Peace Forest District
Mountain Pine Beetle
Comprehensive Strategy

For: BC Forest Service, Peace Forest District

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District Manager Endorsement

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June 7, 2007

Section 1: Executive Summary

In British Columbia, mountain pine beetle is currently at the highest recorded incidence levels in recorded history in North America. It is predicted that 80 percent of the pine forests in British Columbia will be dead within six years. Expansion of the infestation into areas not previously thought to be conducive to support beetle populations are occurring due to global warming, unprecedented levels of infested trees, and lack of extreme weather events. The Peace Forest District is now experiencing extreme infestation levels along the western edge of the Dawson Creek TSA. The historical incidence of mountain pine beetle in the Peace has been short with the first recorded infestation in 2004. Since discovery of MPB in 2004, an extensive sanitation and single tree treatment program was implemented in the Peace Forest District.

Mountain pine beetle historical and current infestation levels:

- Mountain pine beetles levels are extensive in BC and specifically the Peace Forest District with the first recorded attack in 2004.
- Although the level of effort has been significant, harvesting and single tree treatments have been strategically focused according to a priority ranking system.

Implications to harvesting:

- Pine volumes at risk
- Current amount of AAC
- Estimates of NRLs
- Expectations for the future

Some critical issues are:

- It is absolutely critical to ensure that all agencies (MOF, WALP, municipalities, volume licensees, TFL, oil and gas industry, First Nations, etc.) immediately focus on MPB and pine management.
- The responsibilities and roles of individuals and agencies listed above need to be defined.
- Drought-like conditions for the last two summers have accelerated the drying out process of beetle killed wood which most likely will shorten the shelf life period of beetle killed wood.

Spread into surrounding areas more northern and eastern than previously expected into:

- **Alberta** – with the most northern extent north of Lesser Slave Lake and eastern to Fox Creek
- **Fort St. John** – on a northeastern trajectory

Outline of Recommendations

This section outlines a summary of recommendations included in this report.

1. This strategy should be considered a "living" dynamic report which should be reviewed annually as additional information becomes available.

2. Detection is an important tool when determining treatment priorities therefore detailed aerial surveys and ground surveys should be implemented to assist in treatment ranking continually throughout the program.

Communications

3. Define the roles and responsibilities between all involved parties including district, region, and branch staff in the Ministry of Forests and Range, licensees, PricewaterhouseCoopers, other stakeholders, and Alberta government and licensees.

4. Provide monthly updates for all parties to view of spread control operations on both the British Columbia and Alberta side in a centralized location.

5. Send out a cohesive letter of intent outlining the allocations of all areas of responsibility broken down by funding source. A fiscal cycle of May 30th to June 1 would provide a better fit for mountain pine beetle programs.

6. Strengthen data sharing between British Columbia and Alberta including priorities, detailed and ground surveys, treatments, and stand susceptibility. It is recommended that each province make all survey data, susceptibility mapping, and strategies readily available, possibly in a centralized location, in a timely manner.

7. Starting immediately, the Peace Forest District and licensees need to work cooperatively with Alberta Sustainable Resource Management and Alberta licensees to define priorities ensuring adjacent jurisdiction efforts are matched. Discussions need to continue throughout the year.

Stumpage/ Harvesting

8. Major licensees including BCTS should continue to work cooperatively within the district to sanitize and salvage heavily infested areas first. This may require having BCTS harvest outside of their existing pricing units.

9. Increase cost allowances within the current stumpage rates to allow fair and accurate timber valuation in the north east corner of British Columbia.

10. Examine potential of transferring harvesting power into Peace Forest District.

11. In addition to the harvesting of mountain pine beetle infested and susceptible pine an analysis based rationale should be determined to include the prioritization of harvesting burned wood over beetle infested wood. It is understood that burned wood does have a place within a harvest priority matrix however its position of placement must be determined by a strategic, stewardship-based analysis.

Funding

12. Funding for single tree treatment programs need to be finalized early in the program year (i.e. June for surveys and October for treatments) in order to allow for surveys and treatments to correspond with strategic direction both within the district and adjacent jurisdictions including Alberta. Late funding or reduced funding causes numerous issues with timing of treatments, capacity of program to delivery targets due to securing adequate resources, ensuring that treatment direction corresponds to overall strategies, safety of crews, etc.

13. Funding sources for Mountain pine beetle control on private land and agricultural land reserves should be more readily accessible.

Miscellaneous

14. Obtain additional information on mountain pine beetle impacts to caribou to provide recommendations on strategies to proceed which will minimize impacts to caribou in the Peace Forest District.

15. Outline areas where leaving naturally occurring fires will be acceptable and encouraged to reduce pine susceptibility.

16. Develop guidelines for a silviculture strategy.

17. An updated review should be conducted of the mid-term timber supply analysis for the entire Peace Forest District.

18. Increase forestry workforce through recruitment at job fairs.

19. Best Management Practices for the Oil and Gas Sector should change the practice of setting traps around felled timber to either burning or debarking infested pine trees, as bait funnel traps could cause additional attack in surrounding stands.

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Section 3: Introduction

The mountain pine beetle, *Dendroctonus ponderosae*, is the most important damaging agent of mature lodgepole pine in North America. Currently the mountain pine beetle is at epidemic levels in British Columbia, with aerial overview surveys mapping approximately 9.2 million hectares of red attack in 2006. This represents over 10 percent of British Columbia's land base having varying degrees of mortality (Ministry of Forests and Range 2007a) and is up from the 8.7 million hectares in 2005 and 7.0 million in 2004. It has been stated that, "The pine beetle epidemic is the worst natural disaster ever to hit our forests," (Campbell 2005) and over a billion cubic meters of Interior timber is predicted to be killed by mountain pine beetle by 2013 (Hamilton 2007). Figure 1 outlines the distribution of attack recorded during the 2006 aerial surveys.

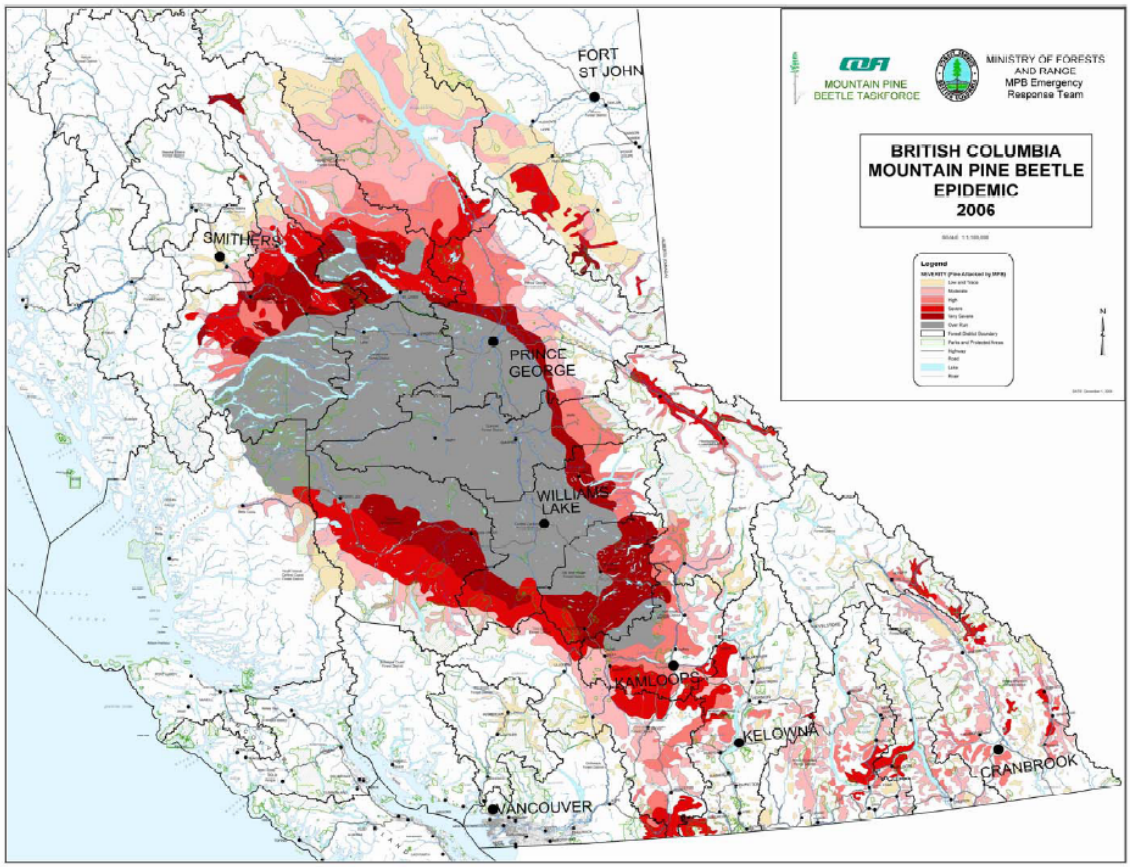

Figure 1. Distribution of Mountain Pine Beetle Attack as recorded from Aerial Overview Surveys (2006).

Source: Ministry of Forests and Range 2007
http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/MPB_Magnitude_Maps_2001to2006.pdf

In comparison to many infested areas in British Columbia, mountain pine beetle was not known to be present in the Peace Forest District until its first detection in the Dawson Creek TSA in 2004. The initial introduction likely occurred in 2002 by way of a mass dispersal event over the Rocky Mountains from the Prince George Forest District. It took

two years for infested trees to change color because of light levels of attack and two year cycles.

Following the confirmation of mountain pine beetle attack, an extensive sanitation harvesting and single tree treatment program was implemented by West Fraser Mills Ltd. Chetwynd, Canfor – Chetwynd Division and British Columbia Timber Sales (BCTS) in 2004. The infestation slowly increased in size and severity in 2005 moving from the western mountain valleys east towards the boreal forest. Extensive areas were sanitation harvested using a variety of tools and remote areas focused on single tree treatments with success rates of 90 to 100% treatment.

Mountain pine beetle spread modeling analysis of the Dawson Creek TSA was conducted by Fall *et al*. (2007) using actual infestation levels from 2004 and 2005. Modeling predicted that if harvesting and single tree treatments efforts were maintained at levels similar to 2004 through 2006, beetle populations could be contained in this area. The analysis also predicted that the beetle outbreak had the potential to kill approximately 17 M m^3 or the equivalent of 15% of the total pine in this area over the next decade. This is relatively low in comparison to other areas of the province due to the combination of a high proportion of mixed species forest and relatively low climatic suitability (Fall *et al.* 2007).

Spread models predicted that single tree treatment efforts would have a greater impact on population suppression than increasing harvest levels because the outbreak was largely driven from external immigration which led to scattered low intensity spots distributed unevenly across the landscape (Fall *et al.* 2007).

However, due to a large influx of beetles from the west again in 2006, the current mountain pine beetle populations far exceeds the capacity for single tree treatment levels along the western portions of the Dawson Creek TSA and Tree Farm License 48 (TFL48). The infestations has also moved further north than expected into the North Peace (Fort St. John TSA), as well as into Alberta as far north as Slave Lake and Fox Creek to the east (Lux Pers. Comm. 2007). The 2006 detailed aerial surveys of the Peace Forest District recorded 37,804 hectares of attack, representing over 10.2 million red trees (Figure 2). In addition to the reds recorded, there were extensive "early faders" which started showing up as early as mid-September due to a combination of drought conditions and heavy mountain pine beetle attack. However, the severity and extent of the 2006 long-range dispersal event will not be fully quantified until the 2007 aerial surveys.

Crude estimates of 10:1 green attack to red attack ratios provides a rough level of infestation in the south Peace at around 100 million infested trees, representing approximately 30 million cubic meters or 20 years of the current AAC for the south Peace.

In addition, Alberta estimates that there are approximately 3 million currently infested pine trees mainly concentrated in Northern Alberta adjacent to the Peace Forest District (Lux Pers. Comm. 2007).

With the South Peace still in the growing stages of a large mountain pine beetle epidemic, estimated levels of mortality, intensity of epidemic, shelf life period, and regeneration delays are still greatly unknown. Uncertainty in the North Peace (Fort St. John TSA) is even greater as the beetles have only moved into this area within the last year.

Pine-leading stands occupy approximately 33% of the timber harvesting land base (THLB) of the South Peace (Dawson Creek TSA and TFL48), with 41% of these stands having moderate to extreme susceptibility to mountain pine beetle attack (Duthie-Holt & Strome 2005). Major licensees including West Fraser Mills Ltd. and Canfor – Chetwynd Division have increased their pine profile from 40% pine pre-beetle in 2003 up to 70% pine in 2006 and 2007 (Kopecky Pers. Comm. 2006). The target of 70% pine profile represents the upper limit which can be harvested as the remaining stands represent more mixed stand types (Kopecky and Pate Pers. Comm. 2007). As the infestation and salvage operations move east, this target will drop as eastern stands have lower percentages of pine.

In comparison, pine stands in the North Peace (Fort St. John TSA) occupy 35% of the THLB and since the infestation just started this year; harvesting profiles have not significantly been adjusted in response to these infestations.

A forward prediction of beetle populations over the next 7 years will be extremely difficult due to the uncertainties associated with potential long-distance dispersal events and unknown beetle reproductive success in climates never previously encountered. Carroll *et al*. (2003) predicts that as warming trends continue in North America, mountain pine beetle will expand further northward, eastward, and into higher elevations. Warming trends will also likely result in higher reproductive success rates of the now local mountain pine beetle populations in the Peace and northern Alberta. In the past, large outbreaks have collapsed due to localized host depletion in combination with adverse climatic conditions (Safranyik 1978). However, it is expected that the current outbreak may not collapse as a result of host depletion in part due to the continual opening up of a supply of mature pine as global warming continues, thereby maintaining populations above normal levels for some decades into the future (Carroll *et al.* 2003).

