roads for logging trucks. This plan proposes very little new road construction. Primary reason is that the ground with timber on it is very steep and it would take a considerable amount of road construction to access the timber. There are areas with soils that are very unstable limiting the ability to construct roads.

Improvements can be made to the existing roads, especially the main road up the drainage, to comply with the current Montana=s Best Management Practices (BMP) for logging roads. The major violations are the long sustain road grades and inside road ditches that drain directly into perennial or intermediate watercourses. The long grades erode the road surface and transport sediment to where the grade changes which are typically at a culvert location and a stream course. At this point the sediment has a high probability of entering the stream and being transported to the

main Sourdough Creek. Driveable dips in the road can be constructed at regular intervals to divert the water off the road and into the forest floor where the sediment would be trapped and filtered out.

Road ditches that drain directly into a stream course in another source of contaminants that can enter Sourdough Creek. These ditches should drain out into the forest floor. Two ways of accomplishing this to install a skewed culvert in the road above the stream course that would carry the water out of the ditch, under the road and have it drain into the forest floor high enough that it wouldn=t reach the stream. The other method is to construct a driveable dip into the road that would drain the water off the road and out of the ditch into the forest floor.

These improvements would become more valuable in the aftermath of a fire where a higher probability of ash and sediment would be transported. The ultimate goal is to prevent any contaminants from entering Sourdough Creek.

Logging Environment

Currently, the lands the City of Bozeman own has a poor environment for logging. Primary reasons are the steep slopes and current market conditions. A high percentage of the slopes exceed 45% which is the upper limits to log with conventional tracked or rubber tire equipment. Line or cable logging can be performed on very steep slopes and it is more expensive. Additional roads need to be constructed to access the timber. The combination of steep sideslopes and occasional unstable ground makes these roads expensive and could potentially create more problems from erosion than the benefits that are trying to be achieved. With line logging, roads are constructed to the top of the cutting units and the forest products are cabled up to the road. Concave slopes are preferred to eliminate the logs from excessively dragging on the ground. There are some visual concerns with line logging, mainly with the road cuts and the lineal lines created vertically across the slope from the cutting. Helicopter logging is the third option and current market conditions of log prices will not pay for the cost of helicopter logging and hauling of the forest products to the destination. Helicopter logging impacts the forest the least among the three harvest systems.

Delivered log prices have dramatically declined in the last few years and it is hard to predict what the future will be. In the summer of 2006, R-Y Timber in Livingston, MT was paying $475 per Thousand Board Feet (MBF) for sawlogs. It dropped to $450/MBF in 2007, $400/MBF in 2008 and currently they are paying $250/MBF. The two major costs in this situation are the log and haul expense. The combinations of helicopter logging and hauling cost out of Sourdough Creek are approximately $375/MBF. In today=s market, any harvesting of forest products by the use of a helicopter would be an expense.

Helicopter logging can be a low impact way of harvesting trees and reducing the fuels in the forest stands. Besides market conditions, silvicultural prescription, log quality and slash treatment requirements influence its cost effectiveness. Fuel spills is a concern and a safety plan would have to be put in place. At minimum refueling should be kept at least 100' from any stream.

Economics

Timber markets drives the economics for trees harvested on a piece of land. The markets are log specific. Different markets require different size and quality logs. For maximum profits, sorting of the logs for species, size and quality is usually necessary, sending the greater amount of logs to the higher paying markets. At this point in time, house logs are the highest paying, requiring the bigger and straighter logs and predominantly from dead trees. Sawlogs are the next higher paying. Firewood, post/poles and pulp are all about the same price. In general, the timber within the Sourdough drainage is of high quality. The trees are tall, have good form and a high percentage of the diameters are of at least sawlog size.

Factors affecting the cost side of the equation are tree size, density, species, log defect, slope, soils and skidding distance. Log weight can also be a factor when log products are bought and sold on a weight basis. Distances to the mills also have an effect on transportation costs.

Today=s markets in both demand for forest products and the price the destinations are paying are very poor. Any helicopter logging will be a deficient timber sale in the amount of roughly $125 to $175/MBF. On the average, approximately 5 MBF per acre is recommended in this plan to be harvested by helicopter bringing the cost to $625 to $875 per acre. This amount of harvest would breakup the canopy and thin the stocking levels enough to reduce the risk of a continuous crown fire. The total area recommended for helicopter harvest is 1271 acres.

Currently the ground-based logging is a break-even situation. The costs of removing and hauling the sawlogs to a destination point equals the revenue received. There are approximately 250 acres recommended for this type of harvesting. The majority of the ground that could have been logged with conventional ground-based equipment has been previously logged and has regenerated very well.

The following spreadsheet lists by section and summarizes recommended harvest acres and timber volumes by cat and helicopter logging, associated costs including roads, revenue and net dollar amount. The top part of the spreadsheet list current market conditions and as a comparison, the bottom part list values as they were in 2008. Costs are estimates and are based on other similar timber sales. Costs are higher in 2008 because of the higher fuel costs compared to 2009. Some miscellaneous costs associated with harvesting timber include sale preparation, administration, grass seeding and slash treatment.

Methods used in these calculations conform within general Forestry practices used in the State of Montana. All calculations and statements in this report are estimates and there are no guarantees implied for timber volumes or dollar amounts.

CITY OF BOZEMAN - SOURDOUGH CREEK OWNERSHIP

FOREST MANAGEMENT PLAN - COST/REVENUE SPREADSHEET

2009 VALUES

	LOCATION	HARVEST ACRE CAT	HARVEST ACRE HELI	HARVEST VOLUME CAT	HARVEST VOLUME HELI	LOG/HAUL COST CAT	LOG/HAUL COST HELI	ROAD COSTS New	ROAD COSTS Reconstr	REVENUE	NET
1	7-T3S-R6E	0	50	0	277	$0	$102,405	$0	$0	$69,250	($33,155)
1	17-T3S-R6E	26	124	123	514	$25,809	$190,099	$1,705	$0	$159,250	($58,363)
1	18-T3S-R6E	0	150	0	818	$0	$302,260	$0	$0	$204,400	($97,860)
2	27-T3S-R6E	49	209	268	1080	$56,323	$399,208	$0	$0	$336,950	($118,581)
3	35-T3S-R6E	47	337	263	1495	$55,322	$552,615	$0	$3,977	$439,500	($172,414)
4	1-T4S-R6E	0	0	0	0	$0	$0	$0	$0	$0	$0
5	31-T3S-R7E	60	58	288	377	$60,485	$139,389	$0	$0	$166,200	($33,674)
7	5-T4S-R7E	23	175	63	881	$13,150	$325,861	$0	$6,000	$236,000	($109,011)
6	7-T4S-R7E	45	167	231	1091	$48,638	$403,260	$0	$7,800	$330,550	($129,148)
8	17-T4S-R7E	0	0	0	0	$0	$0	$0	$0	$0	$0
		249	1271	1236	6533	$259,727	$2,415,097	$1,705	$17,777	$1,942,100	($752,206)

Volumes are in Thousand Board Feet (MBF)

Logging: Cat: $149/MBF Heli: $308/MBF

Haul: $62 /MBF To R-Y Timber Sawmill in Livingston, MT.

Revenue: $250 /MBF delivered to R-Y Timber

2008 VALUES

LOCATION	HARVEST ACRE CAT	HARVEST ACRE HELI	HARVEST VOLUME CAT	HARVEST VOLUME HELI	LOG/HAUL COST CAT	LOG/HAUL COST HELI	ROAD COSTS New	ROAD COSTS Reconstr	REVENUE	NET
7-T3S-R6E	0	50	0	277	$0	$108,922	$0	$0	$110,800	$1,878
17-T3S-R6E	26	124	123	514	$28,698	$202,198	$1,960	$0	$252,840	$19,984
18-T3S-R6E	0	150	0	818	$0	$321,496	$0	$0	$327,040	$5,544
27-T3S-R6E	49	209	268	1080	$62,628	$424,614	$0	$0	$539,120	$51,878
35-T3S-R6E	47	337	263	1495	$61,515	$587,785	$0	$4,574	$698,626	$44,752
1-T4S-R6E	0	0	0	0	$0	$0	$0	$0	$0	$0
31-T3S-R7E	60	58	288	377	$67,255	$148,260	$0	$0	$265,920	$50,405
5-T4S-R7E	23	175	63	881	$14,622	$346,600	$0	$6,900	$370,700	$2,578
7-T4S-R7E	45	167	231	1091	$54,083	$428,924	$0	$8,970	$519,910	$27,933
17-T4S-R7E	0	0	0	0	$0	$0	$0	$0	$0	$0
	249	1271	1236	6533	$288,801	$2,568,799	$1,960	$20,444	$3,084,956	$204,952

Volumes are in Thousand Board Feet (MBF)

Logging: Cat: $160/MBF Heli: $319/MBF

Haul: $74 /MBF To R-Y Timber Sawmill in Livingston, MT.

Revenue: $400 /MBF delivered to R-Y Timber

Future Objectives

Future Objectives within this section will be to manage for forest stands that are moderately open and park like. These open stands will less likely be able to sustain a crown fire. Light ground fires whether prescribed or natural should be encouraged to keep fuels at manageable levels.

Species diversification should be maintained. Natural succession will eventually replace the pine to a more climax species. Creating openings will encourage both pine and fir regeneration. Maintaining the pine component is valuable in regard to the heath of the forest from the stand point of insect and disease resistance and as a viable seed source in the event of a fire.

MANAGEMENT RECOMMENDATIONS

Management recommendations in this report on based on the individual sections that the City of Bozeman owns within the Sourdough Creek drainage. Data collected from an inventory produced the necessary information. The inventory measured or evaluated timber volumes, operability, visual aesthetics, fuel reduction possibilities and down fuel loading. This data generated information to define silvicultural prescriptions, logging methods, potential road locations, cutting units, slash disposal and erosion control applications.

