



Appendix V. Sundance Pine Strategy

A large Mountain Pine Beetle infestation occurred in northern Alberta as the Sundance Forest Management Plan 2007 (FMP) was being developed. In order to align the Sundance FMP with provincial initiatives, the effect of the Preferred Forest Management Strategy (PFMS) was analysed in the context of the Interpretive Bulletin “Planning Mountain Pine Beetle Response Operations” version 2.6 issued September 2006 (the Interpretive Bulletin). The analysis quantifies the potential impact of a Mountain Pine Beetle infestation and further emphasizes the necessity for a proactive approach to planning to create a more evenly-distributed age class structure on the managed landbase.

Introduction

The Sundance FMA area, Forest Management Unit R13, was identified in the Interpretive Bulletin as being situated within the Area of Primary Concern for mountain pine beetle control. As no MPB infestations have been detected yet, the implementation of a Prevention (Pine) Strategy for the area is considered “Highly Important and Very Urgent”.

This Pine Strategy aligns with Alberta’s goal “to alter the current age-class structure of susceptible pine forests to increase their long-term resistance to MPB infestations.”¹ While the provincial target of reducing the area of susceptible pine stands in the Rank 1 and Rank 2 categories to 25% of current levels over 20 years is not realistically attainable, a targeted approach to breaking up areas of contiguous pine will allow progress toward the provincial goal while minimizing impacts on other resource values.

Susceptibility Rating and Priority Setting

A series of predictive models has been adopted in Alberta to rank MPB susceptible stands on a consistent basis for all areas of concern. Use of the resulting susceptibility prediction combined with other planning objectives and logistical considerations can help companies to reduce the potential impact of an infestation. The overall ranking is determined by 3 components; a stand susceptibility index, a climate factor and an estimation of compartment risk. Each is described in this section.

¹ Interpretive Bulletin “Planning Mountain Pine Beetle Response Operations” version 2.6, September 2006.

Stand Susceptibility Index

The Stand Susceptibility Index is based on the relative abundance of susceptible pine basal area, age of the dominant and co-dominant live pine and density of each stand. It is a relative measure of stand attributes on a scale from 0 to 100 with a ranking of 100 for stands most conducive to MPB brood development. Results for the Sundance FMA area are shown in Figure 1.

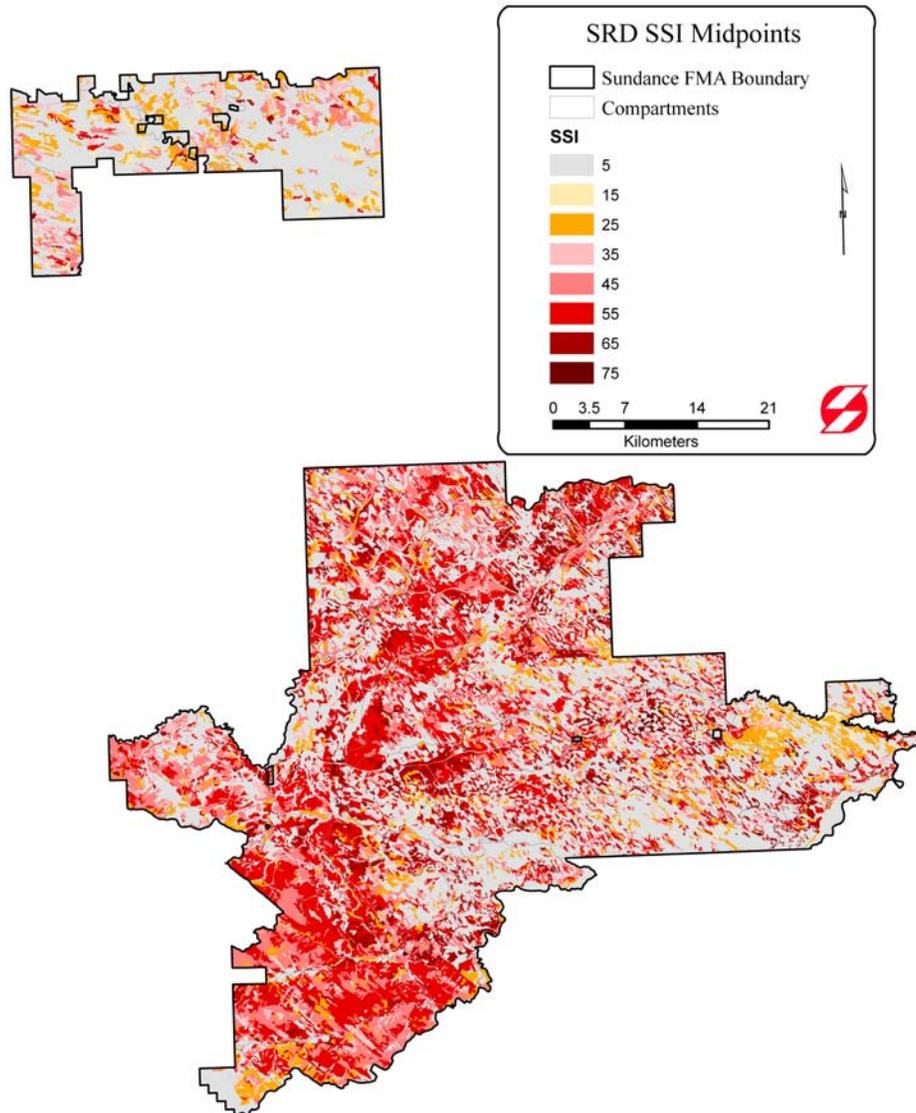


Figure 1. Stand Susceptibility Indices for the Sundance FMA Area.



Climate Factor

The second component of the MPB rating is the Climate Factor. Climate Factor is a measure of the effect that climate will have on beetle development, or the probability that they will undergo one year lifecycles. Higher ranked stands will have more rapid population growth. Results for the Sundance FMA area are shown in Figure 2.