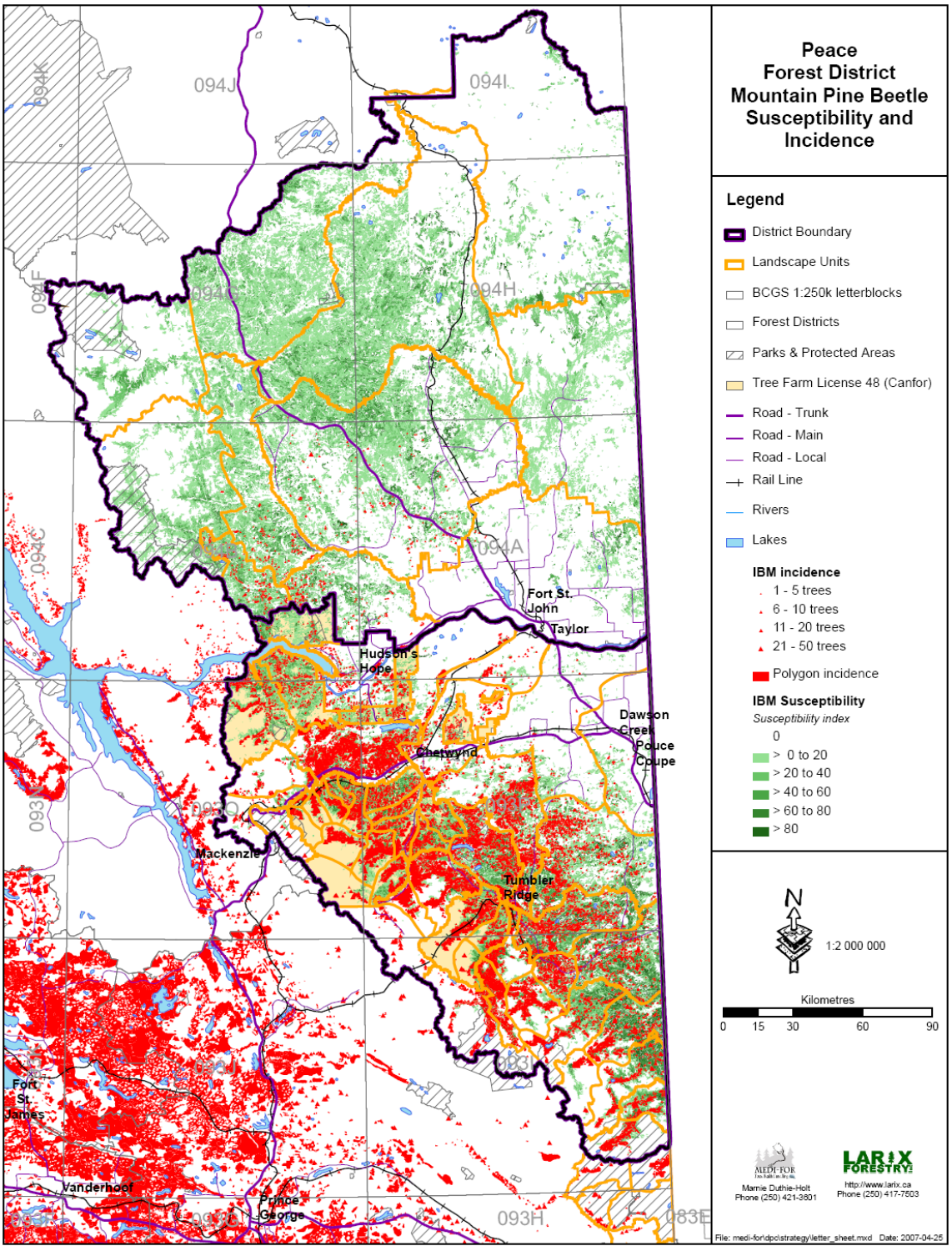

Figure 2. Detailed aerial survey and pine susceptibility map, 2006.

The red indicates Mountain pine beetle incidence and green indicates susceptible stands in the Peace Forest District.

Purpose

The purposed of the Peace Comprehensive Strategy is two fold.

1. Provide background on the following items as they relate to mountain pine beetle management in the Peace Forest District.
    a. General principles of beetle management.
    b. Historical and current beetle incidence and treatment options.
    c. Identify innovative ideas.
    d. Identify constraints that may limit suppression and salvage operations.
    e. Outline communications and other resource users.

2. Develop a harvesting strategy to aid in the deciding where and when to implement harvesting and single tree treatments within the Peace Forest District. This report also identifies ways future activities can improve.

Section 4: Ten Year Framework of Activities: 2004-2014

Historical (2004-2007)

- Starting in 2004 an aggressive detection program with extensive detailed aerial surveys and ground surveys occurred throughout the south Peace,
- extensive population sampling to determine the success rates of established mountain pine beetle populations,
- overwintering mortality assessments to assist in predictive analysis of anticipated spread rates of local mountain pine beetle populations,
- mountain pine beetle stand susceptibility rating analysis for both the Dawson Creek and Fort St John TSA's to determine possible losses during outbreak conditions,
- requested increase in AAC for both Canfor's TFL 48 and West Fraser Mills Dawson Creek F.L. to accelerate harvest of currently infested and highly susceptible stands,
- shift in licensee harvesting profiles from 40% up to the current 70% pine to address infested and highly susceptible pine stands,
- extensive sanitation harvesting program in conjunction with pheromone baiting,
- allowances in allocated NRFL's to shift from small pine diameter restrictions to address larger diameter infested pine stands, and
- extensive single tree treatment program in areas not feasible to harvest.

Short Term (2007-2008)

- Continue to target infested stands for sanitation harvesting in combination with pheromone baiting where applicable,
- continue to target pine leading stands as MPB populations become more dispersed in the mixed forests to the east,
- re-examine and possibly shift harvest schedules in the Fort St John TSA as populations continue to expand northward,
- examine the impact of large areas of infested timber on private lands within a BMU relative to suppression efforts on crown land within the same BMU, especially relevant to the Fort St John TSA,
- continue extensive detection program including both detailed aerial and ground surveys focused in the suppression zone,
- include detection and treatment of Woodlots especially focused in the suppression zone,
- continue single tree treatment program in suppression zone,
- continued discussions between industry and BCTS to increase the number of successful timber sales that address infested or susceptible stands,
- re-examine and update LRMP's for both the Dawson Creek and Fort St John TSA's to reflect changes in the forest landscape,
- re-apply for AAC uplift in the south Peace, and
- continue and expand collaboration with Alberta to ensure co-ordination of future treatment programs with priorities in both provinces as well as federal objectives.

Mid-Term (2008-2010)

- Continue extensive detection program including both detailed aerial and ground surveys focused in the suppression zone,
- shelf-life examination to prioritize stands for salvage,
- detailed re-examination of timber supply as the full scope of stand mortality becomes evident,
- examine and possibly shift harvest schedules into the Peace Forest District from other areas to increase harvesting power,
- active discussions with Ministry of Environment to determine impacts of both mountain pine beetle mortality and any proposed management on the integrity of established wildlife habitat areas and ungulate winter ranges,
- continued province-wide efforts to develop new or expanded uses for dead and dry pine,
- examine feasibility of alternate species planting or planting stock outside current zones in light of both climate change and future forest susceptibility,
- continue sanitation harvesting in combination with pheromone baiting where feasible, and
- continue with single tree treatments within the suppression zone.

Long Term (2010-214 and beyond)

- Rehabilitation of stands that are not salvaged and become classified as not sufficiently restocked (NSR),
- fire hazard analysis related to areas of NSR and potential impacts to communities and other resource industries,
- follow British Columbia's Mountain Pine Beetle Action Plan 2005–2010, Objective #3 which states, "Recover the greatest value from dead timber before it burns or decays, while respecting other forest values." (Government of British Columbia 2005), and
- continue shelf life examination to refine salvage priorities.

Section 5: Priority Setting and Decision Making Considerations

It is not possible to determine a single set of guidelines which outline a priority ranking criteria for activities related to mountain pine beetle management. Decisions are based on a combination of considerations including: infestation location, size of infestation (green:red ratio, total number of infested trees, area covered, mortality assessments), stand characteristics (mountain pine beetle susceptibility, merchantability, and operability), adjacent forest characteristics (risk of spread), access, adjacent resource considerations and priorities of other jurisdictions (federal and inter-provincial).

The key to be able to properly rank areas for either harvest or single tree treatments is having accurate and complete information that starts with having a clear set of biological and political priorities so that information on infestations (green:red ratios, R-values, mortality assessments, susceptibility analysis, detailed aerial survey information, coordination with adjacent areas), access considerations and current operational plans can be put into context of the larger scale situation.

Priority Ranking Criteria

Harvesting

1. Harvesting should target highly infested stands within suppression BMU's, as much as possible.
2. The salvage zone in 2006-2007 (Figure 3) is the area of highest current beetle populations and the highest susceptibility, therefore this is where the greatest harvesting efforts should be applied in the near future.
3. Harvesting should focus on areas with existing road access. Due to the speed with which MPB is moving through the Peace, road development to specifically address suppression efforts will not result in optimal use of resources.
4. Pine leading stands should be targeted in all BMU's. The percent pine within a given stand will decrease as MPB move east into the mixed stands of the boreal forests. While 70% may be reasonable targets for stands in the western portions of the south Peace, 50-60% is a more realistic target for eastern portions.

In addition to the harvesting of mountain pine beetle infested and susceptible pine an analysis based rationale should be determined to include the prioritization of harvesting burned wood over beetle infested wood. It is understood that burned wood does have a place within a harvest priority matrix and will be ranked second after currently infested pine in the Ft. St. John TSA. Discussions are still ongoing in the Dawson Creek TSA to determine where the ranking of burnt wood will be placed.

Table 1 outlines the Peace Harvesting Ranking Criteria based on stand susceptibility and current mountain pine beetle infest.

Table 1. Peace Harvesting Ranking Criteria based on stand susceptibility and current MPB infest.

	% Stand Susceptible to MPB						
% Current MPB infest	0	>0-10	>10-20	>20-40	>40-60	>60-80	>80-100
0							
>0-10							
>10-20							
>20-40							
>40-60							
>60-80							
>80-100							

Ranking order	
1	
2	
3	
4	
5	
6	

Table 2 outlines the biological ranking criteria in combination with operational constraints to come up with an overall harvest ranking by BMU for the Peace. The biological ranking was determined using standards developed in the BC Provincial Bark Beetle Management Technical Implementation Guidelines developed in 2003. Details specific to the biological ranking are outlined on page 13 which state that a BMU can be described in terms of total number of green attacked trees, total number of infested spots (regardless of size), and amount of susceptible area remaining. There are eight combinations assuming that each of the factors (# green attack, # spots, and susceptible area) can be rated as High or Low based on listing all potential BMU's and dividing by using the median value for the factor to identify high and low. These eight combinations are outlined as follows.

Order of Bark Beetle Biological Ranking

The rankings (1=High and 8= Low) indicate which BMU's should be addressed in order of importance.

Code[1]	# Green Attack	# infested spots	Susceptible Area	Ranking
GsA	High	Low	High	1
gSA	Low	High	High	2
gsA	Low	Low	High	3
GSA	High	High	High	4
Gsa	High	Low	Low	5
gSa	Low	High	Low	6
GSa	High	High	Low	7
gsa	Low	Low	Low	8

1. G = high levels of green attack; g = low levels of green attack; S = high numbers of infested spots; s = low numbers of infested spots; A = large amount of susceptible area; a = low amounts of susceptible area

It should be noted that the MPB infestation levels outlined in the table will only be valid until the flight in 2007 and ongoing mortality assessments should be incorporated into future ranking criteria as data becomes available.

As well, green:red ratios should be interpreted with caution since these are difficult to determine as a result of the long range dispersal event in the Peace in 2006.

Table 2. Harvest Ranking Criteria by BMU for the Peace Forest District.