The common goal throughout will be to attempt to reduce the risk of a large catastrophic wildfire that could create a great source of sediment and ash to be carried into Sourdough Creek. The risk is considerably high and suppression efforts are limited due to the continuous canopy cover. The recommendations are to break up the forest canopy while ensuring the water quality is not jeopardized by the work itself. The USDA Forest Services owns the majority of the lands in the drainage and tend to have limited opportunities to manage their timber. Both parties really need to be working toward this common goal in order for it to succeed.

The City of Bozeman and the Forest Service have a good opportunity to work together. Specific treatments should not stop at property lines, but approached on a landscape basis. Coordination could be made with location of activities to improve its effectiveness as well as sharing contractors and equipment. Any new road construction should be located to serve both parties. Landings for helicopter logging could be shared to reduce flight distances and ultimately costs. Treatment options could be discussed between parties in developing ways to achieve common goals. Treatments can vary depending on the site and flexibility should be emphasized between and within both parties to maintain some diversity throughout the drainage.

With any activity, Montana=s Forestry Best Management Practices (BMP) will be adhered to. The ultimate objective is to manage the forests with the least amount of impact and attempting to emulate the natural environment as best as possible. Recreation is a vital component of the drainage and measures should be taken to reduce the conflicts. This could be accomplished first through education. The more the public knows about what is planned and why, the less the conflicts and confusion. Proper signs could be placed at trailheads and access roads notifying specific activities. Contractors could be limited to certain hours of operation, especially

eliminating weekend travel.

All conventional logging with a track or rubber tire equipment would be tree length logged. The trees would be cut and the whole tree would be skidded to a road where it can be limbed, topped and decked for hauling. The slash would be piled there for burning at an appropriate time. There may be areas where there in not enough room at the road to process the trees. The trees would then whole length skidded to an area, processed and then reskidded to the road for hauling. The slash would be piled in open areas away from green trees and burnt at a later time.

It would be preferable to tree length log all helicopter areas. This a little more expensive, but it reduces the amount of slash in the woods and as a result minimizes the fire danger. The whole tree would be flown out and processed at the landing where the logs can be hauled and the slash could be burnt. In some of the areas that have a high concentration of slash from the 1988 storm, the trees could be fallen into the slash, limbed and topped, and then flown to a landing. These areas would be burnt either in the spring or fall when the conditions permit. This would reduce the cost of helicopter logging, eliminate the slash of the cut trees and better consume the slash from the old 1988 storm.

Implementation of the plan would consists of coordinating with the Forest Service to see if it would be feasible to combine efforts and treatments. A proposal would be created with various options. A selection would be made and advertised for bid. A contract would be executed between the City of Bozeman and the contractor. A private forester could assist the City in administrating the contract.

The City of Bozeman would be required to enter into a Hazard Reduction Agreement (HRA) by the Montana Department of Natural Resources (DNRC). The HRA would require the logging slash to be reduced by burning, chipping or any other means that reduces the fire danger from the slash created through logging.

The maps associated with sections do have duplicate stand numbers and unnumbered areas. The duplicate stands are timber stands with similar characteristics of tree species, size, densities and treatments. They are grouped together for simplicity reasons. Unnumbered areas consists of meadow, scree or areas that are completely unmanageable.

Section 7, Township 3 South, Range 6 East

General Conditions

Section 7 is a partial section consisting of 80 acres and located at the mouth of Sourdough Creek just inside the locked gate to the drainage. Sourdough Creek bisects the section. The terrain limits the possibility of road access and as a result limits forest management options. Elevations range from 5300 to 5600 feet. Timber types are predominantly Douglas fir stands with patches of lodgepole pine trees mixed throughout. Aspect is predominantly west with minor areas of east aspects. Slopes are generally steep and limit the use of conventional tracked equipment. The

understory does contain various scrubs and a minimal amount of downfall. This parcel is located below the intake dam.

Logging

This section has limitations for logging. There has been no previous logging in the section. The slopes are steep and the use of a helicopter is the only feasible method of removing trees from this section. An area to the south in section 18 could be utilized to deck the log for processing and later hauling. This site is where the intake dam for the city water supply is located. The refueling of the helicopter and the decking of logs is below the intake.

There is an existing private road on the west side of this property. If permission can be acquired from the landowner, a short road could be constructed to access the City=s property west of Sourdough Creek. This area could then be line logged. This logging system is less expensive than the use of a helicopter and has a better ability to manage the residual fuels.

Fire

This section is within the urban interface. The Forest Service has proposed to selectively harvest trees to the east of this parcel by the use of a helicopter. A similar harvest could be proposed on the City=s property. The main emphasis would be to thin the stands sufficient enough to reduce the probability of a crown fire. The goal would not be to eliminate fire completely, but to have a low intensity fire that would consume the fuels on the ground and not spread to the crowns.

This area is below the intake dam. Any sediment carried to Sourdough Creek will not have any effect on the filtration plant. Managing the timber and reducing fire danger in this area may have a positive affect on controlling a fire upstream of the intake dam.

Harvest Plans

The main goal with the timber harvest plans and subsequent fuel reduction associated with it would be to reduce the risk of a large catastrophic wildfire. The east side of the property has natural openings and the harvest prescription could blend the cutting with these openings to obtain a more natural appearance. Approximately 137 MBF of timber or 32% of the stands could be harvested to accomplish the desired goals. All of the trees would be helicopters logged and flown to a landing on the north end of Section18 where it would be hauled to the various markets.

The west side of the property or the west side of Sourdough Creek contains a denser stand of trees with essentially no natural openings. The desired goals would be the same as on the east side. A higher percentage of trees would have to be removed to obtain the goals. Approximately 140 MBF of timber or 50% of the stand would be harvested.

Roads

The main road up Sourdough Creek runs through the section. No new road construction is possible on the eastside due to the steepness of the terrain. There is a road on the private ground above the city=s ownership on the westside. It is possible to build a short spur off this road to access the city=s property, if permission can be obtained by the private ownership. This spur would access the timber for harvest, provide a fuel break and could be used by fire crews in the event of a fire. The road would be approximately1500 feet in length. Timber harvesting along this road could utilize a line machine which would be significantly cheaper than a helicopter. Further fuel reduction work would also be easier and more effective with this road in place.

Section 17, Township 3 South, Range 6 East

General Conditions

Section 17 is a partial section containing 170 acres and is located higher up Sourdough Creek than section 7 and above the intake dam. Sourdough Creek flows on the west side of this section. Elevations range from 5300 to 6200 feet. Timber types are predominantly Douglas fir stands with some pure stands of lodgepole pine. Aspect is predominantly west and northwest. Slopes are generally steep and there are areas that are operable with the use of conventional tracked equipment. The lodgepole pine stands do contain a considerable amount of downfall from the bark beetle infestation in the late 1970's. The spruce budworm is most severe in stand #5.

Logging

This section does have opportunities for ground based logging as well as helicopter logging. There is a big enough area at the intake dam in section 18 could be utilized for a landing for the helicopter logging. Fuel spills is a concern and a safety plan would have to be put in place. At minimum refueling should be kept at least 100' from any stream. This location is below the intake. There has been no previous logging in the section.

Harvest Plans

The main goal with the timber harvest plans and subsequent fuel reduction associated with it would be to reduce the risk of a large catastrophic wildfire. The Douglas fir stands have natural openings and the harvest prescription could blend the harvesting with these openings to obtain the desired goals and also maintain a more natural appearance. The pine stands have a continuous canopy without any natural openings. Typically in the past, the harvest prescriptions in these stands would be to clearcut them, primarily because the trees grow tightly together and leaving individual trees tend to blow over easily. This plan proposes leaving trees in groups or clumps. This would give the areas a more natural appearance, reduce the risk of windthrow and also reduce the risk of soil erosion.

Approximately 123 MBF of timber on 26 acres would be harvested by conventional equipment. An additional 514 MBF would be helicopter logged.

Roads

The main road up Sourdough Creek runs through the western side of the property. Approximately 1000 feet of new road would be built to access some of the cat logging. This road would be used for the cat logging and access for the helicopter crews. It would keep some of the activities off the main Sourdough road, making it less intrusive to the recreationist using the main road.

Section 18, Township 3 South, Range 6 East

General Conditions

Section is a partial section containing 160 acres and the intake dam is located on the north end. Most of the lands drains into Sourdough Creek above the dam. Elevations range from 5300 to 6400 feet. Timber types are predominantly Douglas fir stands with some isolated pure stands of lodgepole pine. Aspect is predominantly east and northeast. Slopes are generally steep and there are areas that are operable with the use of conventional tracked equipment. The lodgepole pine stands do contain a considerable amount of downfall.

Currently there is no road access to this section. There is a road to the north on private ground that was used for logging 10 to 15 years ago and is in good shape. If access can be acquired from this adjacent landowner, a road could be built off the existing road into section 18. This road would be approximately 3000 feet in length and would greatly improve the management options for the section. The road would make the logging economical, allow for better fuel management, act as a fuel break and provide access for firefighting crews as well as for the helicopter crews.

Logging

The lack of road access only allows the harvesting of trees by the means of a helicopter. Approximately 30 acres could be logged with conventional equipment if access is obtained and a road was built into the section. The helicopter logging could use the landing and decking site at the area of the intake dam. This location is below the intake. There has been no previous logging in the section.

Harvest Plans

The main goal with the timber harvest plans and subsequent fuel reduction associated with it would be to reduce the risk of a large catastrophic wildfire. The Douglas fir stands have natural openings and the harvest prescription could blend the harvesting with these openings to obtain the desired goals and also maintain a more natural appearance. Approximately 818 MBF of timber on 150 acres or 36% would be harvested by the use of a helicopter.

If access could be obtained from the private ground to the north, 30 acres could be logged conventionally, making the timber harvesting and followup fuel treatments more economical. There are some areas that face north and towards Gallatin valley. Visual aesthetics must play an important role when harvesting timber in these areas.