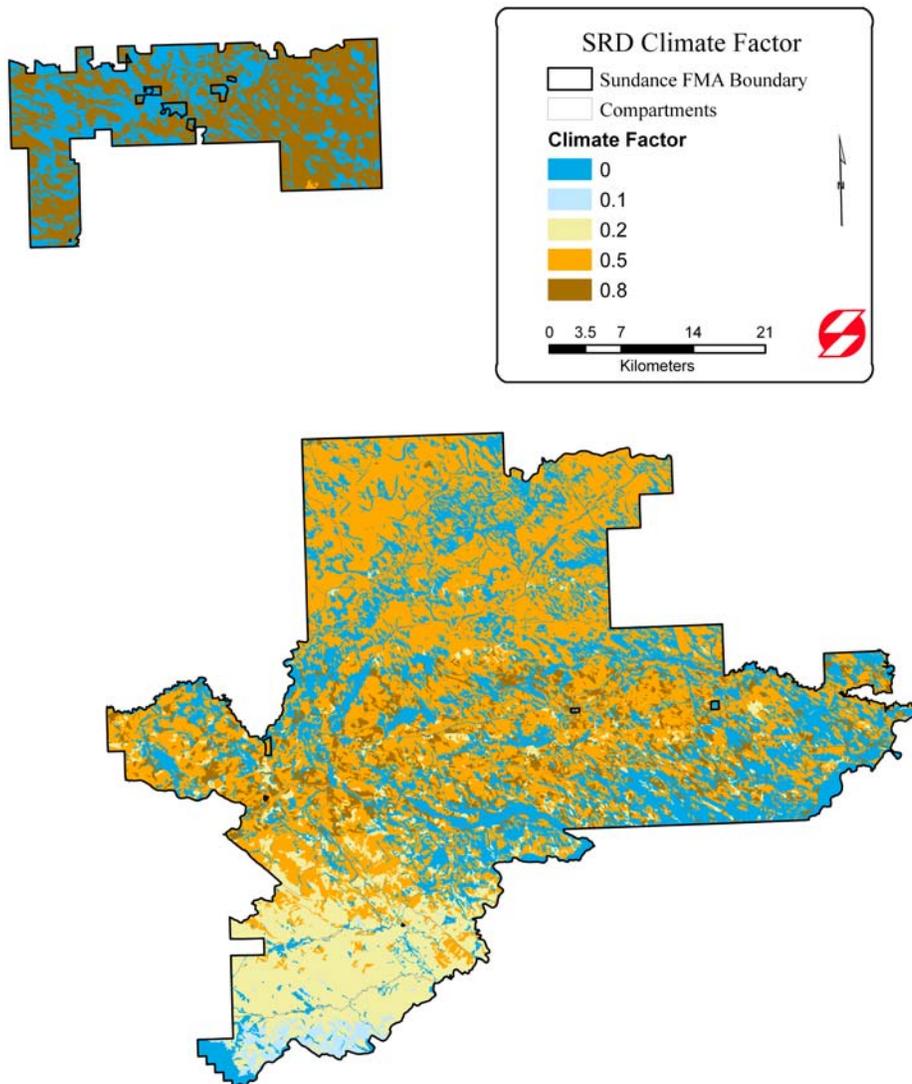


Figure 2. Climate Factors for the Sundance FMA Area.

Compartment Risk

The Compartment Risk was completed by Alberta Sustainable Resource Development for the Sundance FMP. Seven compartments out of 24 were ranked as moderate risk, the rest were ranked as low risk. Results are shown in Figure 3.

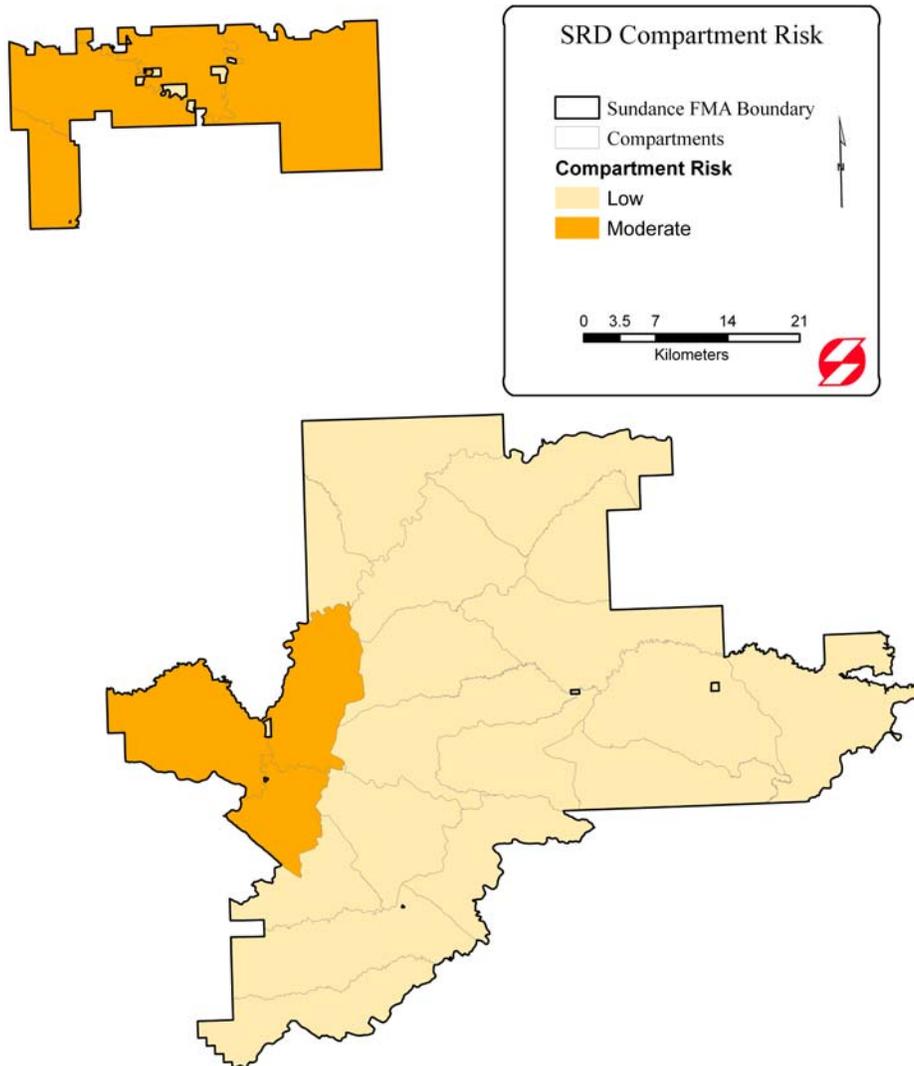


Figure 3. Compartment Risk for the Sundance FMA Area



Pine Strategy Stand Ranking

The three components were combined as shown in Table 1 to calculate the SRD MPB ranking. A map of the SRD ranking can be seen in Figure 4. The Climate Factor and Compartment Risk comprise the main effect of the MPB rating; a climate factor of ≥ 0.8 and a high Compartment Risk would result in a Rank 1 stand, even if there were only 10% pine in the stand. Alternatively, if the Compartment Risk were Low and the Climate Factor were ≤ 0.5 , the highest the rank would be is 2 even if the SSI were 100 (highest SSI possible).

Table 1. SRD MPB Rank Calculation.