TSA	Respons.	BMU	Percent_Susceptible	Infests	Reds	Ratio	Greens	Green Rank	Infests Rank	Area Rank	Code	Biological Ranking	Operational Constraints Ranking*	Opeational Contraints Comments	Access Combined	Overall Ranking
DDC	TSA	Hudon's Hope	0.18	759	7978	101	805778	1	1	0	GSa	7	2	Peace Moberly Track, First Nation sensitivity, Plus private land plus municipal politics, VQO's, mixed woods	good (overall, a fair amount of access), close to mill	1
DDC	TFL	Dickebush	0.66	412	808	1	808	0	1	1	gSA	2	1	Terrain	limited	3
DDC	TFL	Gething	0.65	541	2606	0.2	521	0	1	1	gSA	2	1	Visuals along the Lake, mixed stands, Terrain	good	3
DDC	TFL	North Hasler	0.7	519	1234	1	1234	0	1	1	gSA	2	1	Terrain	moderate	3
DDC	TFL	Westcoast-Caron	0.76	441	819	1	819	0	1	1	gSA	2	1	small pine component		3
DDC	TFL	Boucher	0.45	323	495	18	8910	1	0	1	GsA	1	3	Peace Moberly Track, first nation sensitivity	winter only access	4
DDC	TFL	Falling Creek	0.63	344	2161	1	2161	0	0	1	gsA	3	1	Terrain, Mixed Stands	good	4
DDC	TFL	Highhat	0.7	285	658	1	658	0	0	1	gsA	3	1		Moderate	4
DDC	TFL	Kowen Hills	0.89	384	727	1	727	0	0	1	gsA	3	1	small pine component	good	4
DDC	TSA	One Island	0.47	1649	2342	1	2342	0	1	1	gSA	2	2	One Island Lake Community Society, recreation, VQO around lake, lots of oil and gas activity, caribou, UWR, distance from mill, small wood, lots of deciduous mixed stands making harvesting difficult.	good	4
DDC	TFL	Sukunka-Bluff	0.7	551	3097	1	3097	0	1	1	gSA	2	2	Deciduous component	limited because of Sukunka River crossings	4
DDC	TFL	Willow	0.8	146	322	1	322	0	0	1	gsA	3	1	Terrain		4
DDC	TFL	Club Creek East	0.68	363	806	1	806	0	0	1	gsA	3	2	Terrain, VQO's from Tumbler and Murray Road, small Pine component	limited	5
DDC	TSA	Redwillow	0.64	819	1653	17.1	28266	1	1	1	GSA	4	1	High wildlife values despite UWR (caribou), low lying areas very wet, oil and gas activity high, operational area within this unit approximately 35%	limited (towards eastern section), new Shell road access to the west	5
DDC	TSA	Bearhole	0.68	1421	2501	8.9	22258	1	1	1	GSA	4	2	Caribou not much of a problem as there is Bearhole park and lots very poor timber types that the caribou need which will not be harvested, Height Class 2 Pine	good (well roaded, no access issues), some winter access	6
DDC	TSA	Bullmoose	0.45	2236	1675993	1	1675993	1	1	1	GSA	4	2	Terrain, small piece size, moslty BCTS cell, hieght class 2 pine on north east side of mine access road	limited (restricted to eastern end) tough terrian, good for summer harvesting	6
DDC	TFL	Dunlevey	0.43	67	84	1	84	0	0	1	gsA	3	3	Dunlevy management Plan, Terrain, Small Pine Component, First Nation sensitivity	limited - some restrictions due to plan	6
DDC	TFL	Hart Highway	0.59	69	1038	1	1038	0	0	1	gsA	3	3	Terrain, VQO's	Limited due to crossings on Pine River	6
DDC	TSA	Honeymoon Creek	0.63	794	1236	10.5	12978	1	1	1	GSA	4	2	Easy ground but not much pine merchertanble volume left. Lots of wetlands, distance to mill.	good	6
DDC	TSA	Lone Prairie	0.69	2407	3696	1	3696	1	1	1	GSA	4	2	Gwilliam Lake Park contained within BMU, mostly park with very little pine component	limited	6
DDC	TFL	Lower Burnt	0.57	632	12013	1	12013	1	1	1	GSA	4	2	guideoutfitter, Terrain, High levels of Oil and Gas activity	moderate	6
DDC	TSA	Lower Red Deer	0.64	777	1718	12.6	21646	1	1	1	GSA	4	2	guideoutfitter, distance to mill, fairly benign ground	limited	6
DDC	TSA	Murray-Monkman Mid	0.55	732	2123831	1	2123831	1	1	1	GSA	4	2	small pine component, merchantable pine mostly gone or currently under permit	limited	6
DDC	TFL	Rocky Creek	0.65	469	133712	1	133712	1	1	1	GSA	4	2	Terrain	access limited because of bridge	6
DDC	TSA	Upper Moberly	0.5	5833	486590	1	486590	1	1	1	GSA	4	2	Peace Moberly Track, first nation sensitivity, VQO around Moberly Lake and Hullcross Creek, recreation, water quality (domestic water source), terrain stability	limited (few oil and gas roads), terrain	6
DDC	TSA	Wapiti	0.46	919	1654	36.9	61032	1	1	1	GSA	4	2	WHAs (caribou and mountain goats), Park, Distance to mill, terrain, small wood	limited (but it is on the increase due to the amount of oil and gas activity the last couple years, none in park)	6
DDC	TSA	Murray-Monkman West	0.07	324	3005125	1	3005125	1	0	0	Gsa	5	2	Parks, recreation, VQO around Monkman Park, small pine component, terrain	limited	7
DDC	TSA	Narraway	0.58	330	620	1	620	0	0	1	gsA	3	4	Parks, coal mines, oil and gas activity, big horn sheep, caribou, distance from mill	none	7
DDC	TSA	Upper Sukunka/Gwillim West	0.01	95	260805	1	260805	1	0	0	Gsa	5	2	grizzly bear habitat, coal mines, mixed apsen/pine stands (leading deciduous), terrain, pine tends to be on the steeper slopes or in the rockier areas	good	7

DDC	TSA	Feller's Creek	0.38	1100	1942	1	1942	0	1	0	gSa	6	2	Pine primarliy off valley floor and failry steep. Very little merch as pine stands are young. Height class 2 Pine.	limited	8
DDC	TSA	Murray-Monkman East	0.42	622	2476	1	2476	0	1	0	gSa	6	2	small pine component	limited	8
DDC	TSA	Pine Pass North	0.09	323	387851	1	387851	1	0	0	Gsa	5	3	VQO's along highway, terrain in BCTS area, extreme terrian, very little pine mostly in mixed types as minor component	limited (most of accessable ground already accessed); BCTS existing in Fisher Creek and constructing new road in 2007.	8
DDC	TSA	Puggins	0.41	2659	3370	2.9	9773	1	1	0	GSa	7	1	Tumbler Ridge community, UWR along river, northern 1/3 of BMU extensive oil and gas activity, ground fairly benign	limited	8
DDC	TFL	South Hasler	0.16	327	12054	1	12054	1	0	0	Gsa	5	3	Terrain, High elevation		8
DDC	TFL	Upper Burnt	0.05	43	36746	1	36746	1	0	0	Gsa	5	3	Terrain, High elevation	limited	8
DDC	TFL	Carbon	0.4	720	1612	1	1612	0	1	0	gSa	6	3	Twin Sisters sensitivity, Terrain, Mixed stand composition	limited	9
DDC		Dawson Creek	0.08	61	79	1	79	0	0	0	gsa	8	1	Private land	good (well roaded, no access issues)	9
DDC		Kiskatinaw	0.07	117	116	1	116	0	0	0	gsa	8	1	domestic water source, range, private land, Caribou in upper reaches	moderate to good	9
DDC	TFL	Lemoray	0.13	79	4316	1	4316	1	0	0	Gsa	5	4	High elevation, adjacent to park, terrain	limited	9
DDC	TSA	Pine LeMoray	0.04	60	358721	1	358721	1	0	0	Gsa	5	4	Park	none	9
DDC	TSA	Pine Pass South	0.08	198	1275112	1	1275112	1	0	0	Gsa	5	4	Park plus extreme terrian 90 % inoperable	none	9
DDC	TSA	Pine River	0.14	730	765	144	110160	1	1	0	GSa	7	2	private land, UWR, range, oil and gas activity high, guideoutfitter	good	9
DDC		Septimus	0.07	277	103	1	103	0	0	0	gsa	8	1	UWR along Pine River, ranching, trapper, recreation (snowmobile trails), UWR (elk and moose), extensive oil and gas activity, high deciduous component	good	9
DDC	TSA	Upper Sukunka/Gwillim East	0.18	574	365624	1	365624	1	1	0	GSa	7	2		good	9
DDC	TFL	Wolverine	0.36	856	4700	1	4700	1	1	0	GSa	7	2	small pine component, terrain, Outfitter issues	good	9
DDC	TFL	Club Creek West	0.25	45	390	1	390	0	0	0	gsa	8	2	small pine component, terrain, VQO's	good	10
DDC	TFL	East Pine	0.12	119	113	1	113	0	0	0	gsa	8	2		good	10
DDC		Lower Moberly	0.07	325	232	1	232	0	0	0	gsa	8	2	Peace Moberly Track, first nation sensitivity, oil and gas activity, VQOs from Moberly Lake, scenic area around Moberly River, recreation, trapper, very heavy harvesting by Tembec (one of the most heavily impact area by all combined activities)	limited	10
DDC	TSA	Belcourt	0.42	491	14852	1	14852	1	1	0	GSa	7	4	caribou, guideoutfitter, mountain goat habitat, distance to mill	none	11
DDC	TFL	Gulf	0.32	134	881	1	881	0	0	0	gsa	8	3	Terrain, VQO's from highway 97	limited	11
DDC		Kakwa	0.17	429	1194	31	37014	1	1	0	GSa	7	4	Entire unit is Provincial Park	none	11
DDC		Upper Red Deer	0.09	154	715	1	715	0	0	0	gsa	8	4	No access, terrain, pine almost all gone with 2006 fire, distance to mill	none	12
DDC		Williston Lake	0	0	0	0	0	0	0	0	gsa	8	4	recreation, VQO	limited	12

DJO TSA

TSA	BMU	Percent_Susceptible	Infests	Reds	Ratio	Greens	Green Rank	Infests Rank	Area Rank	Code	Biological Ranking	Operational Constraints Ranking*	Operational Constraints Comments	Access	Overall ranking
DJO	Blueberry	0.32	195	263	40.7	10704	1	1	1	GSA	4	1	highest incidence of MPB 2006, some VQO consideration along AHN	good (summer and winter access)	1
DJO	Lower Beatton	0.06	11	20	56.5	1130	1	0	0	Gsa	5	2	highest incidence of MPB 2006, some attack in 'rotating old growth reserves' which would likely need to be replaced	good	1
DJO	Kobes	0.27	269	371	5.3	1966	1	1	0	GSa	7	2	moderate level of MPB in 2006	good	1
DJO	Crying Girl	0.64	235	298	1	298	0	1	1	gSA	2	3	some parts of LU have (draft), Caribou UWR/WHA's	limited (some summer, but expensive construction required)	2
DJO	Halfway	0.49	142	195	1	195	0	0	1	gsA	3	3	some parts of LU have (draft), Caribou UWR/WHA's	fair-good	2
DJO	Tommy Lakes	0.38	0	0	0	0	0	0	1	gsA	3	3		fair-good	3
DJO	Trutch	0.41	0	0	0	0	0	0	1	gsA	3	4	higher elevation pine, no MPB for 70 km, poor access	poor	4
DJO	Graham	0.27	5	8	1	8	0	0	0	gsa	8	4	MKMA constraints- no current access	none	4
DJO	Kahntah	0.06	0	0	0	0	0	0	0	gsa	8	4	difficult winter access	poor (difficult winter access only)	4
DJO	Milligan	0.2	0	0	0	0	0	0	0	gsa	8	3	Young pine	limited (nearly all winter access)	4
DJO	Sikanni	0.15	0	0	0	0	0	0	0	gsa	8	4	MKMA constraints-no current access	none	4

* Operational constraint ranking Low=1, Moderate=2, High=3, Extreme=4

Where;

	Heading	Description
1	TSA	Timber Supply Area either DDC for the south Peace or DJO for Ft. St. John or the north Peace
2	Respons.	Classification of responsibility either TSA or TFL.
3	BMU	Beetle management unit
	Percent_susceptible	Percentage of the BMU susceptible determined by taking the hectares of MPB susceptible stands in that particular BMU divided by the total hectares of the BMU.
	Infests	Number of sites as recorded from 2006 detailed aerial surveys
	Reds	Number of red trees as recorded from 2006 detailed aerial surveys
	Ratio	Green to red ratio of MPB attack. These were measured from ground surveys and any value of 1 represents an area where no ground surveys were conducted. These values should be interpreted with caution since some of the 2006 attack appeared "red" in the field and it was difficult to determine due to the long range dispersal event.
	Greens	Estimated number currently attacked MPB trees in the Peace as derived from multiplying the number of reds and green:red ratio.
	Green Rank	Ranking of the currently attacked MPB by determining the median value and assigning a 1 for any value above this and a zero for any value below this.
	Infest Rank	Ranking of the number of sites of MPB by determining the median value and assigning a 1 for any value above this and a zero for any value below this.
	Area Rank	Ranking of the MPB susceptible area by determining the median value and assigning a 1 for any value above this and a zero for any value below this.
	Code	Biological ranking code assigned based on ranking critera. G= greens, S=infests, and A=area ranking, where capital letters signify the BMU ranks as a 1 or above the median value and a small letter signifies that the BMU ranks as a 0 or below the median value.
	Biological Ranking	Number assigned for the biological ranking based on the code generated for that particular BMU.
	Operational Constraints Ranking	Number value assigned by BMU for the level of operational constraints. 1= low or very little operational constraints, 2 = moderate amount of constraints, 3 = high level and 4 = extreme level of constraints making harvesting within the next year or so almost impossible.
	Operational Constraints Comments	Verbal description of the operational constraints outlining the various factors
	Access	Level of access currently available or proposed within the next year or two.
	Overall Ranking	Sum of biological ranking value and operational constraints ranking to generate an overall ranking value. Low values represent a high portion of harvesting.

Single Tree Treatments

Single trees treatment efforts should be focused on the following set of criteria.

1. Infestations which are not able to be harvested in the near future.

2. Individual spot infestation less than 3 hectares in size. Areas greater than 3 hectares tend to no longer be feasible for single tree treatment and should be targeted for other management efforts including sanitation harvesting, possibly in combination with pheromone baiting if efforts cannot be achieved within the current year.

3. Infestations in proximity to Alberta and the corridor of continuous pine which stretches from the Fort St John area and leads into the boreal forest and then across Canada. These areas are generally experiencing low numbers of smaller spot infestations and should be considered for 100 percent treatment.

4. The combination of Alberta suppression priorities and current forest susceptibility modeling rank infestations in priority from south to north and east to west. The further north and further west the infestations are, the lower priority for treatment. *This contradicts the current priority ranking in the Peace Forest District which ranks Beetle Management Units in the north Peace in Fort St. John TSA40 higher than the south Peace due to infestation history and magnitude and should be discussed with Alberta in September 2007 once Alberta has redefined their priorities.*

5. Areas of infestation which have a high risk to spread to susceptible timber where there is no road access and access will not be developed within the next 2 years should be considered for single tree treatment programs.

6. Infestations with high green:red ratios indicate a well established population with a high risk of spread to adjacent areas.