SECTION 7, 17, 18 - TOWNSHIP 3 SOUTH - RANGE 6 EAST

			VOLUME (MBF)			HARVEST(MBF)	
STAND #	TYPE	ACRES	VOL/AC	TOTAL	% CUT	CAT	HELI
11	DF13	20	14	280	40%	0	112
12	DF12	10	10	100	25%	0	25
13	DF11	11	5	55	0%	0	0
14	DF12	20	14	280	50%	0	140
15	ES12	19	3	57	0%	0	0
21	DF13	23	16	368	40%	0	147
22	DF13	22	12	264	50%	0	79
23	DF13	71	16	1136	40%	0	454
24	DF13	22	12	264	30%	0	79
25	LP13	2	12	24	30%	0	10
26	ES13	10	16	160	30%	0	48
31	DF13	11	15	165	40%	46	20
32	LP13	9	14	126	50%	16	47
33	LP13	49	12	588	40%	0	235
34	DF13	26	13	338	30%	61	41
35	DF12	13	8	104	30%	0	31
36	DF12	25	6	150	30%	0	45
37	DF13	17	14	238	40%	0	95
		380	12	4697		123	1609

Volumes are in Thousand Board Feet (MBF)

TIMBER TYPES

SPECIES		SIZE CLASS		STOCKING	
LP	Lodgepole Pine	1	11"+ DBH	1	10-39% Cover
DF	Douglas Fir	2	5" to 10" DBH	2	40-69% Cover
ES	Englemann Spruce	3	Less than 5" DBH	3	70-100% Cover
AF	Subalpine Fir				

DBH Diameter at Breast Height

Example: DF13 denotes Douglas Fir tree species, 11" and greater DBH, 70%-100% canopy cover

Section 27, Township 3 South, Range 6 East

General Conditions

Section 27 contains 630 acres and is located 5 miles up the drainage and starts just before the bridge across Sourdough Creek. Elevations range from 5800 to 7200 feet. The main timber type is lodgepole pine. Aspect is predominantly north. Approximately 118 acres have been previously logged and have regenerated very well. The majority of the remaining acres that have not been logged are steep. Bark beetle activity have been increasing the last few years.

A new road was evaluated entering the southwest corner of the section from an existing Forest Service road. The road was unfeasible because of very unstable ground.

Harvest Plans

Approximately 268 MBF on 50 acres could be logged with conventional equipment. 1348 MBF of timber on 210 acres or 36% of the timber within these stands would be harvested by the use of a helicopter. A landing and decking site would have to be created in stand #8. This site could also be used as a safety zone for fire fighters in the event of a fire.

The previously logged areas have regenerated very well with trees ranging from one to twenty feet in height with a high number of trees per acre. The main benefit to thin these areas now would be to reduce the fire danger. In general, the slopes are less than 40%, close to existing roads and can be mechanically thinned. Because of the size of the trees, hand thinning would create an abundant amount of slash on the ground. Mechanical thinning would grind the trees and create mulch that would slowly decompose back into the soil and not become a fire control problem.

The goal would be to shape the stands now as to how they would be best to withstand a crown fire in the future. A random pattern of leave trees and open areas would best mimic the natural surroundings and overall be able to accomplish the desired goals. Thinning the trees, especially adjacent to the roads will reduce the intensity of a fire if it occurs, making it safer for firefighters and also making the roads a more effective fuel break. These areas can act as a buffering zone from ash and sediment that maybe transported from the steeper grounds above if a fire occurs. The material will slow down when it reaches the gentler slopes, have a chance to dissipate its energy and deposit the material in the forest floor and not into the streams.

SECTION 27 - TOWNSHIP 3 SOUTH - RANGE 6 EAST

			VOLUME (MBF)			HARVEST (MBF)	
STAND #	TYPE	ACRES	VOL/AC	TOTAL	% CUT	CAT	HELI
1	LP13	48	14	672	40%	54	215
2	DF11	37	6	222	0%	0	0
3	LP13	13	12	156	30%	0	47
4	DF12	25	10	250	0%	0	0
5	LP13	4	14	56	0%	0	0
6	ES13	9	16	144	20%	9	20
7	LP13	12	12	144	30%	35	9
8	LP23	39	2	78	0%	0	0
9	LP13	9	10	90	50%	45	0
10	LP13	18	14	252	50%	126	0
11	LP23	37	2	74	0%	0	0
12	DF21	42	2	84	0%	0	0
13	LP13	44	16	704	40%	0	282
14	LP13	92	12	1104	40%	0	442
15	LP23	44	6	264	0%	0	0
16	LP23	22	10	220	30%	0	66
17	LP13	29	12	348	0%	0	0
18	LP23	11	10	110	0%	0	0
19	LP13	22	16	352	0%	0	0
20	LP13	55	10	550	0%	0	0
21	LP23	11	2	22	0%	0	0
		123	11	1300		54	262

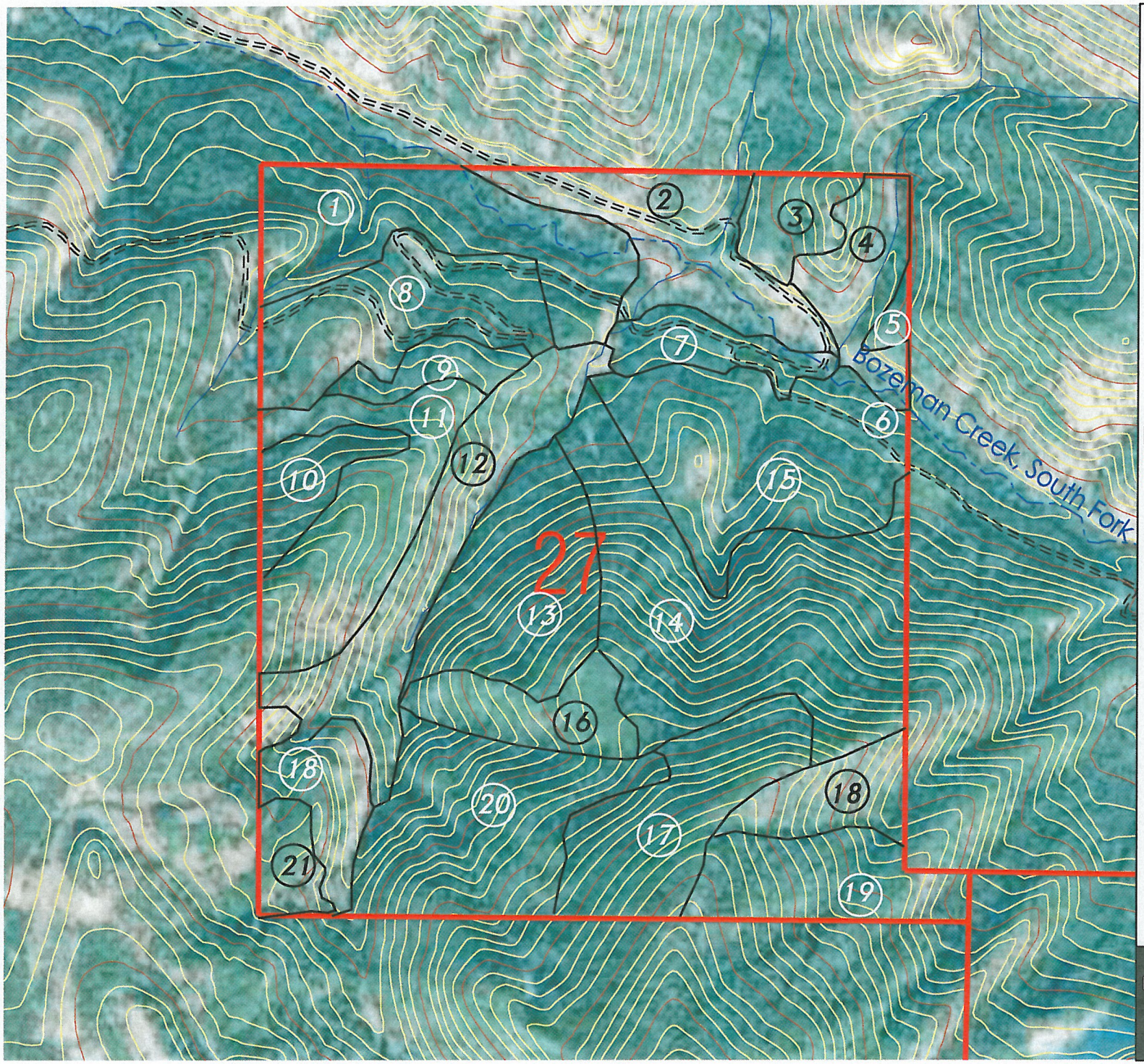
Volumes are in Thousand Board Feet (MBF)

TIMBER TYPES

SPECIES		SIZE CLASS		STOCKING	
LP	Lodgepole Pine	1	11"+ DBH	1	10-39% Cover
DF	Douglas Fir	2	5" to 10" DBH	2	40-69% Cover
ES	Englemann Spruce	3	Less than 5" DBH	3	70-100% Cover
AF	Subalpine Fir				

DBH Diameter at Breast Height

Example: DF13 denotes Douglas Fir tree species, 11" and greater DBH, 70%-100% canopy cover



Timber Stands

1	-	LP13
2	-	DF11
3	-	LP13
4	-	DF12
5	-	LP13
6	-	ES13
7	-	LP13
8	-	LP23
9	-	LP13
10	-	LP13
11	-	LP23
12	-	DF21
13	-	LP13
14	-	LP13
15	-	LP23
16	-	LP23
17	-	LP13
18	-	LP23
19	-	LP13
20	-	LP13
21	-	LP23

Legend

- Existing Road
- Proposed Road
- Reconstruct Road

400 1000'

0 1/4 mile

Mapped Area

This sheet

T3S, R6E
- Sec 7 E ½ SE ¼
- Sec 17 W ½ NW ¼
- Sec 18 N ½ NE ¼
- Sec 27 All
- Sec 35 All

T4S, R6E
- Sec 1 All

T3S, R7E
- Sec 31 S ½

T4S, R7E
- Sec 5 All
- Sec 7 All
- Sec 17 NW ¼

N

City of Bozeman, MT
Forest Management Plan

Peck Forestry, Inc

August 15, 2009

MAPPING: www.alpentech.net

Section 35, Township 3 South, Range 6 East

General Conditions

Section 35 contains 610 acres. Elevations range from 6200 to 8000 feet. The main timber type is lodgepole pine. Aspect is predominantly north with some easternly slopes. Approximately 44 acres have been previously logged and have regenerated very well. There are 50 acres that are not too steep to be logged with conventional ground based equipment and 3500 feet of road would have to be reconstructed to access the timber stand. The remaining acres are steep and the use of a helicopter is the only means of harvesting the timber. At the end of this reconstructed road there is a good location for a staging and decking area for a helicopter logging operation. Bark beetle activity have been increasing the last few years.