Climate Factor (per stand)	Compartment Risk	SRD MPB Ranking			
Very Suitable 1.0	High	1	1	1	1
	Moderate	2	1	1	1
	Low	2	2	1	1
Highly Suitable 0.8	High	1	1	1	1
	Moderate	2	2	1	1
	Low	2	2	2	1
Moderately Suitable 0.5	High	2	1	1	1
	Moderate	2	2	2	1
	Low	3	2	2	2
Low Suitability 0.2	High	2	1	1	1
	Moderate	3	2	2	2
	Low	3	2	2	2
Very Low Suitability 0.1	High	3	2	2	2
	Moderate	3	3	2	2
	Low	3	3	3	3
SSI		0 to 30	31 to 50	51 to 80	81 to 100

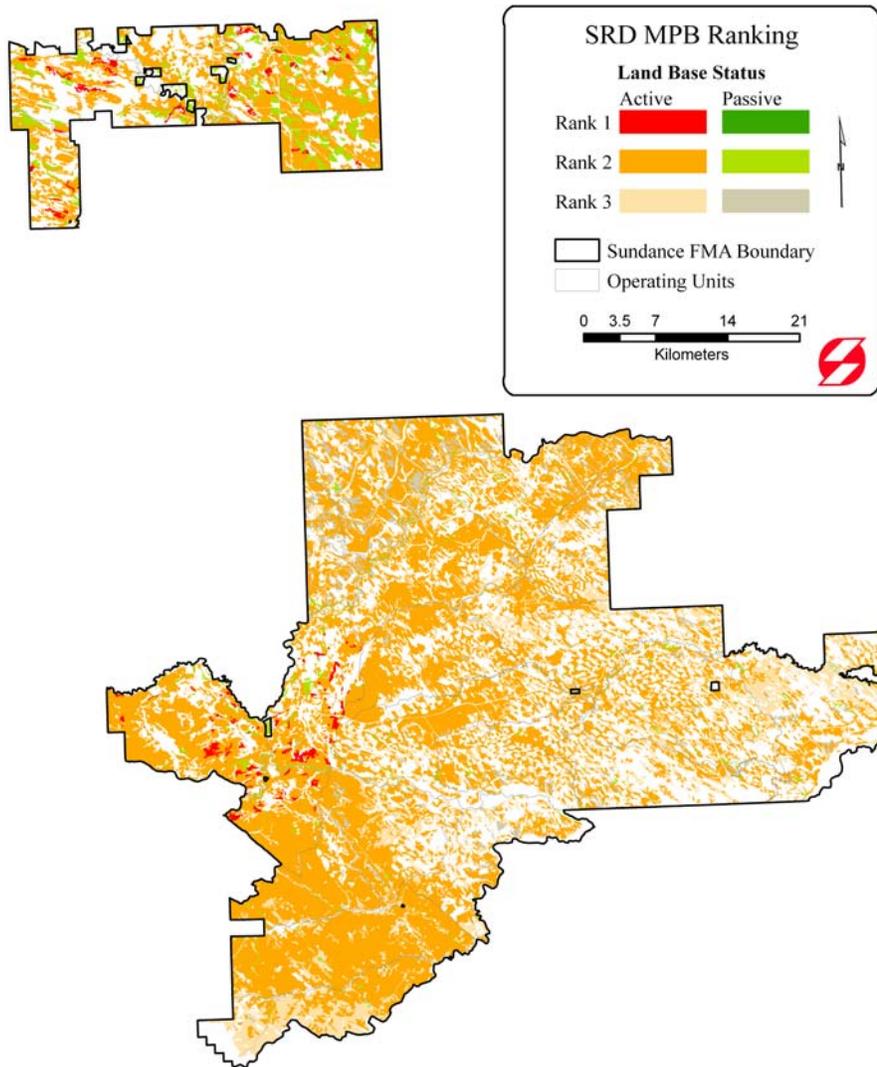


Figure 4. SRD MPB Ranking for the Sundance FMA Area



Sundance Pine Ranking

As 69% of the managed landbase is classified as Rank 1 or Rank 2 under the provincial classification, a Sundance ranking was developed to prioritize stands with high biological and economical risk. Forest areas where the AVI label shows 90 percent or more pine and a height of 20 meters or taller were included in the Sundance Pine Ranking. These stands are a subset of the SRD Rank 1 and Rank 2 stands. Their locations are shown in Figure 5.

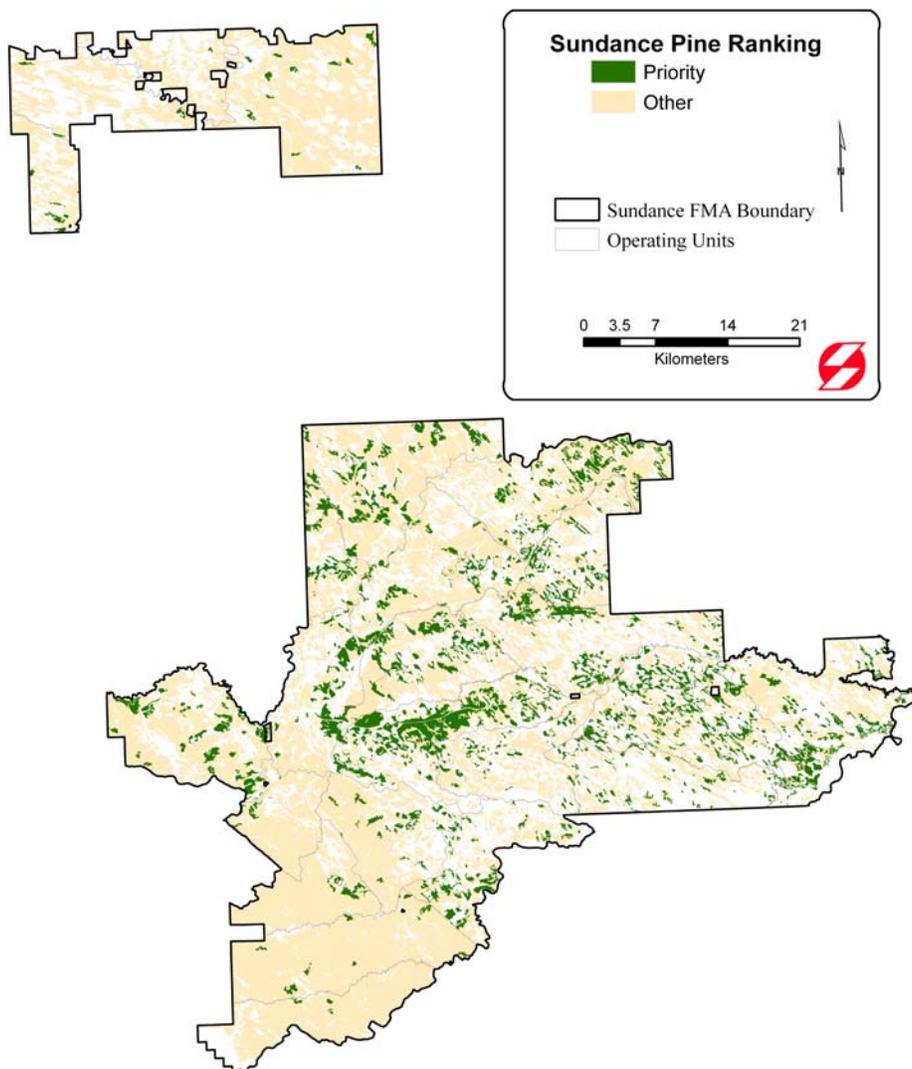


Figure 5. Sundance Pine Ranking for the Sundance FMA Area

Spatial Harvest Sequence

Five different scenarios were tested to help understand the potential impact of an infestation and to develop the spatial harvest sequence that was adopted as the PFMS for this Pine Strategy. They are described in Table 2 below:

Table 2. Scenarios used to examine the MPB effects.