7. Areas of infestation that threaten other resource values (such as ungulate winter range) where harvesting is not a viable treatment option.

Areas designated for single tree treatment require a treatment target of at least 80% of current attack to ensure the efforts applied will be effective. Therefore areas of greatest current infestation are often relegated to the salvage management strategy which targets addressing between 0 and 49% of the current infestation, as there is no capacity to address 80% treatments as in the suppression management strategy. This often leads to harvesting programs and single tree treatment programs concentrating efforts in different priority zones as is the case in the South Peace in 2006-2007.

Single tree treatment programs can be highly effective in suppression zones where infestations are still low with small spot infestations. Harvesting power is best utilized in areas of highest infestations and beetle populations, which in the Peace is currently the salvage management zone in the south Peace along the western border. This is especially true in the Peace where large areas of infestation are not road accessible and forests are too far from a mill to be economical to harvest.

Decision-making Matrix by BMU

Each of the beetle management units (BMUs) in the Peace Forest District outlined as suppression has been ranked in the Peace Forest District Forest Health Strategy (Duthie-Holt 2007) (Appendix 6).

BMUs designated as suppression areas are ranked higher for management activities than either holding or salvage BMUs. However, if infestation conditions similar to 2006-2007 within the Dawson Creek TSA (including TFL 48) continue, harvesting will have the largest impact on reducing mountain pine beetle populations if focused within units assigned to the salvage strategy because these units contain both the highest concentration of attack and largest volume of susceptible host. Harvesting in the southern suppression zones of the Fort St. John TSA will yield the largest impact as this is where current mountain pine beetle populations are concentrated.

With that in mind, where harvesting opportunities exist within suppression BMUs they should be utilized to reduce current beetle populations and remove high hazard host material.

In addition to harvesting an aggressive single tree treatment program should also be implemented to target currently infested trees which will not be harvested within the suppression zone. Funds should be allocated to the suppression BMU order listed in the Peace Forest District Forest Health Strategy (Duthie-Holt 2007).

Suppression BMUs were ranked according to the listed criteria for each priority zone. In addition, overwintering mortality data will be collected and R-values incorporated into future updates of this ranking.

Priority One – North Peace (*Fort St. John TSA 40; parks and protected areas)*

Criteria

1. Leading edge attack and recent history as highest priority overall in the district
2. Overall east to west and north to south priority to correspond to areas adjacent to Alberta

Ranking of BMUs

1. Kahntah
2. Milligan
3. Lower Beatton
4. Tommy Lakes
5. Blueberry
6. Kobes and Dunlevey
7. Crying Girl
8. Halfway
9. Trutch
10. Sikanni
11. Graham

Priority Two - South Peace *(Dawson Creek TSA 41; parks and protected areas, and TFL48)*

Criteria

1. Overall south to north and east to west priority.
2. This corresponds to adjacency to Alberta and areas of contiguous susceptible pine stands leading to the boreal forest.
3. Currently uses Alberta's 2006-2007 priorities. Alberta is in the process of conducting population sampling and overwintering mortality assessments and will re-define their management priorities in September 2007.
4. Target the leading edge of attack on the eastern border of the TSA.
5. Determination of average number of "reds" per site to get an idea of absolute magnitude of attack

Ranking of BMUs

12. Kakwa
13. Narraway
14. Belcourt
15. Lower Red Deer
16. Redwillow
17. Bearhole
18. Wapiti
19. Honeymoon Creek
20. One Island
21. Puggins
22. Lone Prairie
23. Dawson Creek
24. Kiskatinaw
25. East Pine
26. Pine River
27. Septimus
28. Lower Moberly
29. Boucher
30. Hudson's Hope
31. Gething
32. Carbon
33. Williston Lake

While the rankings are used as a general guide for allocating management efforts and funds, they are not absolute in their values. In 2006-2007, the single tree treatment program within the Dawson Creek TSA did not follow the above ranking system in several instances partially due to operational constraints and timing of funding allocations. A few examples of constraints to treatments have been included below.

1. Treatments within the ***Kakwa*** BMU were dropped following late seasons discussions with Alberta that they would not be conducting treatments on the Alberta side of the park due to predicted extreme population levels.

2. Treatments within the ***Narraway*** BMU were not conducted due to a population of caribou which over-winter in the low elevation pine stands. It was anticipated that treatments had the potential to negatively impact this herd and therefore treatments were not conducted. This was a joint decision made with Alberta Sustainable Resource Key Personnel early January 2007 prior to the awarding of any treatment contracts.

3. Treatments within the ***Belcourt*** BMU were not conducted because a large portion of this BMU was netted out because of a population of caribou. The remaining area was targeted for treatments however funding allocation timing impeded the relocation of treatment crews within the allotted timeframe.

4. Treatments within the ***Bearhole*** BMU started in January to ensure treatments were completed prior to the sensitive caribou calving season despite the lowering ranking of these BMU.

Current BMU treatment priorities are found in Figure 3.

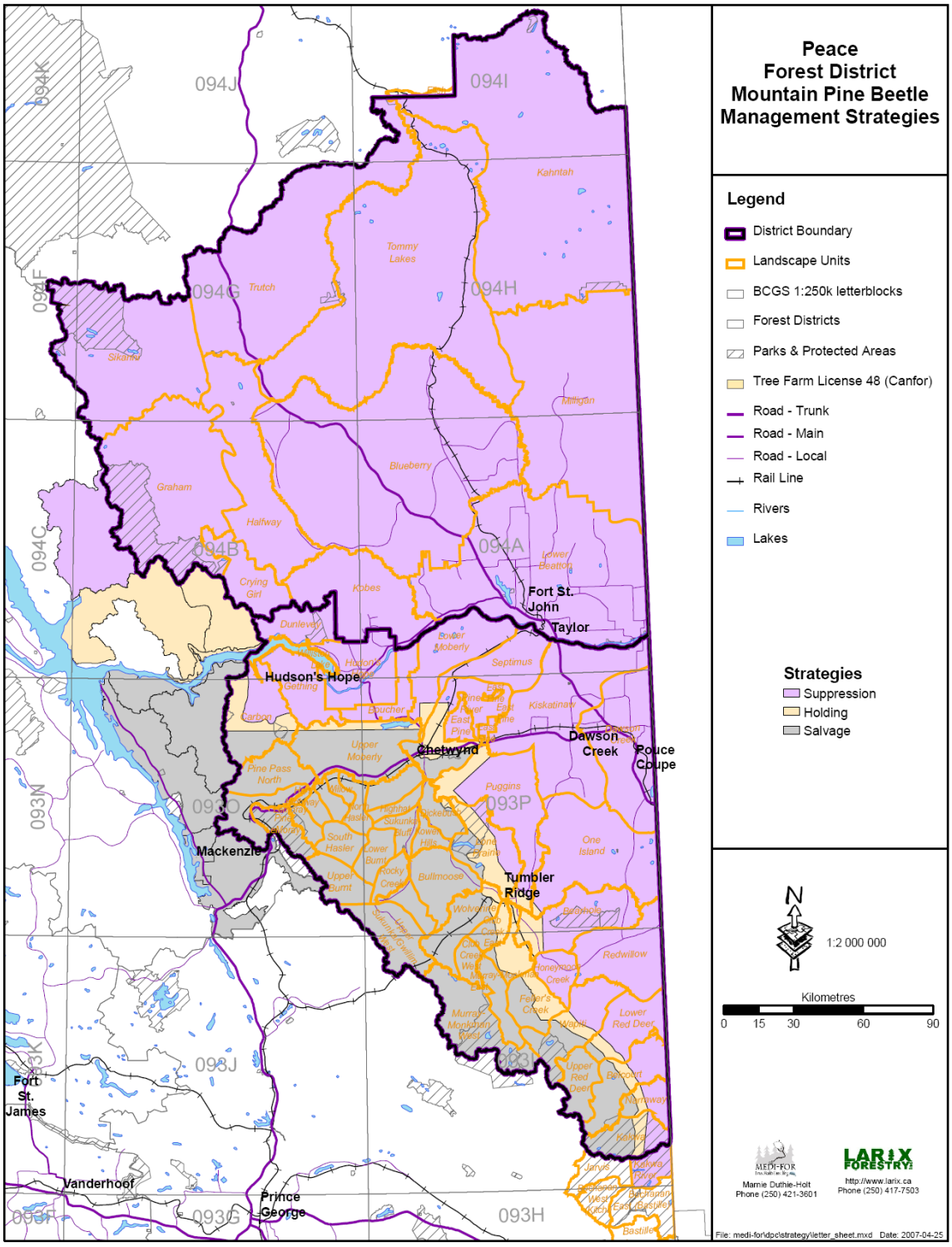

Figure 3. Beetle Management Unit Priority Ranking for the Peace Forest District, 2006.

Section 6: General Principles of Mountain Pine Beetle Management in the Peace Forest District

Describe past and present detection and treatment methods and timing

Aerial Surveys

There are two main types of aerial surveys conducted in the Peace Forest District including overview and detailed aerial surveys. The differences between them are as listed below (BC Ministry of Forests 2005). In addition, in 2005 measle mapping was conducted in parts of the Peace Forest District. However, due to issues with timing of deliverables and accuracy of data this method of aerial survey will not likely be used again.

Aerial Overview Surveys are conducted in a fixed wing aircraft at low flight line intensities on topographic or orthographic maps at 1:100,000 or 1:250 000 scale. The aircraft is flown at altitudes of 500 to 1,000 m at speeds of 80 to 90 knots. The accuracy of these overview surveys is sufficient for historical trends (increasing, decreasing, or static), gross area affected, and general damage location. These surveys also delineate areas where detailed surveys are required. Aerial overview surveys using fixed wing aircraft have been conducted in the Peace on a yearly basis by the BC Forest Service since 1999. Previous to this they were conducted by the Canadian Forest Service by Forest Insect and Disease Survey (FIDS) rangers.

Detailed Aerial Surveys are typically conducted with a helicopter, often equipped with Global Positioning System (GPS) navigation equipment, on a 1:40,000 or 1:50,000 maps. The purpose of these surveys is to accurately map the type, size and location of beetle problems, so that general treatment strategies can be assigned. Detailed aerial surveys were conducted for the south Peace including TSA 41, TFL 48, and parks and protected areas in 2004 and 2005 and were expanded in 2006 to include the southern section of TSA 40.

Measle Mapping Surveys are conducted with a fixed wing aircraft. Photographs are taken and interpreted to determine occurrence of various forest health factors, including mountain pine beetle. However, due to the late delivery of the final product and a variety of interpretation errors, this type of aerial survey will not be conducted in the future (Ebata Pers. Comm. 2006). The errors included missed sites and incorrect forest health factor determination.

Ground Survey Methodology

Ground surveys are conducted to confirm the information gathered from aerial surveys, obtain current attack details, and determined the amount of susceptible host remaining. There are two main types of ground surveys which were conducted in 2006-2007 including star probes and recce probes. These surveys vary in intensity, quality, and quantity of data collected. Both survey protocols are described in the MOF Bark Beetle Management Guidebook (1995), at http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/beetle/betletoc.htm.

Star Probes

Star Probes used for isolated spot infestations (up to ~ 50 red trees). If mountain pine beetle populations are found to be more continuous instead of "expanding from the centralized point" then the survey methodology can be switched to a grid probe (used in 2005-2006) or a recce probe (used 2006-2007).

Information collected includes;

- Assessment of all trees within a 50 metre radius of the infestation centre for beetle activity
- basic stand characteristics are recorded (e.g. species composition, average host dbh and height).
- There will be a maximum of 1 additional sweep in any direction from the centre point of the infestation for a distance of 100 m from the centre point. If the infestation extends beyond this then another site will be established or survey methodology will switch to a recce probe.
- Other pest activity.

Additional details are located in Appendix 1.

Recce Probes

In areas where mountain pine beetle attack levels are high, recce probes were utilized to delineate the outer boundary of attack and provide information on location, attack densities, stems per hectare, and species composition of the stand to determine treatment options.

If the attack extended beyond 100 meters from the site center or if the number of currently attacked trees contained within any given second sweep was over 40 then the survey type switched to a recce probe. The outer boundary of attack is delineated with ribbon and GPSed and infested trees were painted. If the area of attack was greater than three hectares the site was considered too large for single tree treatment and instead was assessed for harvesting opportunities.

Additional details are located in Appendix 2.

Single Tree Treatment

Single tree treatments are considered a short-term tactic, to be used on the leading edge of attack as populations are increasing. Some of the available single tree tactics which are currently used in the Peace Forest District include conventional fall and burn, helicopter assist fall and burn, and possibly mechanical fall and burn. As well there are numerous other single tree treatments, of which some have been listed under the innovative ideas section of this report.

Conventional Fall and Burn

Conventional fall and burn consists of falling infested trees and piling and burning them on site to ensure that all bark is completely destroyed. Complete disposal of the wood is not required. This tactic can be applied in conjunction with ground surveys as a search and destroy program if access costs are high and tree counts are low.

Helicopter Assist Fall and Burn

Helicopter assisted fall and burn treatments are a feasible tactic in areas of large concentrations of attack and where staging sites for refueling are within acceptable distances. Infested trees are hand felled and then flown to designated locations for burning in larger piles. The benefits of helicopter assist fall and burn are outlined in the innovative ideas section. Burn pile criteria within provincial parks are listed in the Best Management Practices document in Appendix 3.

Mechanical Fall and Burn

Mechanical fall and burn treatments may prove to be a feasible tactic in areas with access and high concentrations of attack where harvesting is not an option. Canfor - Chetwynd Division is conducting a trial to assess mechanical fall and burn in March 2007 (Layton Pers. Comm. 2007). This is to determine if the use of heavy machinery is efficient and cost effective to treat mountain pine beetle specific sites. This pilot will track and help determine infestation thresholds and ground conditions conducive to using mechanical means to treat infested stems. The costs for ground type, timber type, percent infestation and distance from roads will be tracked to determine an estimated cost per tree that this work should be done for within the set site conditions.