A road was reviewed to access the timber in the northwest corner of the section. The ground in this area is too unstable to support a logging road.

Harvest Plans

Approximately 260 MBF on 50 acres could be logged with conventional equipment. 1500 MBF of timber on 337 acres or 36% of the timber within these stands would be harvested by the use of a helicopter. There are areas in this section, especially in stands 6 and 7 that were seriously affected by the 1988 storm described earlier. The old blowdown trees are unsalvageable for forest products. They do contribute considerable amounts of fuel on the ground making firefighting very difficult. It is uneconomical to remove this material from the site. Spot or jackpot burning would be the most cost effective way to reduce the fire danger in these areas. Timber harvesting within these spots, directional falling the trees and lopping the tops into the heavy concentration of blowdown would give the fuel more fine material and a better burn.

The areas that have been logged in the past have regenerated very well and could be thinned. A similar application can be applied in this section as described above in section 27.

SECTION 35 - TOWNSHIP 3 SOUTH - RANGE 6 EAST

			VOLUME (MBF)			HARVEST (MBF)	
STAND #	TYPE	ACRES	VOL/AC	TOTAL	% CUT	CAT	HELI
1	ES13	42	14	588	30%	0	176
2	DF12	7	16	112	30%	0	34
3	ES13	7	16	112	40%	0	45
4	ES13	47	14	658	40%	263	0
5	DF12	20	12	240	30%	0	72
6	DF13	161	14	2254	40%	0	902
7	DF12	89	12	1068	20%	0	214
8	LP23	44	0	0	0%	0	0
9	ES13	11	16	176	30%	0	53
10	DF13	92	12	1104	0%	0	0
11	LP13	10	14	140	0%	0	0
12	ES13	10	16	160	0%	0	0
13	ES13	5	14	70	0%	0	0
14	DF13	15	16	240	0%	0	0
		560	12	6922		263	1495

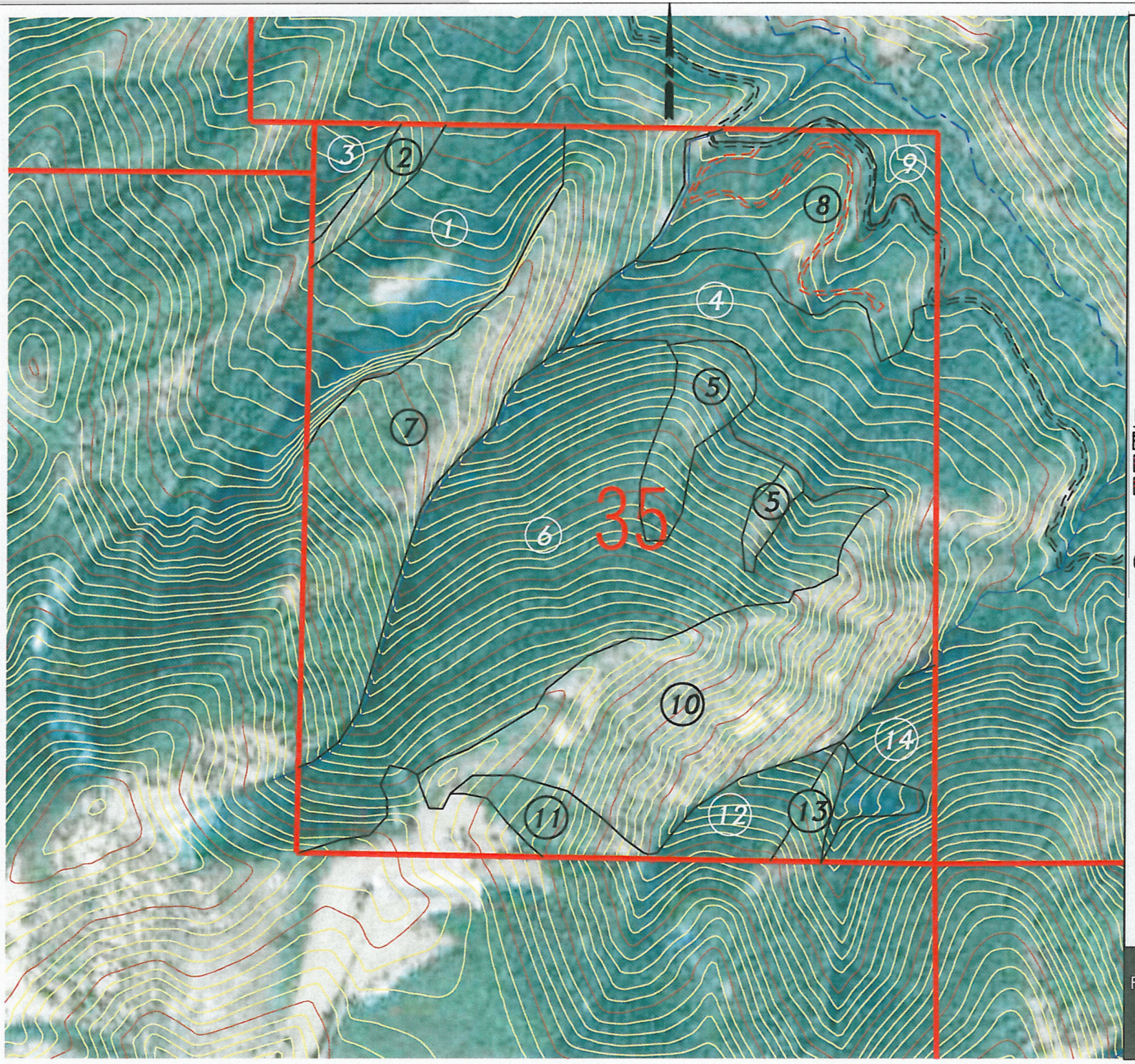
Volumes are in Thousand Board Feet (MBF)

TIMBER TYPES

SPECIES		SIZE CLASS		STOCKING	
LP	Lodgepole Pine	1	11"+ DBH	1	10-39% Cover
DF	Douglas Fir	2	5" to 10" DBH	2	40-69% Cover
ES	Englemann Spruce	3	Less than 5" DBH	3	70-100% Cover
AF	Subalpine Fir				

DBH Diameter at Breast Height

Example: DF13 denotes Douglas Fir tree species, 11" and greater DBH, 70%-100% canopy cover



Timber Stands

1	-	FS13
2	-	DF12
3	-	ES13
4	-	ES13
5	-	DF12
6	-	DF13
7	-	DF12
8	-	LP23
9	-	ES13
10	-	DF13
11	-	LP13
12	-	ES13
13	-	ES13
14	-	DF13

Legend

- Existing Road
- Proposed Road
- Reconstruct Road

400 1000'
0 1/4 mile

Mapped Area

This sheet

T3S, R6E
- Sec 7 E ½ SE ¼
- Sec 17 W ½ NW ¼
- Sec 18 N ½ NE ¼
- Sec 27 All
- Sec 35 All

T4S, R6E
- Sec 1 All

T3S, R7E
- Sec 31 S ½

T4S, R7E
- Sec 5 All
- Sec 7 All
- Sec 17 NW ¼

N

City of Bozeman, MT
Forest Management Plan

Peck Forestry, Inc

August 14, 2009

MAPPING: www.alpentech.net

Section 1, Township 4 South, Range 6 East

General Conditions

Section 1 contains 608 acres. Elevations range from 6300 to 8000 feet. The main timber type is Douglas Fir with minor amounts of lodgepole pine trees mixed throughout. Aspect is predominantly northeast. Approximately 33 acres have been previously logged and have regenerated very well. The remaining acres are steep and the use of a helicopter is the only means of harvesting the timber. The bark beetle has not been very active in this section due to the predominantly Douglas Fir stands. This section has a low priority for timber management due favorable forest stand conditions and steep slopes limiting logging options. There are minimal amounts of Douglas Fir blowdown from the May 1988 storm.

Harvest Plans

This section appears to have a low priority to manage the timber to reduce the fuels. The stands have good spacing, there is a clean understory and there are very little ladder fuels that would carry a fire from the ground to the tree crowns. Tree thinning by the use of conventional tracked or wheeled equipment could be use to widen the roads as fuel breaks and also make travel safer for firefighting personnel.

SECTION 1 - TOWNSHIP 4 SOUTH - RANGE 6 EAST

			VOLUME (MBF)			ARVEST (MBF)	
STAND #	TYPE	ACRES	VOL/AC	TOTAL	% CUT	CAT	HELI
1	DF13	40	16	640	0%	0	0
2	DF13	31	12	372	0%	0	0
3	DF13	27	16	432	0%	0	0
4	DF13	153	16	2448	0%	0	0
5	DF13	92	12	1104	0%	0	0
6	DF12	42	10	420	0%	0	0
7	DF13	44	12	528	0%	0	0
8	DF13	46	14	644	0%	0	0
9	DF13	35	16	560	0%	0	0
10	LP33	33	0	0	0%	0	0
		543	13	7148		0	0

Volumes are in Thousand Board Feet (MBF)

TIMBER TYPES

SPECIES		SIZE CLASS		STOCKING	
LP	Lodgepole Pine	1	11"+ DBH	1	10-39% Cover
DF	Douglas Fir	2	5" to 10" DBH	2	40-69% Cover
ES	Englemann Spruce	3	Less than 5" DBH	3	70-100% Cover
AF	Subalpine Fir				

DBH Diameter at Breast Height

Example: DF13 denotes Douglas Fir tree species, 11" and greater DBH, 70%-100% canopy cover

Section 7, Township 4 South, Range 7 East

General Conditions

Section 7 contains 634 acres. Elevations range from 6800 to 8200 feet. The main timber type is lodgepole pine. Aspects vary greatly with all aspects represented. Approximately 172 acres have been previously logged and have regenerated very well. There are 50 acres that are not too steep to be logged with conventional ground based equipment and 1.3 miles of road would have to be reconstructed to access the timber stand. The remaining acres are steep and the use of a helicopter is the only means of harvesting the timber. Bark beetle activity have been increasing the last few years.