Scenario Name	Features
Determine Area of Rank 1 and 2 Stands Remaining	
Based on 2002 TSA	Harvest levels as per 2002 TSA
PFMS	Harvest levels as per 2007 PFMS
Policy	Harvest level to remove 75% of Rank 1 and Rank 2 stands in 20 years
MPB Disaster Scenarios	
Disaster with recovery	Pine attacked in 10 years, harvest level recovers in future
Disaster no recovery	Pine attacked in 10 years, harvest level recovers is even flow after attack and salvage period.

2002 Timber Supply Analysis (TSA)

In 2002, additional data were collected and analysed to update the harvest levels that had been approved in the 1999 Detailed Forest Management Plan. A new timber supply analysis was completed and a 5% surge cut was approved with new harvest levels for all operators within the Sundance FMA area.

Sundance PFMS

As described in Section 4 of the Sundance FMP, the PFMS was developed to focus on reducing the area of Sundance Ranked pine over the next 10 years. In order to decrease the area of mature pine forest more quickly, a 10 year period of harvesting at levels 100% above the long run sustained yield average was used. Following the initial 10 year period, the harvest levels decrease to 420,670 m³ of coniferous timber annually.

Reduce the Area of Rank 1 and Rank 2 Stands to 25% of Current

Given that the managed landbase, as described in Section 2 of the FMP, is predominantly pine, harvesting 75% of the Rank 1 and Rank 2 Stands would require an annual allowable cut of 1,048,424 m³ annually for the next 20 years. This level of harvest would not be practical, nor feasible as there is not sufficient manufacturing capacity in the area to utilize the volumes that would be generated and any new facilities would have volume available for only a limited time.

This harvest level (called the “Policy” level) is compared to the Sundance 2002 TSA and to the PFMS level to compare the area of Rank 1 and Rank 2 stands left after 20 years. Results for the gross and managed landbase are shown in Tables 3 and 4 below. Results for the Sundance Ranked Pine are shown in Table 5.

**Table 3. Gross SRD MPB ranked areas currently and in 20 years from selected scenarios.**

Scenario	SRD MPB Rank Area (ha)		Percent Reduction (%)	
	1 & 2	3	1 & 2	3
Current Status (2007)	128,460	27,175		
2027 Based on 2002 TSA	94,782	24,479	26%	81%
2027 PFMS	79,081	23,679	38%	81%
2027 Policy	38,039	27,175	70%	79%
2027 MPB Disaster	-	-	100%	100%

Table 4. Managed SRD MPB ranked areas currently and in 20 years from selected scenarios.

Scenario	SRD MPB Rank Area (ha)		Percent Reduction (%)	
	1 & 2	3	1 & 2	3
Current Status (2007)	120,583	19,572		
2027 Based on 2002 TSA	86,905	16,876	28%	86%
2027 PFMS	71,204	16,076	41%	86%
2027 Policy	30,161	19,572	75%	84%
2027 MPB Disaster	-	-	100%	100%

Table 5. Sundance Pine Ranking currently and in the future based on selected scenarios.

Scenario	Sundance Pine Ranking (ha)		Percent Reduction (%)	
	Gross	Managed	Gross	Managed
Current Status (2007)	22,457	22,151		
2027 Based on 2002 TSA	4,947	4,641	78%	79%
2027 PFMS	425	119	98%	99%
2027 Policy	5,828	5,522	74%	75%
2027 MPB Disaster	-	-	100%	100%

MPB Infestation (“Disaster Scenarios”)

If it is assumed that there is a massive pine mortality of all pine stands 20 years of age or older in 2017, and harvesting continues at 1,048,424 m³ per year in the dead wood, there would still be large areas that would not be harvested. For the Disaster scenarios, the unsalvaged stands were assumed to regenerate as follows:

For stands with greater than 60% pine content, the entire stand was assumed to die and return to the yield curve for the stratum at age 0 in 2032.

For stands with less than or equal to 60% pine content, the yield curves shown in the Yield Curve Documentation for the Sundance FMP 2007 were reduced to remove the pine content on a proportional basis and the stand continued to grow at its current age. No assumption was made for stand release due to opening of the canopy by the pine mortality.

The evenflow harvest that would result from this scenario has been estimated to be 84,908 m³ of coniferous fibre per year. If the harvest level is allowed to increase as the forest recovers, the annual allowable coniferous cut would be 88,661 m³ for approximately 50 years, at which time it would increase to 421,627 m³.

Table 6. Harvest levels from the selected mountain pine beetle runs

Scenario	Year	Harvest level (m ³ /yr)		
		Conifer	Deciduous	Total
2027 Based on 2002 TSA	2007-2026	437,659	59,264	496,923
	2027-2206	413,545	52,849	466,394
2027 PFMS	2007-2016	841,666	60,041	901,707
	2017-2206	420,670	55,017	475,687
2027 Policy	2007-2016	1,048,424	74,751	1,123,175
	2017-2206	301,506	37,920	339,426
Disaster with recovery	2007-2026	1,048,424	73,144	1,121,568
	2027-2076	88,661	39,765	128,425
	2077-2206	421,627	48,182	469,809
Disaster no recovery	2007-2026	1,048,424	73,144	1,121,568
	2027-2206	84,908	21,312	106,220