Harvest

Sanitation Harvest

Harvesting is conducted to maximize the removal of currently infested mountain pine beetle trees to reduce the existing population and to prevent their spread. The highest priority is given to stands with high levels of new attack, high hazard, and a high risk of spread (BC Ministry of Forests 1995).

Salvage Harvesting

Salvage harvesting recovers trees previously attacked by mountain pine beetle. Harvested trees no longer have any living brood. Salvage harvesting is primarily conducted to recover damaged timber before it loses its value for potential wood products. This tactic does not reduce mountain pine beetle populations, but is the first step in returning the site to forest production (BC Ministry of Forests 1995).

Prescribed burning

Prescribed burning is a tool which may be used for mountain pine beetle management. Fire objectives related to mountain pine beetle management are usually two fold; high hazard host removal and to a lesser extent reduction of current mountain pine beetle incidence.

Prescribed fires for the removal of high hazard hosts can be quite effective provided that stressed trees either within the burn or on the boundary of the burn are carefully monitored for post-fire attack. As well, prescribed burning can provide adequate control of pre-felled infested trees when burning conditions are extremely hot, however mountain pine beetle mortality in standing infested trees can be quite variable and depends on local fire intensity (Stock and Gorley 1989).

Attractant and repellant baiting

Attractant Baiting

Synthetic mountain pine beetle attractants are available to manipulate and monitor small outbreaks (Nevill Pers. Comm. 2007). The use of pheromone baiting and trapping can allow managers to contain small spot infestations, thus preventing their spread into adjacent susceptible stands. Areas in the Peace Forest District which are scheduled to be harvested or where roads are planned to be built within one year should be baited to contain and concentrate beetles. This will ensure that sanitation harvesting efforts maximize the number of beetles removed. However, caution must be used not to bait an area that will not be harvested prior to beetle flight as populations will increase exponentially once pheromones are deployed.

In addition to pheromone baiting in forest stands, pheromones can be used in logyards or log sorts to monitor flight and help contain beetles that may emerged from decked timber (Nevill Pers. Comm. 2007). Additional details are located in Appendix 4.

Repellant Baiting

Pheromone baits can be used to deter mountain pine beetle from attacking certain selected stands. This use is limited to areas with low to moderate levels of attack and high value stands such those around cities, campgrounds, golf courses, seed orchards, or ungulate winter range, etc. (Borden Pers. Comm. 2007). Verbenone is a commercially available product for this use. Verbenone when deployed in grid pattern across a stand will result in overall decreased levels of mountain pine beetle attack within the area. It does not however guarantee individual tree protection. Verbenone is best used as part of a push-pull tactic where beetles are attracted to one area (either stand or traps with attractant pheromones) while being diverted from another (through the use of verbenone).

Additional details are located in Appendix 5.

Peace Forest District Tactical plan

The 2006-2007 Peace Forest District Tactical Plan is attached as Appendix 6.

Section 7: Description of Timber Harvesting Land Base

Description of TFL48, Dawson Creek TSA41, and Fort St. John TSA40 pine volume, area and current infestation

Pine contributes 34, 35, and 31 percentages to the THLB for TFL48, Fort St. John TSA40, and Dawson Creek TSA41, respectively.

Table 3 outlines the hectares, susceptible pine volumes, and average species profile associated with each of the landbase breakdowns specified.

Table 3. Pine volume, average species profile and hectares associated with the various landbases in the Peace Forest District.

Category	Landbase	Area (ha)	Susceptible Pl Volume (m^3)	Species Profile (forested lands, by area)
Dawson Creek TSA				
1	TSA	1,671,084.42	41,249,514.74	Pl32 Decid26 Sx23 Other10 Bl9
2	TFL 48*	617,331.27	Not available	Sx36 Pl32 Bl16 Decid15 Other1
3	Woodlots	14,274.37	629,092.94	Sx38 Pl35 Decid24 Other3
4	Parks and Protected Areas	204,332.19	2,778,073.90	Sx36 Bl26 Pl24 Decid9 Other5
5	Private Land	482,710.54	1,139,906.06	Decid90 Sx4 Other4 Pl2
6	Ecological Reserves	53.78	-	Decid91 Sx9
7	Crown Federal	49.89	-	Decid100
	Total DDC	***2,989,836.46***	***45,796,587.65***	
Fort St. John TSA				
1	TSA	3,754,543.46	62,987,692.13	Other40 Sx21 Pl19 Decid19 Bl1
2	TFL 48*	123.76	Not available	Pl37 Sx26 Decid25 Bl12
3	Woodlots	14,968.43	665,297.96	Decid41 Sx37 Pl20 Other2
4	Parks and Protected Areas	197,761.44	1,803,115.14	Sx60 Bl22 Pl11 Other4 Decid3
5	Private Land	706,291.51	4,812,843.55	Decid71 Pl11 Sx9 Other
6	Ecological Reserves	2,693.55	-	Decid46 Bl35 Sx16 Other3
7	Crown Federal	1,250.44	-	Decid97 Sx3
	Total DJO	***4,677,632.60***	***70,268,948.78***	
	Peace District Total	***7,667,469.06***	***116,065,536.43***	

*No volume information available for TFL48 in VRI data.

Table 4 outlines the number and area of mountain pine beetle infested and susceptible polygons, along with the percent infested by overall area. It should be noted that the value represented in Table 4 for infested stand area is the sum of the total stand area. Therefore, if a stand is infested at all regardless of actual attack magnitude its total hectares are included. The actual hectares of mountain pine beetle attack by area are outlined in the Table 5.

Table 4. Number and area of mountain pine beetle infested and susceptible polygons along with the percent infested area for the Peace Forest District, 2006.

Area	No. Infested Polygons	No. Susceptible Polygons	Infested Stand Area (ha)	Susceptible Area (ha)	Percent Stands Infested
TFL48	5,591	39,365	65,279	306,947	14.20%
Dawson Creek TSA41	8,958	38,689	303,204	712,941	23.15%
Fort St. John TSA40	312	79,718	10,222	1,180,585	0.39%
Peace Forest District	***14,861***	***157,772***	***378,705***	***2,200,473***	***9.42%***

Table 5. Mountain pine beetle infest in the Peace Forest District, 2006.

Area	No. sites	No. reds	Area attack (ha)	Percent Actually Infested
TFL48	7,859	221,384	3,342.22	1.09%
Dawson Creek TSA41	27,972	10,120,809	34,705.46	4.87%
Fort St. John TSA40	856	1,154	214.25	0.02%
Peace Forest District	***36,687***	***10,343,347***	***10,343,3 38,261.93***	***1.74%***

As well as pine leading stands, the Peace Forest District is different from many areas of British Columbia currently experiencing mountain pine beetle outbreaks in that pine is present as a minor species in deciduous stands. The following table breaks down the hectares of pine within deciduous stands by TFL48, TSA40 and TSA41. As can be seen by Table 6 Fort St. John TSA 40 contains significant deciduous stands with pine as a minor component. These stand types will make management efforts difficult because mountain pine beetle has been shown to be extensive in these areas but harvesting efforts will yield relatively low volumes of pine.

Table 6. Breakdown of pine hectares in deciduous stands in TFL48, TSA40 and TSA41.

Area	Area (ha)
TFL48	28,837.50
Dawson Creek TSA41	103,178.80
Fort St. John TSA40	213,200.41
Peace Forest District	***345,216.71***

Table 7 outlines a comparison of small pine identified as age class 2 and 3 versus regular pine identified as age class 4 through 9. It should be noted that 20% of the area covered by pine is included in the small pine profile. This will be particularly important in dealing with the mountain pine beetle as the population increases along the eastern border.

Table 7. Comparison of small pine (age class 2 and 3) versus regular pine (age class 4+) in the Peace Forest District.

	Area (ha)	
Area	**Small pine (Age class 2 or 3)**	**Regular Pine (Age Class 4+)**
TFL48	26,867.79	128,702.33
Dawson Creek TSA41	38,641.35	379,793.17
Fort St. John TSA40	161,303.26	423,485.46
Peace Forest District	***226,812.40***	***931,980.97***

Table 8 outlines the percentage of pine in the three categories; >80%, 50-80%, and < 50%. The largest area is covered by pine between 50-80%, especially in the Fort St. John TSA. As stated previously in relation to pine in deciduous stands, this will be particularly important as the beetle moves north as these mixed wood stands will be difficult to control and still achieve high targets of pine harvesting.

Table 8. Percentage of pine in the three categories; >80%, 50-80%, and < 50% in the Peace Forest District.

Area	< 50 %	50 - 80 %	> 80 %
TFL48	2,143.50	90,064.06	68,532.33
Dawson Creek TSA41	9,919.55	219,065.33	216,560.25
Fort St. John TSA40	23,144.11	399,496.59	200,202.85
Peace Forest District	***35,207.16***	***708,625.99***	***485,295.43***

Define Current Beetle Management Units

Figure 4 outlines the distribution of the Peace Forest District Beetle Management Units (BMU). The BMUs in the Dawson Creek TSA and TFL48 follow work areas boundaries delineated by drainages and other specific operational boundaries. They were revised from the original Landscape Units for ease of integration of treatment programs with forest operations.

In the Ft. St. John TSA, landscape unit boundaries are currently used as beetle management units. Table 9 outlines the susceptible hectares and volume and total hectares for each BMU in the Peace Forest District.

Table 9. Total and mountain pine beetle susceptible hectares and volume by Beetle Management Unit (Work Area/ BMU) in the Peace Forest District, 2006.

District	Responsibility	Code	WorkArea/ BMU	Total area (ha)	Susceptible area (ha)*	Susceptible volume (m^3)**
DDC	TFL48	BOU	Boucher	39,309	17,635	1,722,318.43
DDC	TFL48	CAR	Carbon	95,615	38,004	3,852,937.88
DDC	TFL48	CLC	Club Creek East	20,468	13,898	1,344,663.11
DDC	TFL48	CLC	Club Creek West	17,485	4,353	515,702.53
DDC	TFL48	DIC	Dickebush	25,793	12,999	1,504,771.82
DDC	TFL48	DUN	Dunlevey	49,738	17,070	1,403,389.58
DDC	TFL48	EAP	East Pine	22,866	32,768	160,570.16
DDC	TFL48	FAC	Falling Creek	13,077	40,463	961,576.80
DDC	TFL48	GET	Gething	61,976	1,760	3,628,293.24
DDC	TFL48	GUL	Gulf	10,561	9,699	166,954.33
DDC	TFL48	HAH	Hart Highway	2,965	19,478	89,313.12
DDC	TFL48	HIG	Highhat	13,806	17,010	1,043,315.88
DDC	TFL48	KOW	Kowen Hills	15,443	13,720	1,661,851.82
DDC	TFL48	LMY	Lemoray	13,950	1,847	87,083.34
DDC	TFL48	LBU	Lower Burnt	27,672	15,752	1,850,793.74
DDC	TFL48	NHA	North Hasler	21,260	14,853	1,951,970.61
DDC	TFL48	ROC	Rocky Creek	20,339	13,311	1,323,729.56
DDC	TFL48	SHA	South Hasler	27,345	4,504	281,188.04
DDC	TFL48	SUK	Sukunka-Bluff	21,097	14,678	1,272,926.17
DDC	TFL48	UBU	Upper Burnt	38,709	1,824	63,744.95
DDC	TFL48	WEC	Westcoast-Caron	26,345	20,045	2,615,821.59
DDC	TFL48	WIW	Willow	8,611	6,873	1,126,075.62
DDC	TFL48	WOV	Wolverine	56,162	20,484	1,722,318.43
DDC	TSA	BEA	Bearhole	95,041	64,829	6,642,846.81
DDC	TSA	BEL	Belcourt	71,282	29,643	2,601,926.13
DDC	TSA	BUL	Bullmoose	62,474	27,972	3,157,342.32
DDC	TSA	DAW	Dawson Creek	157,189	502	461,117.30
DDC	TSA	EAP	East Pine	1,753	16,682	1,020,497.95
DDC	TSA	FEL	Feller's Creek	43,606	3,404	1,917,321.14