The road to be reconstructed is in relatively good shape. Most of the drainage structures are functioning and the road prism is in good shape. Removing of the regeneration which is up to twenty feet tall involves the majority of the work. This road could be used to access the timber stands and also access for fire crews in the event of a fire. The Sourdough Creek drainage has had numerous fires in the past and they have been controlled while they are still small. Road access can be vital in containing fires in a timely manner.

Harvest Plans

Approximately 230 MBF on 50 acres could be logged with conventional equipment. 1090 MBF of timber on 167 acres or 30% of the timber within these stands would be harvested by the use of a helicopter.

The areas that have been logged in the past have regenerated very well and could be thinned. A similar application can be applied in this section as described above in section 27. The management of the new trees is the most important asset in managing this section. The goal would be to shape the stands now as to how they would be best to withstand a crown fire in the future. These stands are lower down in the section and adjacent to the main watercourse. Keeping an intense fire out of these stands would help reduce the risk of sediment from entering the streams.

SECTION 7 - TOWNSHIP 4 SOUTH - RANGE 7 EAST

			VOLUME (MBF)			HARVEST (MBF)	
STAND #	TYPE	ACRES	VOL/AC	TOTAL	% CUT	CAT	HELI
1	LP13	13	12	156	40%	0	62
2	LP33	57	0	0	0%	0	0
3	DF13	16	14	224	30%	0	67
4	LP13	20	13	260	30%	0	78
5	LP33	23	0	0	0%	0	0
6	LP13	11	10	110	50%	55	0
7	LP13	40	12	480	30%	0	144
8	LP13	66	14	924	30%	42	235
9	LP13	60	14	840	40%	134	202
10	LP33	92	0	0	0%	0	0
11	LP13	42	12	504	30%	0	151
12	LP13	22	6	132	0%	0	0
13	LP13	36	14	504	30%	0	151
		498	8	4134		231	1091

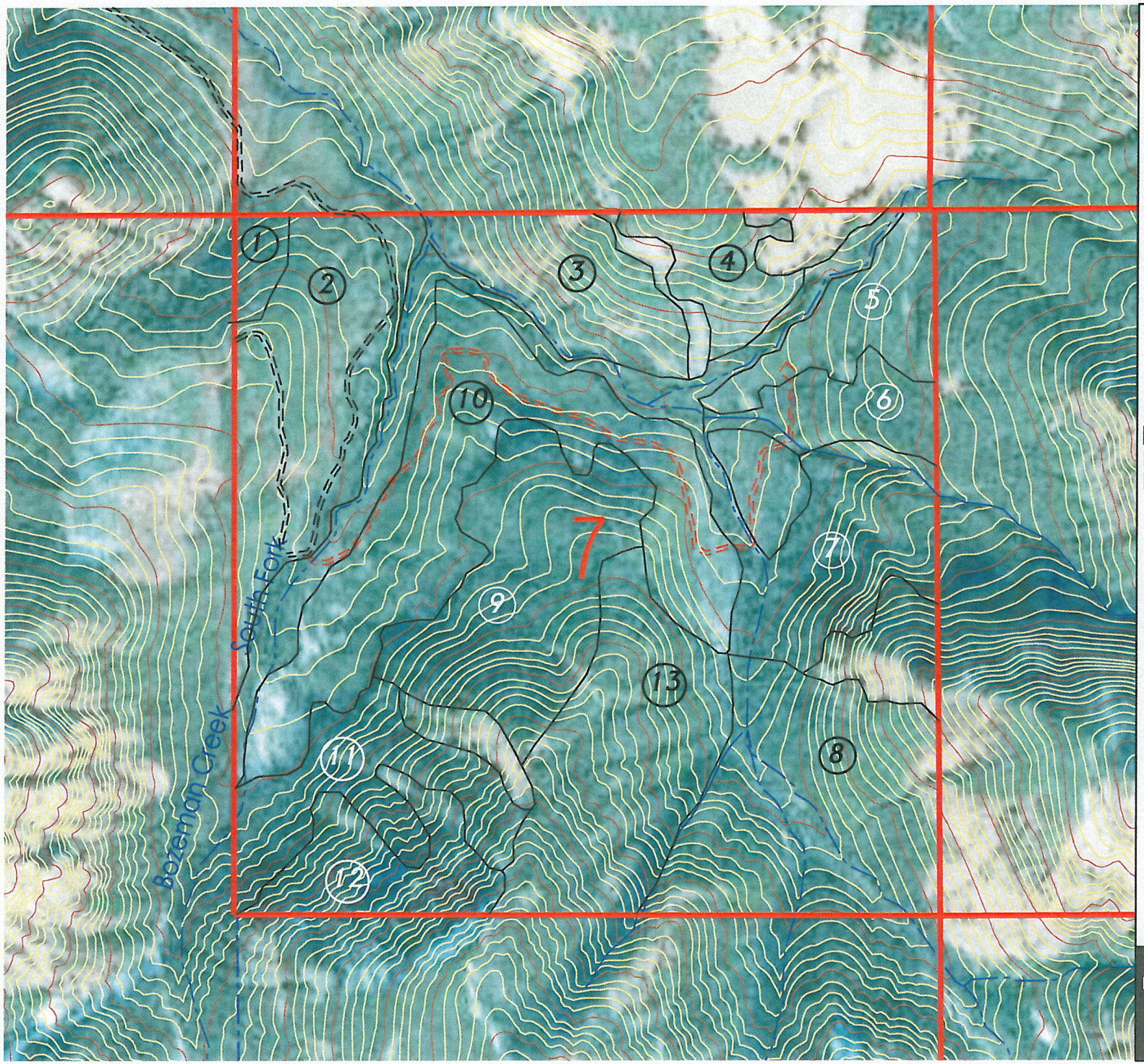
Volumes are in Thousand Board Feet (MBF)

TIMBER TYPES

SPECIES			SIZE CLASS		STOCKING
LP	Lodgepole Pine	1	11"+ DBH	1	10-39% Cover
DF	Douglas Fir	2	5" to 10" DBH	2	40-69% Cover
ES	Englemann Spruce	3	Less than 5" DBH	3	70-100% Cover
AF	Subalpine Fir				

DBH Diameter at Breast Height

Example: DF13 denotes Douglas Fir tree species, 11" and greater DBH, 70%-100% canopy cover



Timber Stands

1	-	LP13
2	-	AF13
3	-	AF13
4	-	AF13
5	-	AF13

Legend

- Existing Road
- Proposed Road
- Reconstruct Road

400 1000'
0 1/4 mile

Mapped Area

This sheet

T3S, R6E
- Sec 7 E ½ SE ¼
- Sec 17 W ½ NW ¼
- Sec 18 N ½ NE ¼
- Sec 27 All
- Sec 35 All

T4S, R6E
- Sec 1 All

T3S, R7E
- Sec 31 S ½

T4S, R7E
- Sec 5 All
- Sec 7 All
- Sec 17 NW ¼

N

City of Bozeman, MT
Forest Management Plan

Peck Forestry, Inc

August 14, 2009

MAPPING: www.alpentech.net

Section 17, Township 4 South, Range 7 East

General Conditions

Section 17 contains 160 acres. Elevations range from 7600 to 8800 feet. The main timber types are englemann spruce and subalpine fir. Aspects are predominantly north and northeast. This section is located around a major tributary of the south fork of Sourdough Creek has no road access and as a result has limit forest management possibilities.

Timber types are predominantly open spruce stands along the main drainage. Further up the slope to the south, thick stands of subalpine fir dominate with patches of lodgepole pine and whitebark pine scattered throughout. The subalpine fir stands have had some mortality from competition and bark beetles which has created substantial fuel loading.

This section has a poor potential for logging and no harvest is planned. There is no road access and is essentially uneconomical to obtain. There is insufficient timber to pay for the cost of a road. The flight distance from the timber stands to an existing roads is approximately one mile and it makes helicopter logging uneconomical except with a good timber market.

The spruce stands are mature and are widely spaced, sufficient enough as not to be a risk for a continuous crown fire. There are smaller trees growing under the mature trees that would act as ladder fuel if there was a ground fire. Ladder fuels are trees or scrubs that can carry a fire that is burning on the ground to the crowns of taller, overstory trees. Hand thinning could be performed in the spruce stands with the objective of eliminating the ladder fuels. A fire burning through the area would then remain on the ground where the intensity would be low. The goal would be to trap sediment from a hot fire burning above. Future considerations would be to maintain the spruce spacing. Reduce the ladder fuel but allow some young trees to grow to eventually replace the spruce.