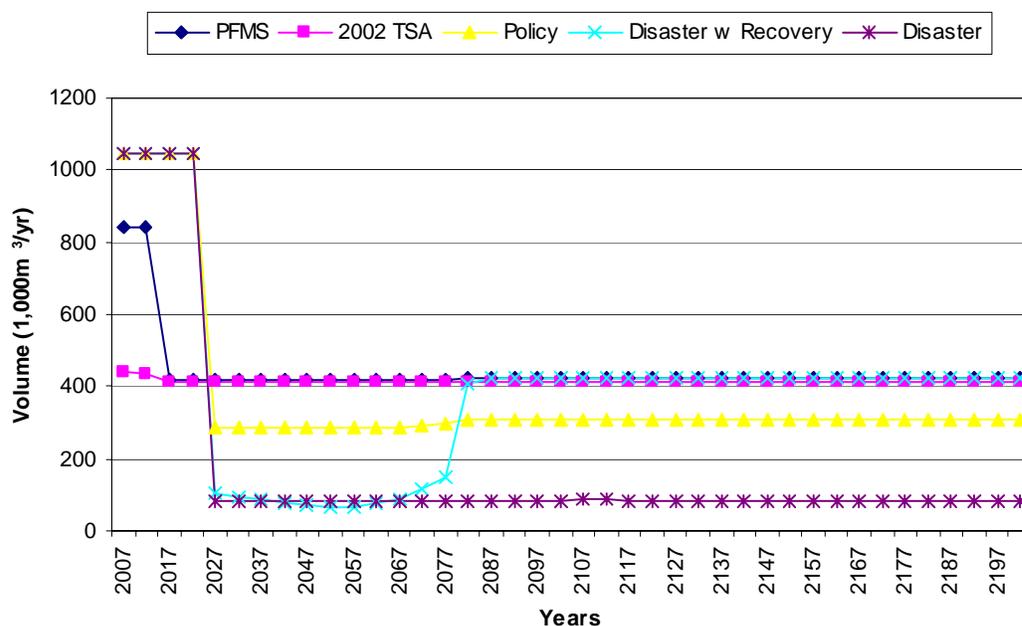


Figure 6. Predicted Annual Coniferous Harvest for 200 years

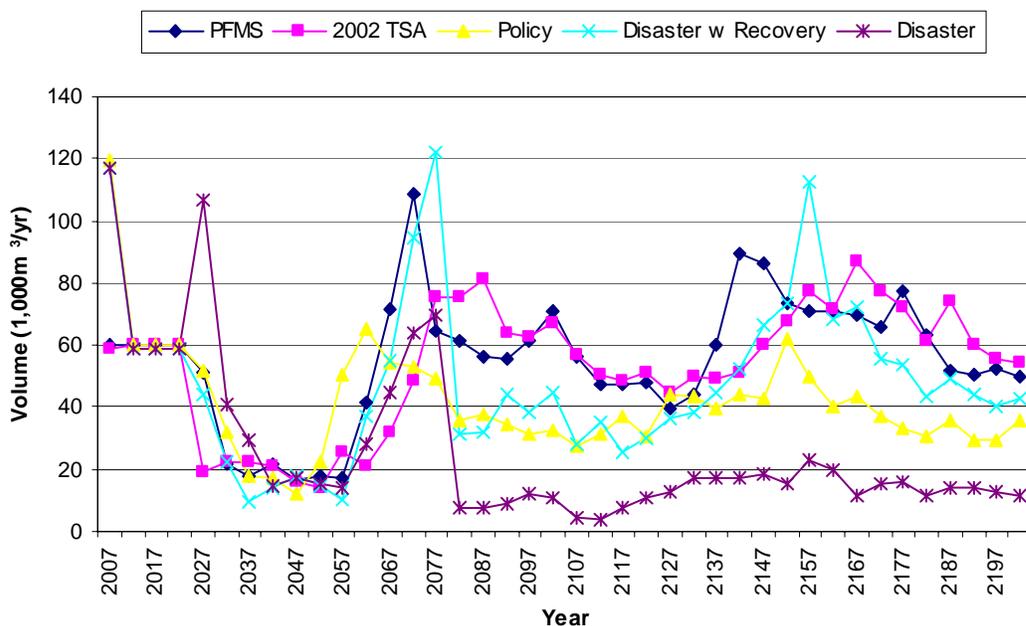


Figure 7. Predicted Annual Deciduous Harvest for the next 200 years.

Access Development

No new permanent roadways are required to be built to implement this Pine Strategy. Any new roads built will be for short term access and will be built to the minimum practical standard. These temporary roads will be left open for the shortest possible time.

Habitat Considerations for Species of Special Concern

This Pine Strategy will minimize effects on species of special concern. It should be recognized that further habitat impacts may occur if a mountain pine beetle infestation requires control at some future date.

Woodland Caribou

The Sundance FMA area does not overlap with any woodland caribou zones and no caribou are known to be living within the area.

Grizzly

A habitat analysis was done for the Sundance FMA area by the Foothills Model Forest to determine existing and future grizzly bear habitat. Details are shown in Appendix III of the Sundance Forest Management Plan 2007. The Mean RSF and Safe Harbour Index are both forecast to increase with implementation of the Spatial Harvest Sequence. Although the Open Road Density will not change, there will be some increase in mortality risk, associated with public use of temporary access structures, over the duration of this harvest sequence (2008-2016) and for a couple of years afterward.

The results are based on no new permanent roads being constructed for this harvest plan. As described in Section 3.2 and Appendix IV of the Sundance Forest Management Plan 2007, all access required for this Spatial Harvest Sequence will be temporary and will be reclaimed as soon as possible following harvesting and silvicultural activities. The use of visual buffers in core habitat areas will also help to reduce the visibility of bears in new and existing openings.

Trumpeter Swan

There are 4 lakes in the Sundance FMA area that have been identified as potential habitat for Trumpeter Swans as shown in Figure 8. No harvesting has been scheduled within 200 metres of any of these lakes. In addition, activities in the vicinity of the identified lakes will be limited to the time between October 1st and March 31st and only Level I treatments, if required, will be conducted within 200 metres of high water marks.