DDC	TSA	HON	Honeymoon Creek	30,846	8,674	1,582,710.69
DDC	TSA	HUD	Hudon's Hope	92,703	16,849	567,374.80
DDC	TSA	KIS	Kiskatinaw	239,914	866	578,435.04
DDC	TSA	LON	Lone Prairie	77,177	53,212	4,660,227.98
DDC	TSA	LMO	Lower Moberly	98,250	6,698	694,128.14
DDC	TSA	LRD	Lower Red Deer	66,052	42,169	4,341,618.18
DDC	TSA	MUM	Murray-Monkman East	30,827	12,869	1,218,623.51
DDC	TSA	MUM	Murray-Monkman Mid	30,202	16,655	1,356,537.73
DDC	TSA	MUM	Murray-Monkman West	97,450	6,974	547,952.04
DDC	TSA	NAR	Narraway	29,116	16,792	1,211,339.38
DDC	TSA	ONE	One Island	191,001	89,079	7,649,355.51
DDC	TSA	LEM	Pine LeMoray	29,845	1,081	68,258.61
DDC	TSA	UMP	Pine Pass North	52,600	4,815	465,952.12
DDC	TSA	UMP	Pine Pass South	44,586	3,545	251,498.44
DDC	TSA	PIR	Pine River	91,084	12,500	1,219,047.40
DDC	TSA	PUG	Puggins	141,523	58,048	4,762,034.42
DDC	TSA	RED	Redwillow	104,986	67,012	7,170,714.40
DDC	TSA	SEP	Septimus	67,297	4,577	93,810.66
DDC	TSA	UMP	Upper Moberly	116,877	58,163	7,747,824.82
DDC	TSA	URD	Upper Red Deer	39,640	3,685	249,561.36
DDC	TSA	USG	Upper Sukunka/Gwillim East	21,373	3,844	306,470.71
DDC	TSA	USG	Upper Sukunka/Gwillim West	65,210	485	36,023.49
DDC	TSA	WAP	Wapiti	79,989	36,571	3,076,115.69
DDC	TSA	WIL	Williston Lake	18,013	31	259.74
DJO	TSA	BLU	Blueberry	730,966	233,414	18,158,089.33
DJO	TSA	CRY	Crying Girl	67,291	42,821	3,275,550.41
DJO	TSA	ELL	Elleh	6,733	218	4,530,474.92
DJO	TSA	GRA	Graham	334,945	91,041	5,730,088.03
DJO	TSA	HAL	Halfway	206,274	100,174	3,220,244.23
DJO	TSA	KAH	Kahntah	749,011	47,428	4,182,992.46
DJO	TSA	KOB	Kobes	159,746	42,926	2,299,965.00
DJO	TSA	LBE	Lower Beatton	498,312	30,175	4,240,590.40
DJO	TSA	MIL	Milligan	473,876	96,967	3,324,412.40
DJO	TSA	SIK	Sikanni	312,049	45,621	15,684,732.05
DJO	TSA	TOM	Tommy Lakes	705,234	267,954	5,626,386.54
DJO	TSA	TRU	Trutch	436,391	180,478	18,158,089.33
DPG	TSA	BAS	Bastille	20,114	N/A	3,275,550.41
DPG	TSA	BUC	Buchanan East (Bastille)	45,726	N/A	4,530,474.92
DPG	TSA	BUC	Buchanan West (Kitchi)	23,692	N/A	5,730,088.03
DPG	TSA	JAR	Jarvis	30,150	N/A	3,220,244.23

DPG	TSA	KAK	Kakwa	49,992	N/A	4,182,992.46
DPG	TSA	KAR	Kakwa River	24,743	N/A	2,299,965.00
Total				***7,813,739***	***2,200,473***	***166,353,942.02***

*Note: Susceptibly analysis used the location factor in calculations for consistency between TSA's.
**Note: DJO and DDC TSA volumes are net primary utilization 12.5 whereas TFL48 are gross.

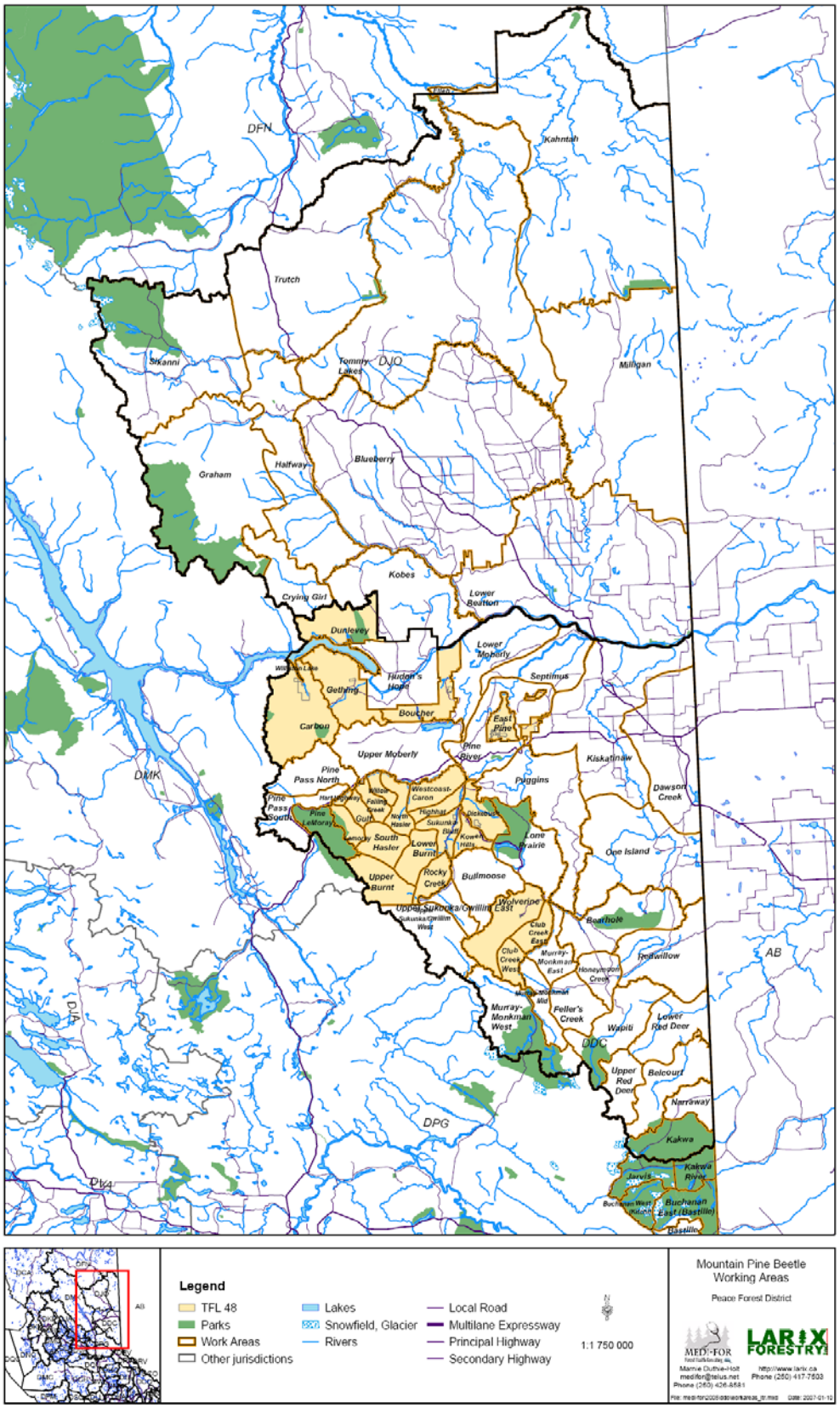

Figure 4. Map of the Peace Forest District Beetle Management Units/ Work Areas (2006-2007).

Define Forest Management Goals and Priorities

The Peace Forest District contains one Tree Farm License, TFL 48 and two Timber Supply Areas - Dawson Creek TSA 41 and Fort St. John TSA 40. Each unit will be addressed separately to outline their individual forest management goals and priorities.

Dawson Creek - TSA 41

Natural resources play an integral role in the economy of communities within the Dawson Creek TSA 41. A resource development planning framework was presented in the Dawson Creek Land and Resource Management Plan (LRMP). The framework outlines a set of guidelines developed from interactions with stakeholders from industry, First Nations, government agencies, the public, and various interest groups which are meant to guide resource management and development within the TSA (BC Ministry of Forests 1999). The plan outlines 17 General Management Directions (GMDs) which are meant to guide policy and operations with respect to specific resources within the Dawson Creek TSA.

Forestry objectives are outlined by GMD #17 and include the following;

- Sustain or enhance existing forest management, and provide new opportunities for forest management activities
- Manage for a sustained forest resource (Intent: to maintain a sustainable level of timber harvest over the long term, recognizing that the AAC is subject to the Chief Forester's consideration of the social and economic objectives of the Crown)
- Where feasible, increase the area of the operable forest land base
- Where feasible, increase the productivity of the operable land base
- Minimize risk to the proposed and existing forestry investments while recognizing agricultural investment and potential on Crown ALR land
- Ensure the availability of the short-term timber supply without compromising future sustainability and other resource values

Fort St. John - TSA 40

The Fort St John LRMP follows the same general principles as the Dawson Creek LRMP. The general management direction is to manage forest resources for a variety of values (BC Ministry of Forests 1997). A range of silviculture systems and flexible harvesting activities are used to accommodate various resource values across the landscape. While not specific in stating resource management directions, there are specific references to forest management activities being conducted with specific considerations given to ungulate wintering habitat.

Work is currently being conducted by ILMB to determine the impacts of the current mountain pine beetle infestation will have on the resource objectives outlined in the

Dawson Creek LRMP and Dunlevy Plan (Maundrell Pers. Comm. 2007). The analysis is ongoing and results will be available for inclusion in subsequent updates to this strategy.

Tree Farm License 48

TFL 48 falls within the area covered by the Dawson Creek LRMP, and Canfor has committed to manage in the spirit and intent of the LRMP (Canadian Forest Products Ltd. 2005). In addition, Canfor's Sustainable Forest Management Plan 4 defines specific objectives, goals, commitments and strategies for TFL 48. The plan is in effect from October 15th, 2006 through October 14th, 2011.

The following is a subset of forest management objectives for TFL48:

1. To conserve or restore ecosystem diversity within the natural range of variation within TFL over time.
2. To conserve genetic diversity of both wildlife and plant species.
3. To sustain a natural range of variability in ecosystem function, composition and structure which allows ecosystems to recover from disturbance and stress.
4. To sustain sufficient and appropriately distributed suitable habitat elements to maintain native species richness.
5. To have representative areas of naturally occurring and important ecosystems and rare physical environments protected at both the broad and site specific levels across or adjacent to the TFL.
6. Maintain water quality and quantity.
7. Maintain sufficient habitats for species at risk.
8. To conserve genetic diversity of tree stock (conifer and deciduous).
9. Implement management strategies appropriate to the long-term maintenance of protected areas and sites of special biological significance.
10. To sustain the natural range of ecosystem productivity to support naturally occurring species. Protect soil resources to sustain productive forests.
11. Balance annual growth rate and harvest rate.
12. Maintenance of the processes for carbon uptake and storage within the natural range of variation.
13. Provide opportunities for a feasible mix of timber, recreational activities, visual quality and non-timber commercial activities.
14. Ensure that harvest levels do not adversely impact the long-term harvest level.
15. Maintain a local, up to date timber processing facility and infrastructure.
16. Recognize and respect Treaty 8 rights, and respect known traditional aboriginal forest values and uses.
17. Support land use processes including the LRMP implementation.
18. Provide an effective and satisfactory process that enables public participation of stakeholders and first nations.
19. Improve and apply knowledge of forest ecosystems, values and management.

Section 8: Historical Accounts

History of beetle in Peace

Mountain Pine Beetle

Mountain pine beetle attack in the Dawson Creek area was first confirmed in February 2004, with the proposed initial flight having occurred in 2002 (Figure 5). The main BC provincial outbreak has been expanding rapidly on the western side of the Rocky Mountains and it was thought that the combination of Rocky Mountains and scarcity of host material at the heights of land could provide the only opportunity for a geographical break large enough to disrupt the beetle's spread. However, this was not the case and scattered spots along the eastern slopes of the Rockies most likely originated from the main outbreak, and beetles were transported long-distances via wind currents up and through the mountain passes. Initial population growth and spread rates were relatively low in 2004-2006 (Figure 6); however the infestation significantly expanded in 2006 following another long-range dispersal (Figure 7).

Optimal temperatures and wind conditions during the 2006 mountain pine beetle dispersal flight carried substantial beetle populations over the Rocky Mountains into the Peace Forest District, north into the Ft. St. John TSA and east into Alberta. A total of 37,804 ha of attack were recorded during the 2006 detailed aerial surveys, with 10,211,441 red trees mapped. In addition to the usual recording of red attack, by mid-September 2006 currently attack trees were already starting to fade in areas of the Dawson Creek TSA, TFL48 and Kakwa Provincial Park areas. Subsequently a "fader line" was established to delineated areas where infestation levels ranged from 40-100% to the west of the line with spot infestations to the east. The area west of the fader line was then netted out of single tree treatment operations and was the focus of sanitation harvesting.

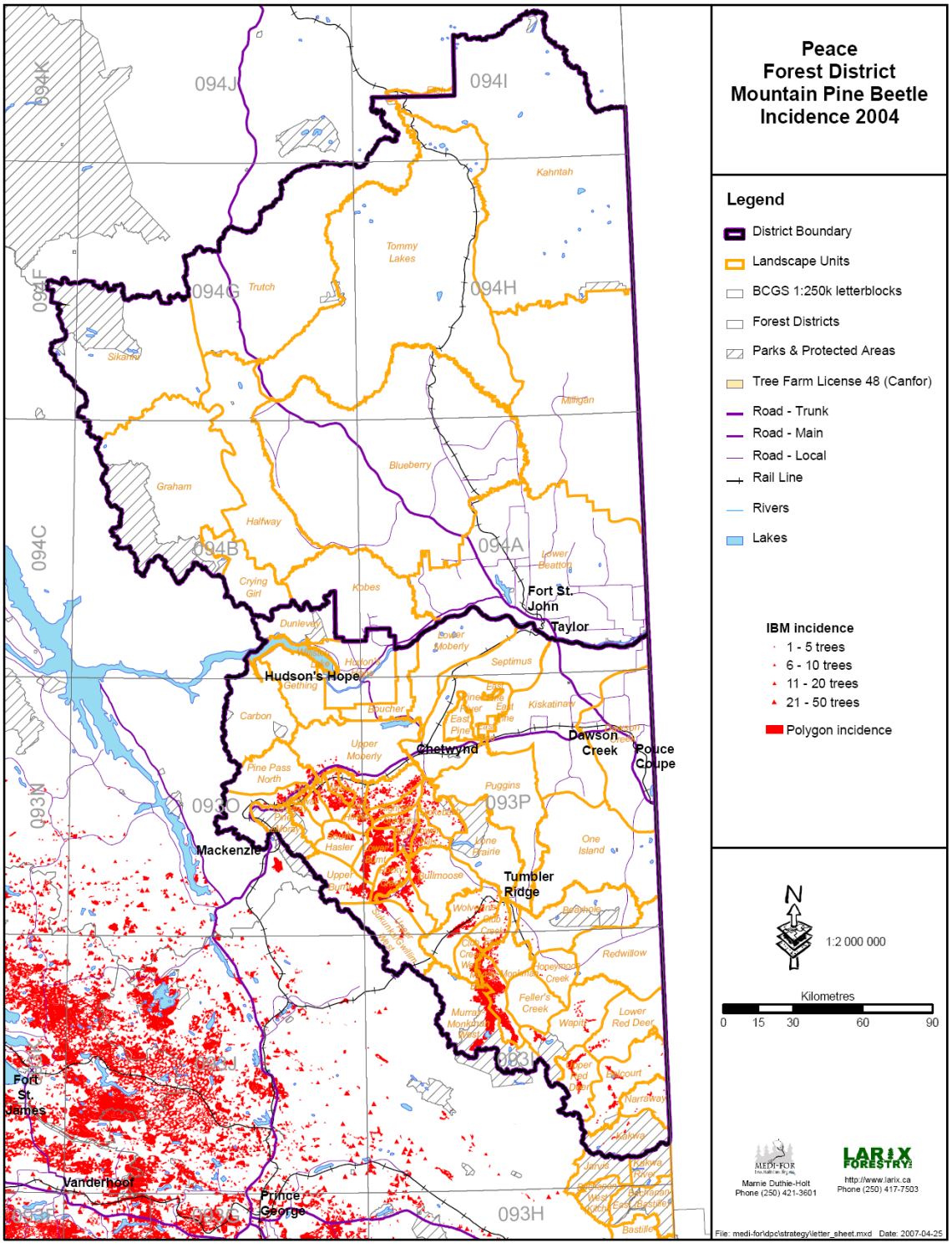

Figure 5. Mountain pine beetle detailed aerial incidence, 2004.