SECTION 17 - TOWNSHIP 4 SOUTH - RANGE 7 EAST

			VOLUME (MBF)			HARVEST (MBF)	
STAND #	TYPE	ACRES	VOL/AC	TOTAL	% CUT	CAT	HELI
1	ES13	63	14	882	0%	0	0
2	AF13	14	10	140	0%	0	0
3	AF13	24	8	192	0%	0	0
4	AF13	9	8	72	0%	0	0
5	AF13	16	10	160	0%	0	0
		126	11	1446		0	0

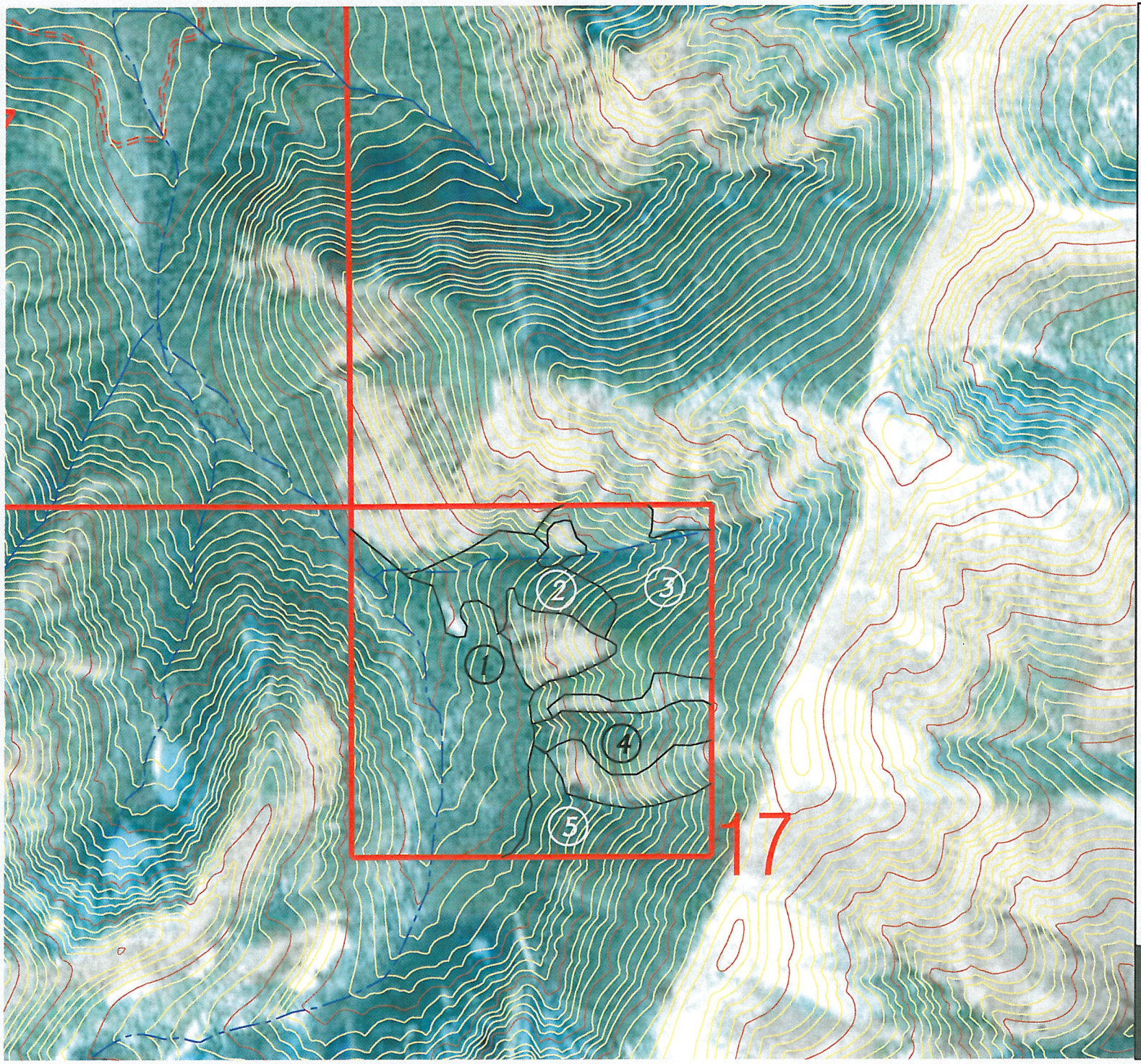
Volumes are in Thousand Board Feet (MBF)

TIMBER TYPES

SPECIES			SIZE CLASS	STOCKING	
LP	Lodgepole Pine	1	11"+ DBH	1	10-39% Cover
DF	Douglas Fir	2	5" to 10" DBH	2	40-69% Cover
ES	Englemann Spruce	3	Less than 5" DBH	3	70-100% Cover
AF	Subalpine Fir				

DBH Diameter at Breast Height

Example: DF13 denotes Douglas Fir tree species, 11" and greater DBH, 70%-100% canopy cover



Timber Stands

1	-	ES13
2	-	AF13
3	-	AF13
4	-	AF13
5	-	AF13

Legend

- Existing Road
- Proposed Road
- Reconstruct Road

400 1000'
0 1/4 mile

Mapped Area

This sheet

T3S, R6E
- Sec 7 E ½ SE ¼
- Sec 17 W ½ NW ¼
- Sec 18 N ½ NE ¼
- Sec 27 All
- Sec 35 All

T4S, R6E
- Sec 1 All

T3S, R7E
- Sec 31 S ½

T4S, R7E
- Sec 5 All
- Sec 7 All
- Sec 17 NW ¼

N

City of Bozeman, MT
Forest Management Plan

Peck Forestry, Inc
August 14, 2009
MAPPING: www.alpentech.net

Section 31, Township 3 South, Range 7 East

General Conditions

Section 31 contains 338 acres. Elevations range from 7200 to 7800 feet. The main timber type is lodgepole pine. Aspects are predominantly north and south. Approximately 74 acres have been previously logged and have regenerated very well. There are 60 acres that are not too steep to be logged with conventional ground based equipment and 3 miles of road would have to be reconstructed to access the timber stand. This road would also be used to access section 5. The remaining acres are steep and the use of a helicopter is the only means of harvesting the timber. Bark beetle activity have been increasing the last few years.

The road to be reconstructed is in relatively good shape. Most of the drainage structures are functioning and the road prism is in place. There are a few spots where the road has slumped and needs repair. This road could be used to access the timber stands and also access for fire crews in the event of a fire. The Sourdough Creek drainage has had numerous fires in the past and they have been controlled while they are still small. Road access can be vital in containing fires in a timely manner.

Harvest Plans

Approximately 473 MBF on 60 acres could be logged with conventional equipment. 377 MBF of timber on 58 acres or 30% of the timber within these stands would be harvested by the use of a helicopter.

The areas that have been logged in the past have regenerated very well and could be thinned. A similar application can be applied in this section as described above in section 27.

SECTION 31 - TOWNSHIP 3 SOUTH - RANGE 7 EAST

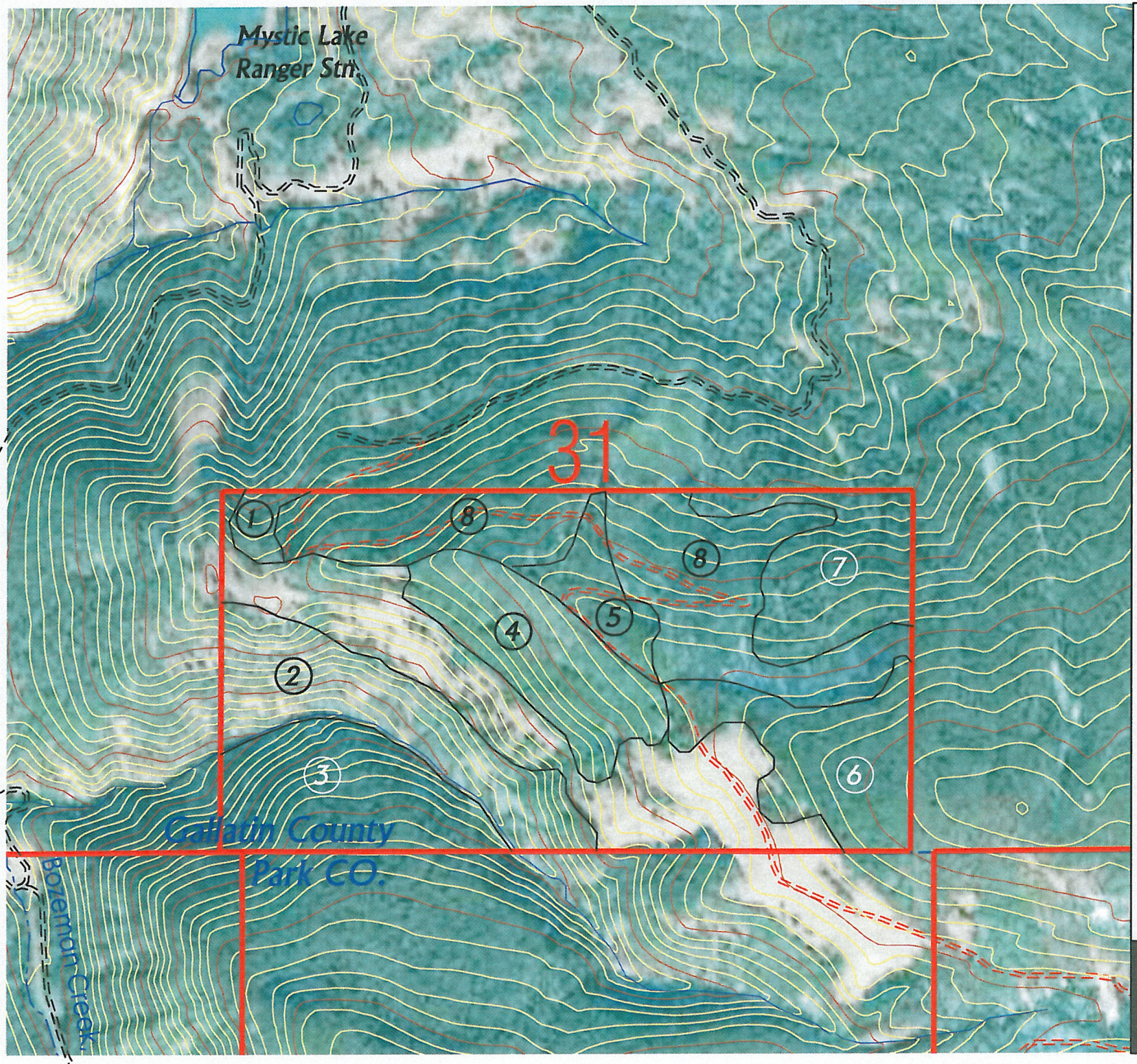
			VOLUME (MBF)			HARVEST (MBF)	
STAND #	TYPE	ACRES	VOL/AC	TOTAL	% CUT	CAT	HELI
1	LP13	6	14	84	0%	0	0
2	DF12	47	8	376	0%	0	0
3	LP13	40	16	640	30%	0	192
4	LP23	39	8	312	30%	9	84
5	LP13	15	12	180	40%	72	0
6	LP13	29	12	348	40%	139	0
7	LP13	30	14	420	40%	67	101
8	LP33	74	0	0	0%	0	0
		280	8	2360		288	377