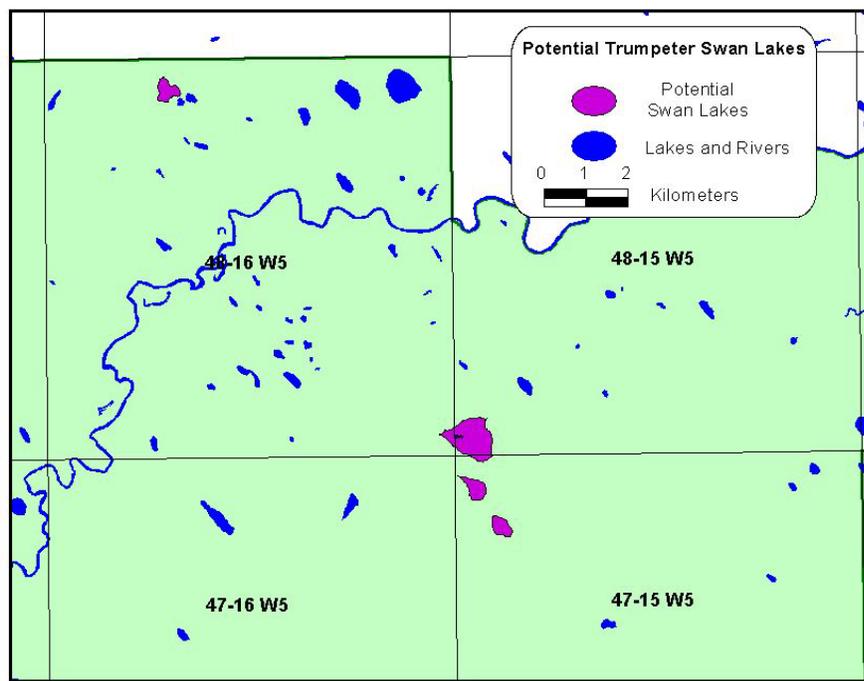


Figure 8. Potential Trumpeter Swan Lakes

Riparian Areas

Riparian areas have been withdrawn from the timber harvesting landbase and are not sequenced for harvest in the PFMS. If MPB are detected in riparian areas, Level I tactics will be used whenever possible to treat all infested trees before the population has a chance to grow and infest more trees. In the event that Level I resources are not available, harvests will be conducted to control the infestation. At all response levels, adhering to the following principles will minimize the impact to the riparian area:

- i. Harvesting will be done in a manner that will minimize the potential for soil erosion and soil damage.
- ii. Soil, logging debris or deleterious materials will not be deposited into the water or onto the ice of any watercourse or water body during road construction, harvest,



reclamation or reforestation operations. Such material unavoidable deposited onto the ice will be removed immediately.

- iii. Operations will be completed as quickly as possible.

Watershed

An analysis of the hydrologic effects of harvesting the PFMS was conducted by Watertight Solutions Ltd. (See Appendix VII). The analysis included modeling annual water yield, maximum daily flows and hydrologic recovery for the 20 year period of the spatial harvest sequence. Twenty-four sub-watersheds ranging in size from 10 to 103 km² were selected for simulations.

Predicted water yield increases in parts of the Elk River Operating Area have the potential to cause elevated watertables in some locations. Additionally, the % Equivalent Clearcut Area (ECA) for 3 of the Elk River sub-watersheds (representing less than 200 km²) exceed 25%, showing potential for slow hydrologic recovery. There are also some sub-watersheds where frequent peak flows increase by over 5%. While increased peak flows in the lower elevation blocks may not cause much impact due to the storage effects in such blocks, the increase in the most frequent peak flows in the high elevation blocks can be of concern due to potential to cause erosion of steep slopes and delivery of sediment to watercourses.

For one 24.6 km² sub-watershed in the Erith Operating Area, the increase in water yield is predicted to be significant at 12.2%, however the %ECA is less than 25%, and hydrologic recovery is within 17 years, showing potential for quick recovery. The most frequent peak flows (ie 2-year, 5-year, 10-year and 20-year peak flows) in this sub-watershed increase by over 5%, with potential to cause erosion and sediment delivery to watercourses.

The analysis concludes that the simulated increases in water yield and peak flows for the proposed harvesting are considered small to moderate in magnitude and duration with no adverse impacts on water quality and aquatic habitat expected.

Existing regulations and company ground rules require that harvesting and road building activities be carried out using methods that minimize watershed impacts. The Sundance Pine Strategy, as presented, also maintains stream buffers along permanent water courses. While implementing the Pine Strategy, potential watershed impacts will be closely monitored within sub-watersheds shown to be most susceptible.

Whitebark and Limber Pine Stands

At this point in time, no whitebark or limber pine stands have been identified in the Sundance FMA area. If any stands are found and become infected, they will be managed in a manner that strives to maintain the integrity of the stand and pheromone baits will not be placed on any of the trees. Non-infested trees will not be harvested.

Operating Ground Rules

New ground rules will be developed once the Sundance FMP is approved. MPB criteria and issues will be incorporated in the new ground rules, if necessary.

Annual Allowable Cut Sharing

As described in Section 5 of the Sundance Forest Management Plan 2007, the annual allowable cut derived from the PFMS will be shared with the other existing disposition holders as shown in Table 7 and Table 8.

Table 7. Proposed Allocations for FMU R13 1 May 2007 to 30 April 2017

Company Name	Disposition Number	Coniferous AAC		Deciduous AAC		Effective Date
		Basis for Cut	m ³ /year	Basis for Cut	m ³ /year	
Tall Pine Timber	CTQR130003	0.16% of FMU AAC	1,347	n/a	0	01-May-07
Precision Forest Industries	CTQR130001	0.46% of FMU AAC	3,872	n/a	0	01-May-07
Medicine Lodge Timber Products	CTQR130002	1.92% of FMU AAC	16,160	n/a	0	01-May-07
E1 Community Timber Program	R13 CTP	1.21% of FMU AAC	10,184	11.85% of FMU AAC	7,115	01-May-07
Edson Community Harvesting Org.	CTQR130004	0.94% of FMU AAC	7,912	n/a	0	01-May-07
Edson Community Harvesting Org.	CTQR130004	Fixed Volume	7,062	n/a	0	01-May-07
Sundance Forest Industries	FMA 9700032	Balance of FMU AAC	795,130	Balance of FMU AAC	52,926	01-May-07

Table 8. Proposed Allocations for FMU R13 1 May 2017 to 30 April 2027

Company Name	Disposition Number	Coniferous AAC		Deciduous AAC		Effective Date
		Basis for Cut	m ³ /year	Basis for Cut	m ³ /year	
Tall Pine Timber	CTQR130003	0.16% of FMU AAC	670	n/a	0	01-May-17
Precision Forest Industries	CTQR130001	0.46% of FMU AAC	1,926	n/a	0	01-May-17
Medicine Lodge Timber Products	CTQR130002	1.92% of FMU AAC	8,040	n/a	0	01-May-17
E1 Community Timber Program	R13 CTP	1.21% of FMU AAC	5,067	11.85% of FMU AAC	7,113	01-May-17
Edson Community Harvesting Org.	CTQR130004	0.94% of FMU AAC	3,936	n/a	0	01-May-17
Edson Community Harvesting Org.	CTQR130004	Fixed Volume	7,062	n/a	0	01-May-17
Sundance Forest Industries	FMA 9700032	Balance of FMU AAC	392,061	Balance of FMU AAC	52,916	01-May-17

Public Review of Plans

The Sundance Forest Management Plan 2007, including the PFMS described in this Pine Strategy, was developed with input from a range of public and professional individuals and groups. Consultation has been ongoing since 2004.