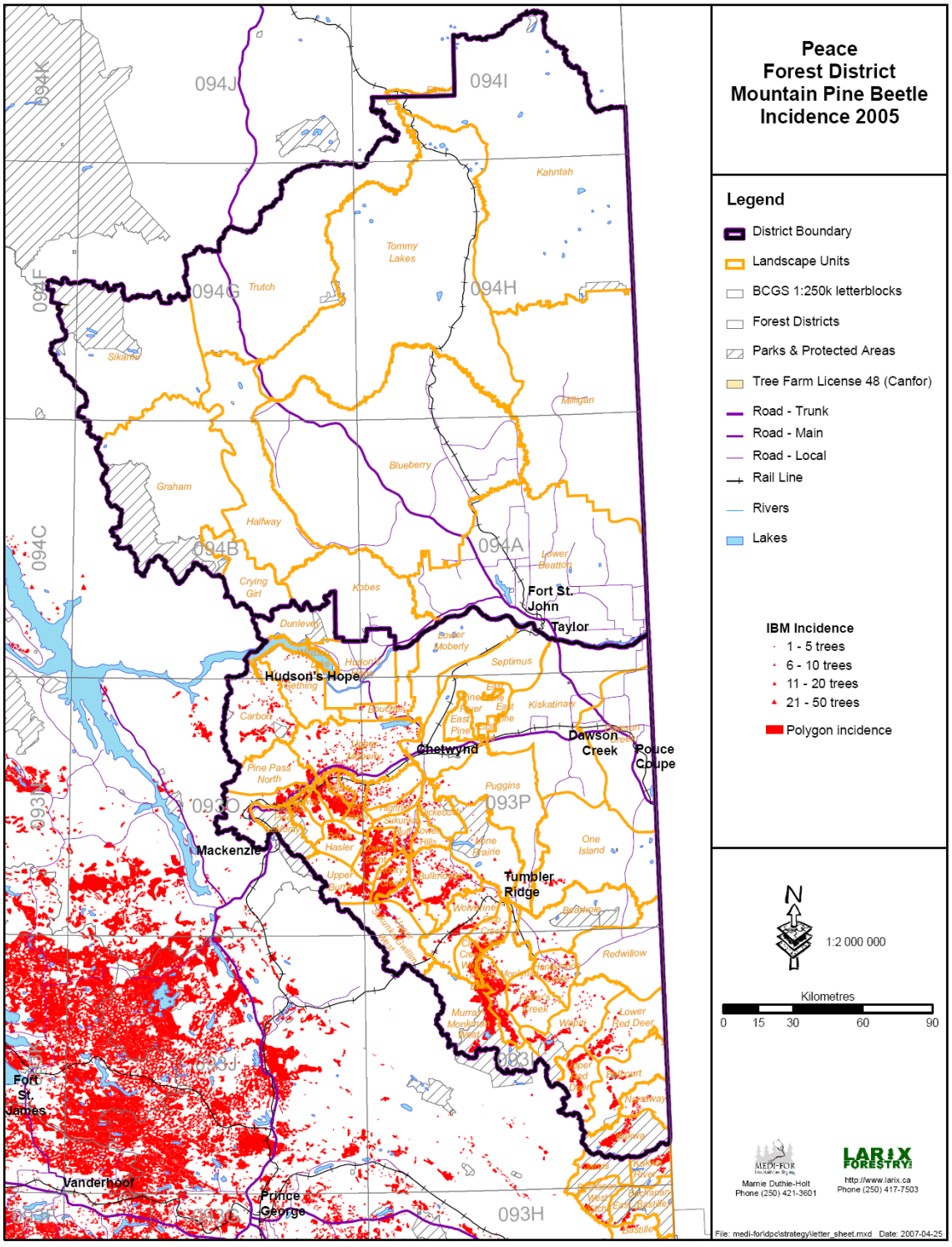

Figure 6. Mountain pine beetle detailed aerial incidence, 2005.

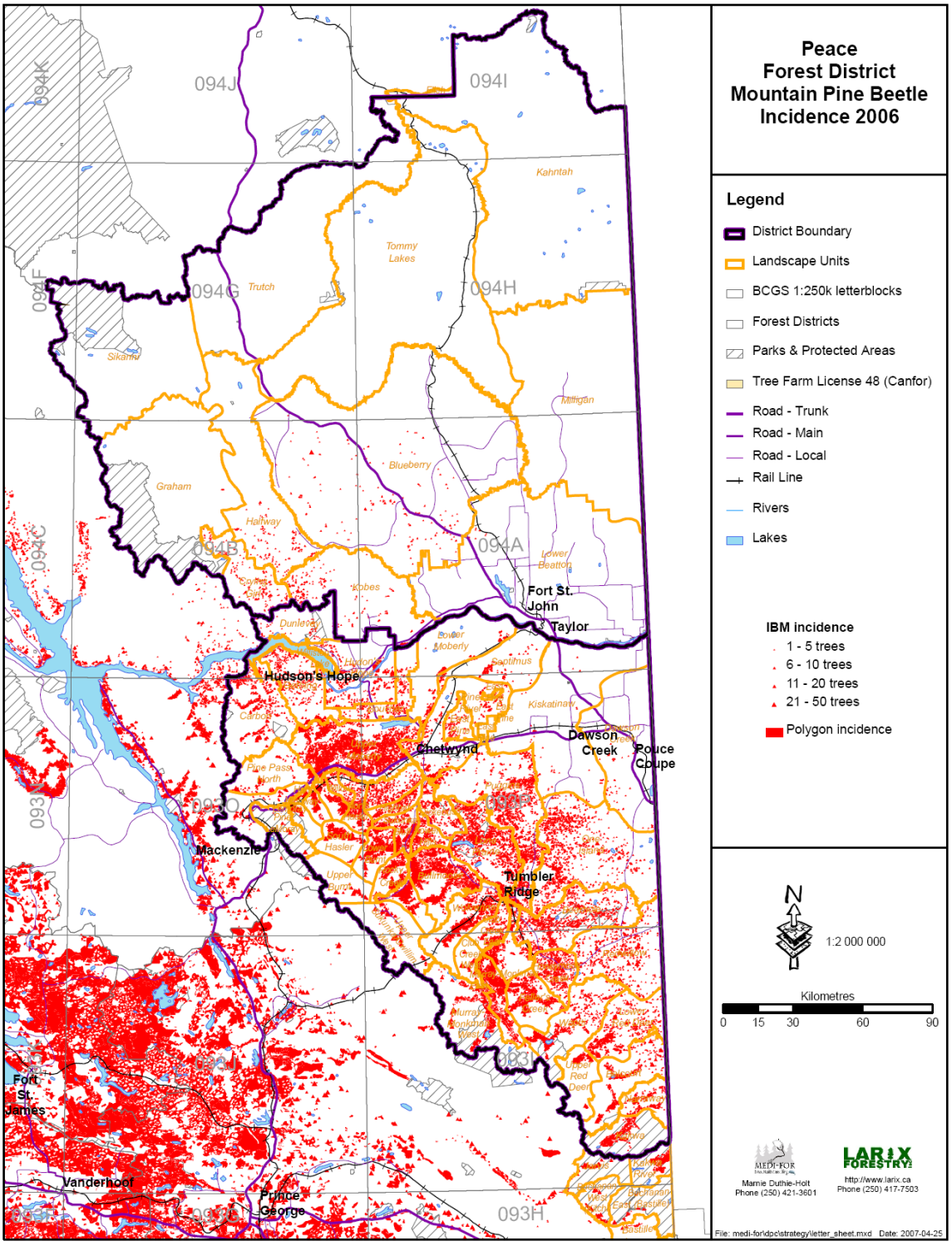

Figure 7. Mountain pine beetle detailed aerial incidence, 2006.

Mountain Pine Beetle Range Expansion in British Columbia

To add to the knowledge of currently infested areas in the Peace, Allan Carrol, Steve Taylor, Jacques Regnière, and Les Safranyik have conducted extensive research on the potential effects of climate change on range expansion by the mountain pine beetle in British Columbia. Details on this work can be found in Carroll *et al* (2003).

As previously discussed, changes in climate has allowed mountain pine beetle to expand it's range northward, eastward and into higher elevation stands throughout British Columbia and Alberta. Range expansion is expected to continue as warming trends continue, with mountain pine beetle moving further north into Fort St. John and further east into Alberta. As well, the climate in the Peace Forest District has become more favorable to the establishment and proliferation of mountain pine beetle populations throughout the district.

Spruce Beetle

Spruce beetle, *Dendroctonus rufipennis*, has had a relatively sporadic recorded incidence within the Peace Forest District. This is in part due to less intensive survey efforts within the northern districts of British Columbia in early years (prior to 1999). When recorded, patches tend to be scattered and transient, often not appearing in the same area two years in a row. There is a general trend of infestations appearing on the western portions of the Dawson Creek TSA and TFL 48. Infestations in the Fort St John TSA are more scattered and less predictable in their occurrence.

Spruce beetle (IBS) was first recorded by the Federal Insect and Disease Survey (FIDS) in the Dawson Creek TSA in 1984 in the Puggins and One Island landscape units (Figure 8). The largest recorded incidence was 1992 when IBS was mapped along the western edge of the Dawson Creek TSA from the Carbon south through Club Creek and a few isolated patches in the Upper Red Deer (Figure 9), covering approximately 50,943 ha. FIDS written reports state that the infestation dropped to 10,000 ha in 1993 within the Dawson Creek Forest District, however the spatial files for IBS for 2003 do not contain any incidence for the Peace Forest District and therefore these patches cannot be spatially represented. The next recorded incidence was in 2000-2001, with scattered small patches in Lone Prairie up through Upper Moberly and Boucher and was recorded for the first time within the Fort St John TSA up in the Tommy Lakes and Kahntah (Figure 10). In 2002-2003 (Figure 11) patches were in the northern portions of TFL 48 and in Pine LeMoray Park, as well as scattered sites in the northern stretches of the Trutch and Halfway work areas.

IBS occurrence in 2005 (Figure 12) saw a dramatic increase along the western half of the Dawson Creek TSA. However, this was mostly made up of measle mapping within the Dawson Creek TSA, and this technique's accuracy has been highly suspect and spruce beetle activity was not confirmed in these areas. There were however, several large polygons mapped along river drainages in the upper Kahntah and Tommy Lakes.