Volumes are in Thousand Board Feet (MBF)

TIMBER TYPES

SPECIES			SIZE CLASS		STOCKING
LP	Lodgepole Pine	1	11"+ DBH	1	10-39% Cover
DF	Douglas Fir	2	5" to 10" DBH	2	40-69% Cover
ES	Englemann Spruce	3	Less than 5" DBH	3	70-100% Cover
AF	Subalpine Fir				
		DBH	Diameter at Breast Height		

Example: DF13 denotes Douglas Fir tree species, 11" and greater DBH, 70%-100% canopy cover



Timber Stands

1	-	LP13
2	-	DF12
3	-	LP13
4	-	LP23
5	-	LP13
6	-	LP13
7	-	LP13
8	-	LP33

Legend

- Existing Road
- Proposed Road
- Reconstruct Road

400 1000'
0 1/4 mile

Mapped Area

This sheet

T3S, R6E
- Sec 7 E ½ SE ¼
- Sec 17 W ½ NW ¼
- Sec 18 N ½ NE ¼
- Sec 27 All
- Sec 35 All

T4S, R6E
- Sec 1 All

T3S, R7E
- Sec 31 S ½

T4S, R7E
- Sec 5 All
- Sec 7 All
- Sec 17 NW ¼

City of Bozeman, MT
Forest Management Plan

Peck Forestry, Inc
August 14, 2009
MAPPING: www.alpentech.net

Section 5, Township 4 South, Range 7 East

General Conditions

Section 5 contains 607 acres. Elevations range from 7300 to 9300 feet. The main timber type is lodgepole pine. Aspects are predominantly north and west. Approximately 120 acres have been previously logged and have regenerated very well. There are 20 acres that can be logged with conventional ground based equipment and 1 mile of road would have to be reconstructed in additional to the 3 miles of reconstruction road in section 31 to access the timber stand. The remaining acres are steep and the use of a helicopter is the only means of harvesting the timber. Bark beetle activity have been increasing the last few years.

The road to be reconstructed into section 5 is in relatively good shape. Most of the drainage structures are functioning and the road prism is intact. This road could be used to access the timber stands and also access for fire crews in the event of a fire. The Sourdough Creek drainage has had numerous fires in the past and they have been controlled while they are still small. Road access can be vital in containing fires in a timely manner.

Harvest Plans

Approximately 63 MBF on 28 acres could be logged with conventional equipment. 881 MBF of timber on 175 acres or 30% of the timber within these stands would be harvested by the use of a helicopter.

The areas that have been logged in the past have regenerated very well and could be thinned. A similar application can be applied in this section as described above in section 27.

SECTION 5 - TOWNSHIP 4 SOUTH - RANGE 7 EAST

			VOLUME (MBF)			HARVEST (MBF)	
STAND #	TYPE	ACRES	VOL/AC	TOTAL	% CUT	CAT	HELI
1	LP13	20	8	160	30%	48	0
2	ES13	17	16	272	0%	0	0
3	ES13	9	14	126	0%	0	0
4	ES13	105	16	1680	30%	0	504
5	LP13	21	12	252	40%	0	101
6	LP13	52	14	728	40%	15	277
7	LP33	120	0	0	0%	0	0
		344	9	3218		63	881

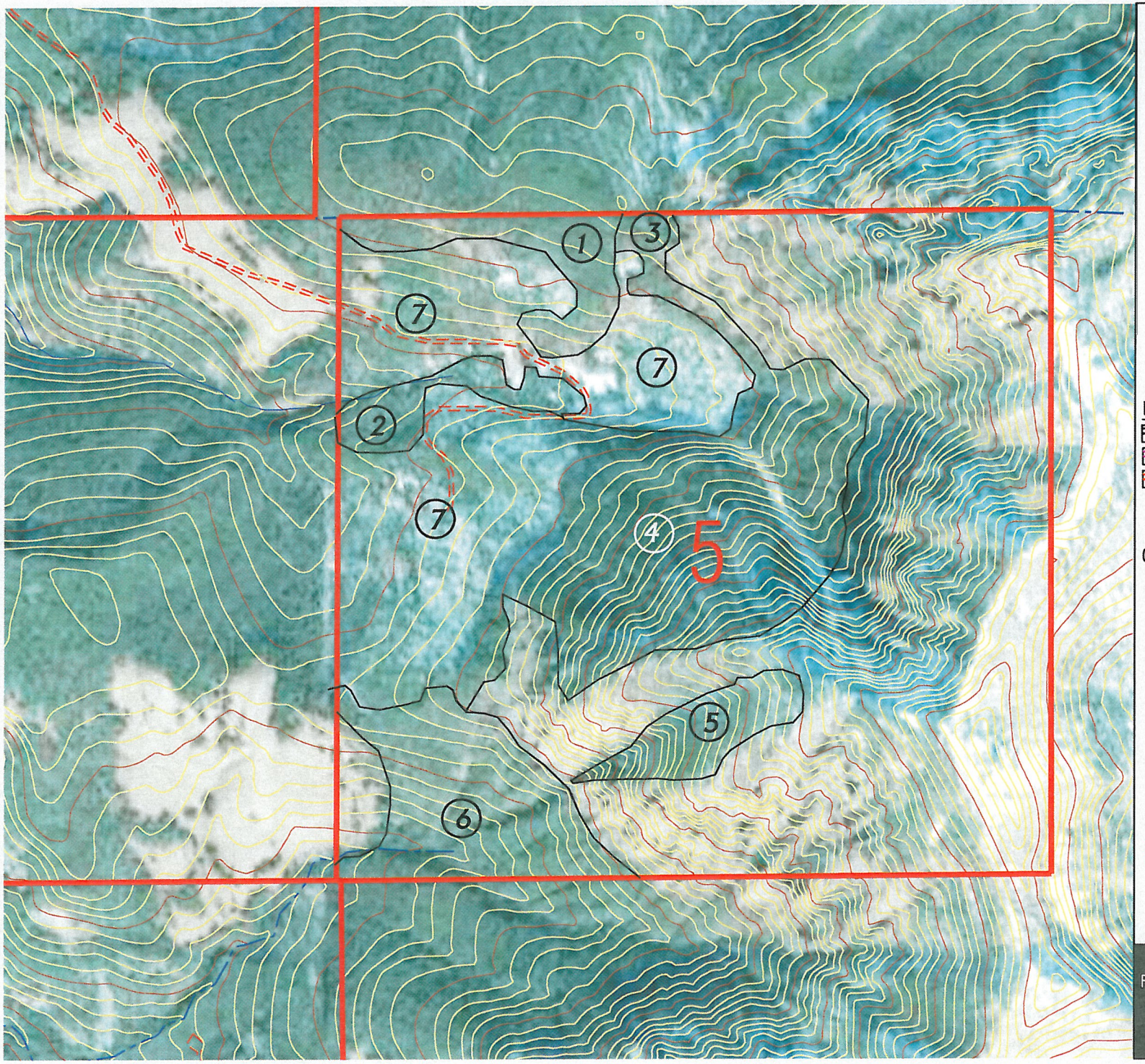
Volumes are in Thousand Board Feet (MBF)

TIMBER TYPES

SPECIES			SIZE CLASS		STOCKING
LP	Lodgepole Pine	1	11"+ DBH	1	10-39% Cover
DF	Douglas Fir	2	5" to 10" DBH	2	40-69% Cover
ES	Englemann Spruce	3	Less than 5" DBH	3	70-100% Cover
AF	Subalpine Fir				

DBH Diameter at Breast Height

Example: DF13 denotes Douglas Fir tree species, 11" and greater DBH, 70%-100% canopy cover



Timber Stands

1	-	LP13
2	-	ES13
3	-	ES13
4	-	ES13
5	-	LP13
6	-	LP13
7	-	LP33

Legend

- Existing Road
- Proposed Road
- Reconstruct Road

400 1000'
0 1/4 mile

Mapped Area

This sheet

T3S, R6E
- Sec 7 E ½ SE ¼
- Sec 17 W ½ NW ¼
- Sec 18 N ½ NE ¼
- Sec 27 All
- Sec 35 All

T4S, R6E
- Sec 1 All

T3S, R7E
- Sec 31 S ½

T4S, R7E
- Sec 5 All
- Sec 7 All
- Sec 17 NW ¼

N

City of Bozeman, MT
Forest Management Plan

Peck Forestry, Inc
August 14, 2009
MAPPING: www.alpentech.net

INSECT AND DISEASE

INSECTS

Lodgepole Pine / Mountain Pine Beetle

Mountain Pine Beetle (Dendroctonous ponderosae) is the major forest insect present in the lodgepole and whitebark pine trees. The pine beetle is host specific in that they will only attack the pine trees. The main indicators of lodgepole pine susceptibility to mountain pine beetle attack are: 1) tree diameter, 2) tree age, and 3) elevation of the stand. Trees over 8" in diameter, greater than 80 years in age, and are growing at a low elevation (below 7200') pose the greatest risk of beetle attack. The risk of another widespread outbreak in the next twenty years is minimal due to species diversification and the larger, older, high risk trees have been killed leaving lower risk, smaller diameter trees.

The mountain pine beetles have a one year life cycle with four stages of development. All stages are found under the bark where they feed on the cambium and are protected by the weather. The adult beetles bore directly into the bark, construct a tunnel and lay eggs. They are in constant danger of drowning in their tunnels by tree pitch. The beetles therefore must kill the tree or at least portions of it to stop this pitching and to establish a generation. These tunnels, in conjunction with different fungi, stop the resin flow and girdle the tree. The adult beetle introduces the fungus at the time of attack.

The mountain pine beetle usually doesn't attack small diameter trees because they dry out too fast after the initial attack for the eggs to hatch and survive. The beetle populations of the late 1970's became so large that they attacked all sizes of pine trees.