The Sundance Plan Development Team met 14 times between September 2004 and March 2007 to review components of the Sundance Forest Management Plan 2007. Team members included forest practitioners and biologists from Sundance and from Alberta Sustainable Resource Development. In addition, SRD staff from the Foothills Area reviewed the spatial harvest sequence for the northern compartments on behalf of the imbedded disposition holders.

The Sundance Public Advisory Committee served as the Public Advisory Group for development of the FMP. All aspects of the FMP, including the Spatial Harvest Sequence for the PFMS were presented to the group. Group membership included representatives from organizations as shown in Table 9.

Letters were sent to 12 different First Nations with Indian Reserves in western Alberta advising them that preparation of a Forest Management Plan was in progress and providing contact information. Sundance staff members subsequently met with Council Members from two of the First Nations to discuss current and future planning as well as employment opportunities.

**Table 9. Public Advisory Group Membership**

Name	Location/Represents
Mr. Norm Rodseth	Trout Unlimited
Mr. Elmer Hohne	Imbedded Quota Holders
Mr. Keith Williams	Public Member – Edson Area
Mr. John Frank	Alberta Trappers Association
Mr. Dave Harrison	Public Member – Drayton Valley Area
Mr. Dave Cobb	EDFOR (Community Timber Program)
Mr. Rob Gibb/Mr. Jesse Kirillo	Oil & Gas Industry (Talisman Energy Corp.)
Mr. Gary Conger/Mr. Roger Byrt	Yellowhead County
Mrs. Bonnie Dietner/Mrs. Mary Olson	Town of Edson
Mr. Bert Ciesielski	Alberta Sustainable Resource Development, Clearwater Area
Mr. John Huey	Sundance Forest Industries Ltd.
Ms. Pat Golec	Sundance Forest Industries Ltd.

Sundance staff members presented the Sundance Pine Strategy to the Alberta Mountain Pine Beetle Advisory Committee on 6 December 2007. The purpose of the Committee is to provide the Minister of Alberta Sustainable Resource Development with advice on the strategies and approaches that can be used to minimize the threat posed by the mountain pine beetle. No concerns were expressed by committee members at the meeting. Committee membership is shown in Table 10.

Table 10. Alberta Mountain Pine Beetle Advisory Committee Membership

Name	Location/Represents
His Worship Dr. John Irwin	MPB Advisory Committee Chair Mayor, Municipality of Crowsnest Pass
Chief Cameron Alexis	Chief, Alexis First Nations
Mr. Andy Boyd	Environmental Chair, Alberta Fish & Game Association
His Worship Ron Casey	Mayor, Town of Canmore
Mr. Kyle Clifford	Acting Executive Director, Field Operations, Parks, Conservation, Recreation & Sport Division, Alberta Tourism, Parks, Recreation and Culture.
Mr. D. Wayne Clogg	Vice President, Woodlands, West Fraser Timber Co. Ltd.
Her Worship Louise Krewusik	Mayor, Town of Grande Cache
Mr. Lorne Goff	Public Member, Rocky Mountain House, Alberta
Mr. Ron Hallman	Executive Director, Mountain Parks, Parks Canada
Mr. Cliff Henderson	Assistant Deputy Minister, Sustainable Resource Development, Forestry Division
Mr. Gordon Lehn	Woodlands Manager, Spray Lake Sawmills Member, Board of Directors, Alberta Forest Products Association
Mr. Everett McDonald	Reeve, County of Grande Prairie No. 1
Dr. Gordon Miller	Director General, Canadian Forest Service, Northern Forestry Centre
Mr. David Pryce	Vice President-Western Canada Operations, Canadian Association of Petroleum Producers (CAPP)
Mr. Philip Rowland	Public Member, High River, Alberta
Mr. Ross Risvold	Public Member, Hinton, Alberta
Mr. Doug Sklar	Executive Director, Sustainable Resource Development, Forest Management Branch
Dr. John Spence	Chair, Department of Renewable Resources, University of Alberta
His Worship Trevor Thain	Mayor, Town of Whitecourt

Source: <http://www.srd.gov.ab.ca/forests/health/pestalerts/mpbadvisory.aspx> accessed Jan. 29/08.

Individual letters were sent to all imbedded disposition holders stating the proposed AAC for their disposition and showing the location of future harvesting as per the spatial harvest sequence. One quota holder (0.46% of the conifer AAC) expressed an unspecified concern regarding the increased allocation and the sequencing. Further discussion will take place.

Conclusion

The Sundance Pine Strategy incorporates mountain pine beetle planning in combination with other values, providing a measured response to a potential threat. It demonstrates that long-term sustainability will not be affected and impacts on other resources will be minimized. By targeting a subset of the Rank 1 and Rank 2 stands, the PFMS prioritizes harvesting efforts in areas where the value of the standing timber is the greatest. It also incorporates other values and objectives, not all related to MPB control:

- Breaking up areas of contiguous pine forest is expected to reduce the rate of spread of an MPB infestation, should one occur.
- Breaking up areas of contiguous pine forest will help reduce the rate of spread of wildfires that may occur in the future.
- Reducing the amount of large diameter pine should help to reduce the survival rate of MPB larvae as smaller diameter trees have less insulation and less food for overwintering broods.
- Modification of the age class structure will create a more diverse, healthier forest.
- Riparian areas have been avoided.
- No new permanent access is planned.
- Patch size targets have been incorporated.
- Volume commitments to imbedded operators have been increased.

In addition to the abovenoted benefits, this Strategy, in combination with the Sundance Forest Management Plan 2007, also provides background data to allow the company to respond more effectively if the mountain pine beetle threat materializes.

The resulting annual allowable cut for the next 200 years is shown in Table 11 and the allocation by compartment is described in Table 12. The Spatial Harvest Sequence is shown in Figure 9.

Table 11. Annual Allowable Cut for the Sundance FMA Area (R13)

Year	Harvest Level (m ³ /yr)	
	Conifer	Deciduous
2007-2016	841,666	60,041
2017-2026	418,763	60,029
2027-2206	420,776	54,739



Table 12. Allocation by Compartment and Quadrant for the Sundance FMA Area

Comp.	Quadrant 1		Quadrant 2		Quadrant 3		Quadrant 4		Total	
	C Vol. (m ³)	D Vol. (m ³)	C Vol. (m ³)	D Vol. (m ³)	C Vol. (m ³)	D Vol. (m ³)	C Vol. (m ³)	D Vol. (m ³)	C Vol. (m ³)	D Vol. (m ³)
1	0	0	0	0	16,865	238	74,888	1,065	91,753	1,303
2	6,214	144	70,959	1,580	126,586	2,548	194,591	3,063	398,350	7,335
3	33,922	2,967	201,403	12,209	110,400	8,957	97,729	9,813	443,454	33,945
4	138,156	7,960	247,065	5,714	86,045	14,312	67,649	11,013	538,914	38,999
5	0	0	63,722	1,487	21,343	429	32,160	526	117,225	2,442
6	5,996	147	81,158	1,827	63,889	1,165	73,915	1,328	224,957	4,468
7	26,234	585	123,541	1,673	310,710	3,622	242,103	2,453	702,588	8,333
8	225,076	5,141	218,592	4,396	216,685	4,155	37,441	827	697,794	14,520
9	687,893	24,171	189,444	13,646	106,918	20,384	116,306	9,725	1,100,560	67,925
10	145,627	9,174	68,589	2,919	33,253	3,958	71,224	8,077	318,693	24,129
11	94,343	8,990	89,221	16,724	37,977	11,957	64,852	28,085	286,392	65,756
12	254,996	27,008	93,781	2,997	99,049	19,636	81,528	33,419	529,354	83,060
13	527,992	43,721	282,998	70,645	86,310	14,599	39,957	10,839	937,257	139,804
14	434,140	40,610	68,202	1,318	48,707	16,391	111,300	20,488	662,349	78,806
15	318,996	8,071	235,336	5,441	177,611	4,318	142,605	3,567	874,549	21,397
16	365,754	8,513	531,710	11,264	56,517	919	105,128	2,185	1,059,109	22,880
17	141,790	9,472	101,667	2,420	73,731	5,264	32,927	3,716	350,115	20,871
18	276,390	7,841	377,321	8,126	105,788	7,532	159,612	20,858	919,110	44,357
19	96,837	2,797	708,558	31,424	106,014	22,079	141,626	10,227	1,053,034	66,526
20	76,848	1,261	88,271	1,423	38,623	726	18,996	262	222,738	3,672
21	31,653	778	29,226	6,731	7,223	1,623	25,914	9,657	94,016	18,789
22	103,024	57,092	111,982	22,818	55,092	58,851	51,568	33,098	321,666	171,859
23	25,105	5,955	24,834	1,089	13,075	12,174	14,222	32,015	77,237	51,232
24	190,346	27,906	201,752	72,241	95,482	64,334	95,497	43,818	583,076	208,298
Total	4,207,329	300,304	4,209,333	300,110	2,093,891	300,168	2,093,738	300,124	12,604,290	1,200,706

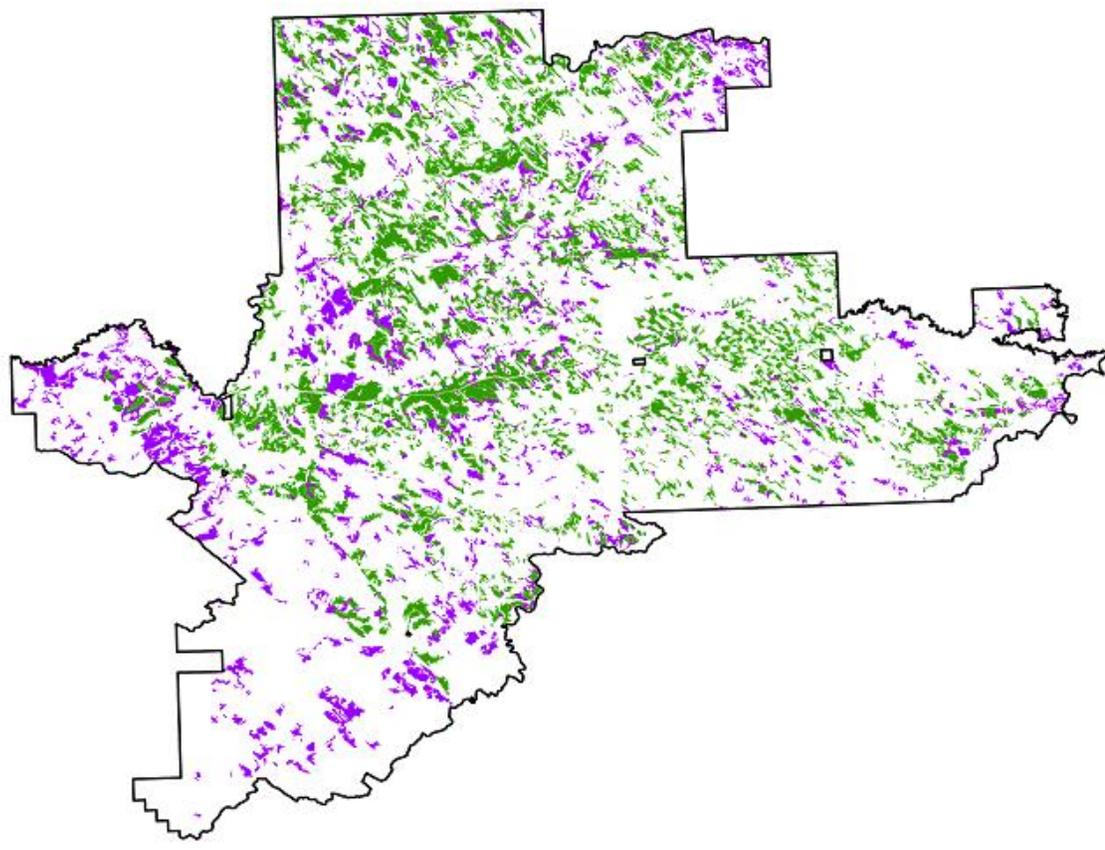
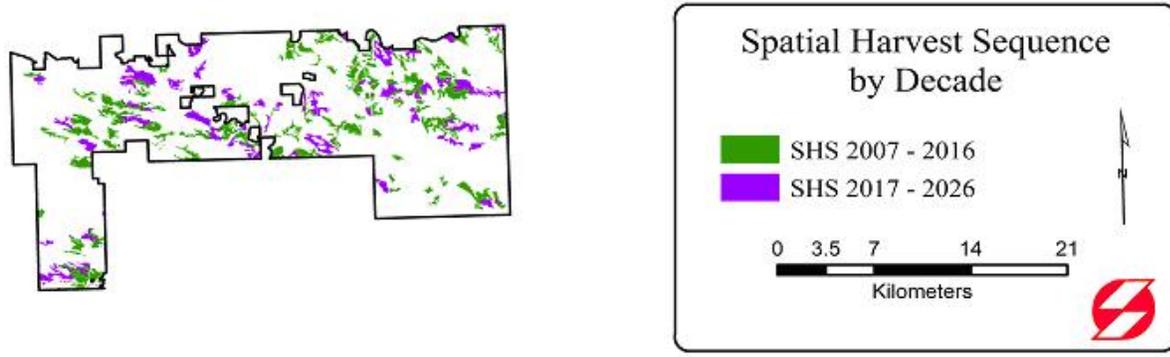


Figure 9. Spatial Harvest Sequence for the Sundance PFMS