Management options for the mountain pine beetle include either suppression or prevention. Suppression of beetle populations by using direct control such as spraying is usually temporary. Preventive management strategy is to keep the populations under control by reducing stand susceptibility and therefore its food supply. Prevention alternatives include:

Shorten rotation. A short rotation will prevent the trees from reaching the size needed for beetle survival. This may be an economically alternative in today=s market where the sawmills are using smaller material.

Species conversion. Achieving a mosaic of age sizes and tree species in a drainage minimizes the risk of a large beetle outbreak. This naturally occurring through forest secession over time. The younger regeneration in these pine stands are spruce and subalpine fir. Future harvest should concentrate on removing the pine trees.

Sanitation and salvage cutting. Sanitation and Salvage cutting utilize infected timber

and reduces the number of beetles and their food source.

Stocking control. Good tree spacing maintains fast growing, vigorous trees that are able to produce abundant amounts of pitch to drown the beetles. It also produces a larger diameter tree at a younger age. Stocking control is most effective at around age 15 to 20 years. This is recommended in the harvest areas where the lodgepole pine regeneration is thick. Thinning to a 10'X 10' spacing will accomplish this. The existing stands are too mature to benefit from thinning.

Subalpine Fir / Western Balsam Bark Beetle

The Western Balsam Bark Beetle (Dryocoetes confusus) is the most destructive beetle attacking the subalpine fir trees in this area. The beetle population survives in weakened trees from old age, slash and weather damage trees. Their populations can buildup during periods of drought or other environmental stresses and infest lower susceptible trees. Mortality commonly occur in groups and generally in the larger diameter classes.

Beetle populations will decrease as susceptible trees are killed by beetles, stand density is reduced through logging or mortality, or environmental conditions are improved to increase tree growth and relieve water stress.

As with the lodgepole beetle, management options for the western balsam beetle include either suppression or prevention. The best suppression option today is the use of pheromone traps. The traps are set out on a subalpine fir tree in the spring before beetle flight. The beetles up to a 1/2 mile in radius are attracted to that tree and kill it. The tree is cut down in the fall and removed. The traps are fairly cheap and can be effective in high risk and visually sensitive areas.

Preventive management is the most effective way in reducing tree mortality from beetle attacks. Prevention methods include thinning young stands to a desired spacing and removing windthrow and damaged trees.

DISEASE

Dwarf Mistletoe

Dwarf mistletoe is a parasitic plant and the most serious disease affecting lodgepole pine. It extracts water and nutrients from live trees. Essentially all lodgepole stands in this area are infected to some degree. The main impact is the loss of growth. Timber harvesting is the only effective way in preventing the spread of dwarf mistletoe. The loss of growth isn't substantial enough to warrant harvesting all the remaining lodgepole stands, especially since tree productivity isn't the only objective in managing the timberlands. There is no dwarf mistletoe that affects the other species of trees in this area. The witches brooms or clumps of branches are the result of dwarf mistletoe.

White Pine Blister Rust

The white pine blister rust is a stem disease that only affects the whitebark and limber pine in the management units. It is a parasite and requires a living host for survival. The blister rust requires both a primary and alternate host to complete their life cycle. Currant and gooseberries are the alternate hosts.

Only a small percentage of the whitebark and limber pine are resistant to this non-native disease. Management options are very limited in this area. Most of the research has been with the more commercial western white pine species. An improvement program has been developed, emphasizing in rust resistant trees. Planting is expensive and is occurring with second and third generation trees. On the adverse, the fungus is probably capable of making genetic adjustments of its own to overcome the host resistant.

The fungus affects the main stem and branches and eventually kills the portion of trees above the affected area. The smaller trees usually die quicker than the bigger ones after infection. Pruning the affected stems can reduce mortality, but is impractical within a large area.

Root rot is a serious disease that affects Douglas fir trees and there are very minimum amounts in the area of concern to address at this time.

TREE DESCRIPTIONS

The primary tree species within the drainage are lodgepole pine, Douglas fir, subalpine fir, spruce and whitebark pine.

Lodgepole Pine

Lodgepole Pine (Pinus contorta) is a medium size tree 75 to100 feet in height and 15 to 24 inches in diameter. It has a long, clear slender bole with a short, narrow, open crown. The lodgepole pine is found in pure dense, even-aged stands or mixed with the other conifers. It is rated as intolerant to shade. Meaning it requires full sunlight to attain its optimum growth.

The trees are productive seeders and often produce fertile seeds before they reach 15 years of age. Heavy seed crops are produced at intervals of 2 or 3 years. As the seeds mature, some drop from the cones, but many cones remain closed and stay fertile on the trees for many years. With the closed cones, large quantity of seeds can gradually accumulate. The trees become fire dependent as it requires heat to open the cones to release the seeds. A fire passing through also prepares a seed bed by exposing fresh mineral soil.

Logging can produce the same regeneration affect as a fire. Cone dispersal is obtained through the cutting and skidding operations. The air temperature at ground level during the summer time is usually sufficiently warm enough to open the cones. The seeds finding mineral soil typically have a better chance of survival than the ones found in the duff layers. This natural regeneration

on logged stands is usually remarkably successful as evident on the old clearcuts throughout the drainage.

Lodgepole pine is usually the first tree to establish itself after a disturbance. They also grow quicker in the early stages then the other species to rapidly become a dominant species. The spruce and firs are slower to establish themselves and are able to grow under the pine canopy. They are released to grow further when a disturbance such as wind or beetle mortality creates opening in the canopy.

Lodgepole pine is highly susceptible to bark beetles as they reach maturity. Dwarf mistletoe decreases tree growth. The thin bark is not very resistant to fire.

Whitebark Pine

Whitebark pine (Pinus albicaulis) is a small alpine tree with heights rarely above 50 feet. Diameters vary and the largest obtained with open growth trees ranging from 15 to 40 inches. It is found in pure stands at high elevations or mix with other upper elevation trees such as lodgepole pine, spruce and subalpine fir. In this region the boles are often multi-stemmed and of little in the way of commercial value. Bark beetles and blister rust are the main damaging agent with this species.

Engelmann Spruce

Engelmann Spruce (Picea engelmannii) is a medium to large tree reaching 100 to120 feet in height and 18 to 30 inches in diameter. It has a long, clear bole with often a large, wide spreading crown. The Engelmann spruce is found in pure dense stands or mixed with the other conifers. It is rated as tolerant to shade and it is only exceeded in this area by subalpine fir. If established in full sunlight, Engelmann can grow rather rapidly. Typically, it is found under the canopy of older trees and growing quite slowly. It takes a disturbance to the overstory to release the spruce. Within the management area, the spruce has been growing up underneath the lodgepole pine. The mortality to the pine from the bark beetles, has provided increase sunlight and soil nutrients to release the spruce.

Engelmann spruce produces large seed crops every 3 to 6 years. Germination is best in moist mineral soil, but can also establish themselves in moist duff. Occasional outbreaks of the Engelmann spruce bark beetle can cause damage to the mature stands. The trees have a thin bark and fires can cause considerable damage.

Subalpine Fir

Subalpine Fir (Abies lasiocarpa) is a medium to large tree reaching 80 to 100 feet in height and 18 to 24 inches in diameter. In dense stands, it has a narrowly pyramidal crown with a moderately tapering bole. Open grown trees tend to form tapered boles with dense conical crowns often extending to the ground. The subalpine fir is found in small pure stands, but most commonly with

the other conifers. The fir is the most tolerant of all the local species and is typically found under the canopy of the lodgepole pine stands.

A minor outbreak of the western balsam bark beetle has been occurring for the last 10 years and it is still relatively active. The trees have a thin bark and fires can cause considerable damage.

Douglas Fir

Douglas Fir (Pseudotsuga menziesii) is a major tree species at the lower elevations. The Douglas fir is a medium to large tree reaching 80 to 100 feet in height and 18 to 36 inches in diameter. It forms pure dense stands at lower elevations and at higher elevations it is commonly associated with lodgepole pine, spruce and subalpine fir.

GLOSSARY

Basal Area - Cross-sectional area of a tree measured in square feet at 4.5 feet above ground level.

Bole - Main stem of a tree.

Cable Logging - Method of harvesting timber. A machine is located on a road at the top of a cutting unit. A cable is suspended above the ground to the bottom of a cutting unit. A second cable with a carriage travels down the main cable, logs are hooked to it and are carried up to the road.

Crown fire - A fire spreading through the tops of trees.

DBH- Diameter of a tree at breast height measured 4.5 feet from the upperside of a tree.

Decked - Where logs are staged before being transported to a destination point.

Fuel Break - An area of ground free of trees and large woody material.

Houselog - A tree or log that is of high quality and suitable for house construction.

Jackpot burning - Intentionally setting a fire on areas with large amounts of slash or woody debris. Performed when conditions are wet enough to limit fire spread to other areas of lesser fuels.

Limbed - Process of cutting branches off a felled tree.

Ladder fuels - Fuels at or near ground level that can carry a ground fire into the tree tops or crown.

Percent Cover - Percentage of the ground that is covered with tree crowns.

Pulp - Trees or logs that do not meet the minimum specifications of a sawlog

Sawlog - A log that at minimum contains a 16' segment with a 51/2" top and being 331/3 sound.

Scarification - Removing all woody and duff material down to mineral soil.

Shade intolerant - Trees that require full sunlight for optimum growth.

Shade tolerant - Trees that can grow under a canopy with partial sunlight.

Silvicultural - The art and science of growing a forest.

Slash - Limbs and branches that are removed from the tree prior to shipping..

Spot Burning - Similar to jackpot burning.

Stocking - Density of trees per square feet of ground usually expressed in the number of trees per acre.

Topped - Cutting the tops off the tree.

Tree length logged -

REFERENCES

City of Bozeman, Western Ground Services, City of Bozeman=s Source Water Delineation and Assessment Report, January 2001

City of Bozeman, Western Ground Services, City of Bozeman=s Source Water Protection Plan for the Drinking Water System of Bozeman, Montana, June 2006

City of Bozeman, Bozeman Watershed Council, Sourdough Creek Watershed Assessment, April 2004

USDA, Forest Service, Gallatin National Forest, Draft Environmental Impact Statement, Bozeman Municipal Watershed Project, August 2007