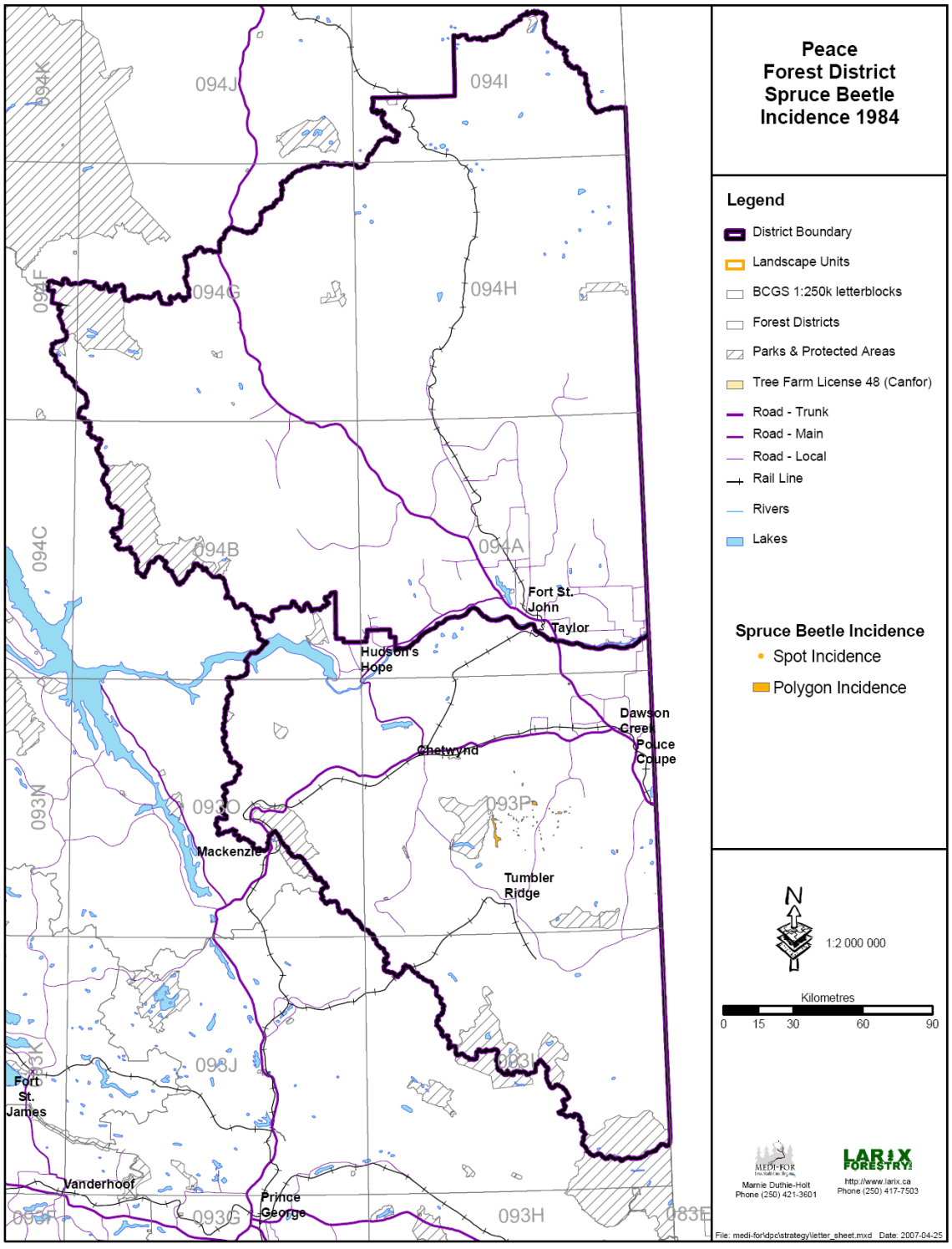

Figure 8. Spruce Beetle incidence from overview data, 1984.

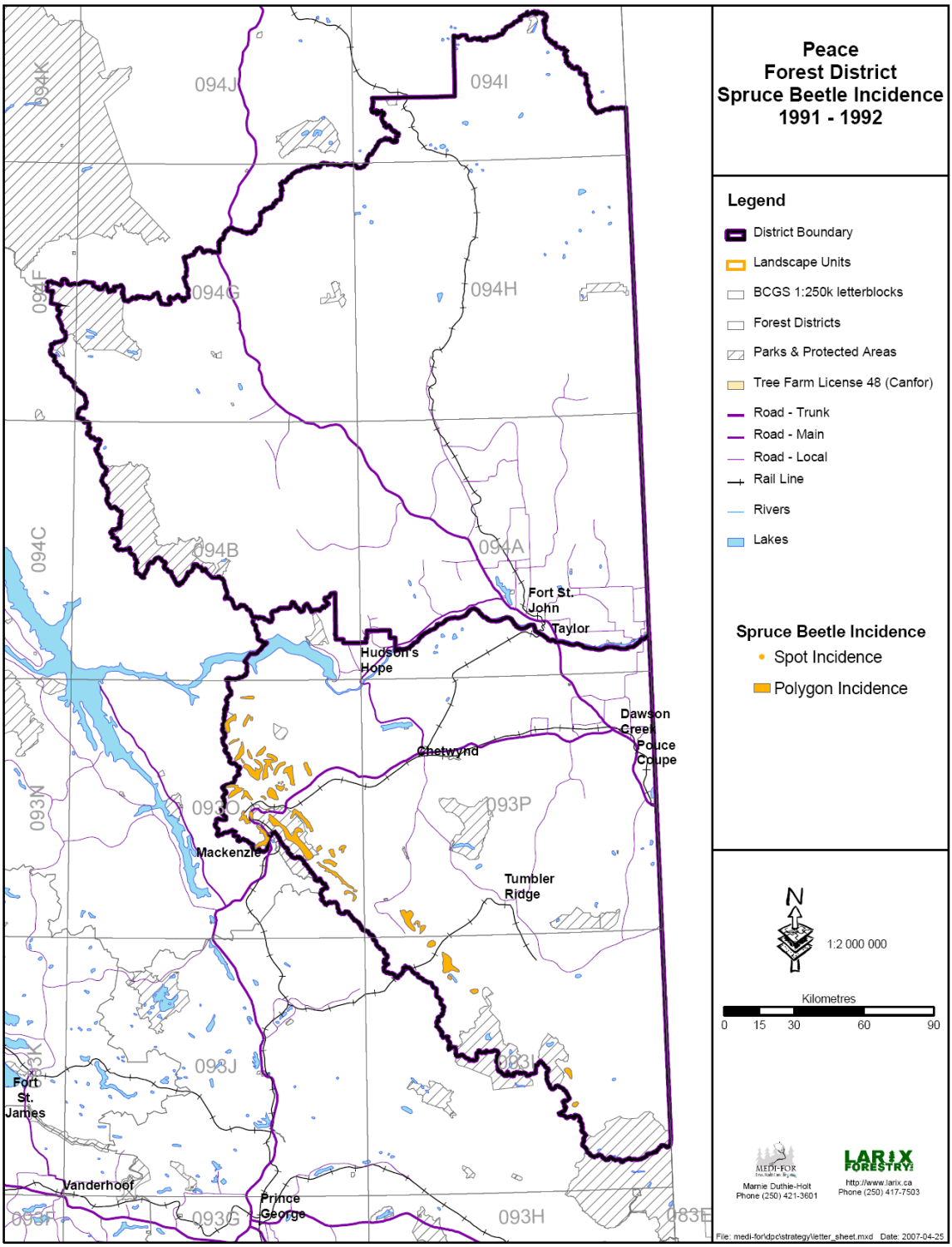

Figure 9. Spruce Beetle incidence from overview data, 1991-1992.

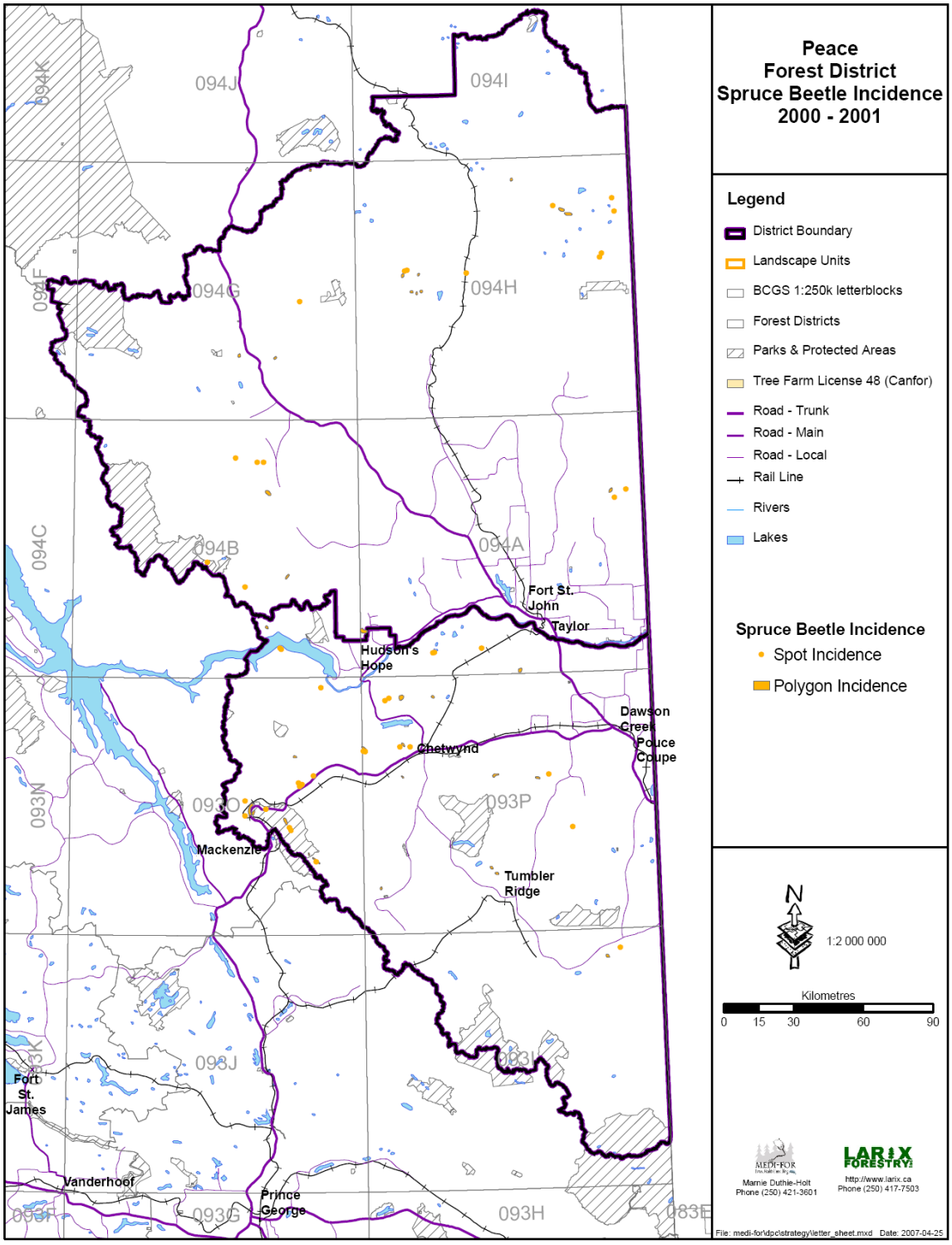

Figure 10. Spruce Beetle incidence from overview data, 2000-2001.

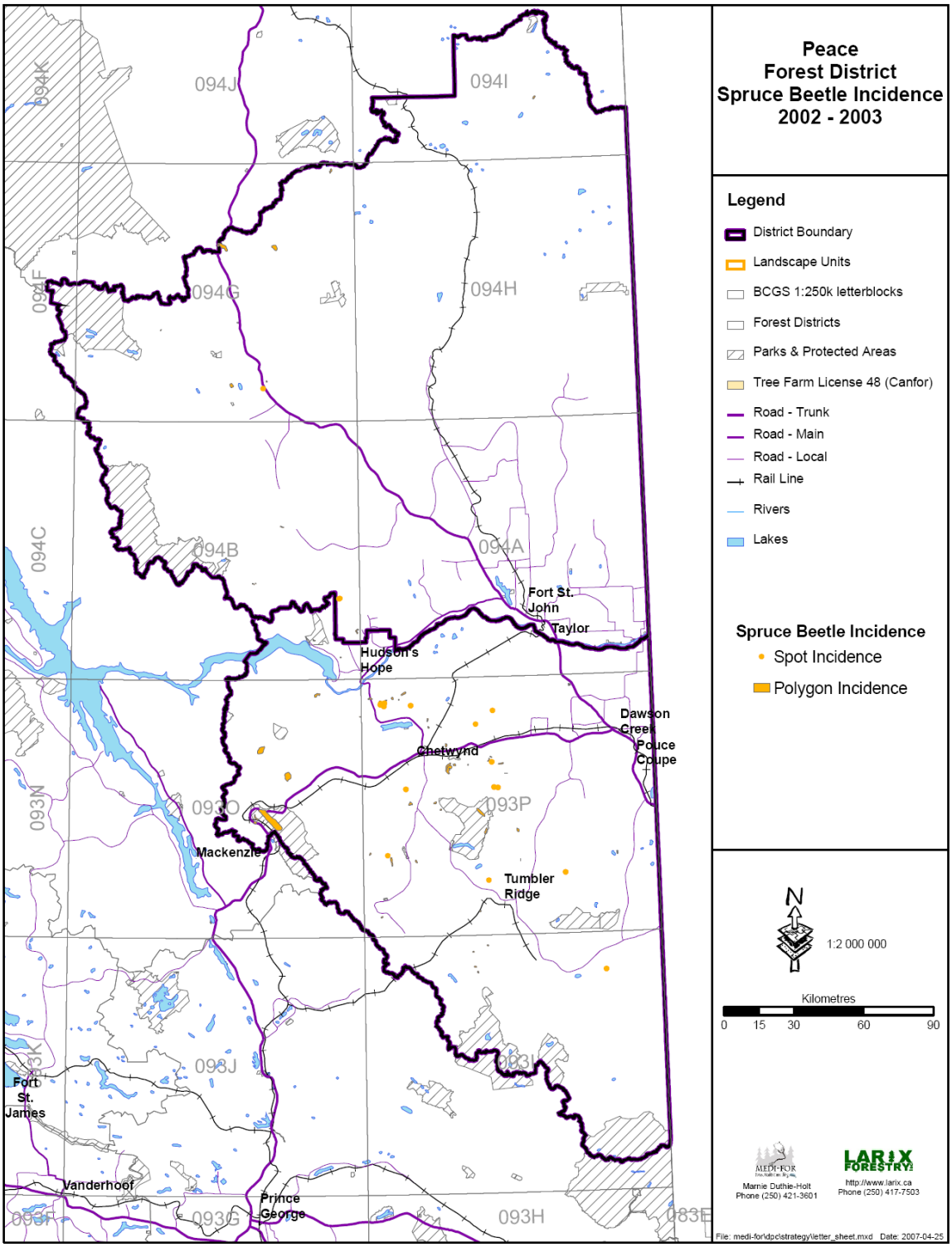

Figure 11. Spruce Beetle incidence from overview data, 2002-2003.

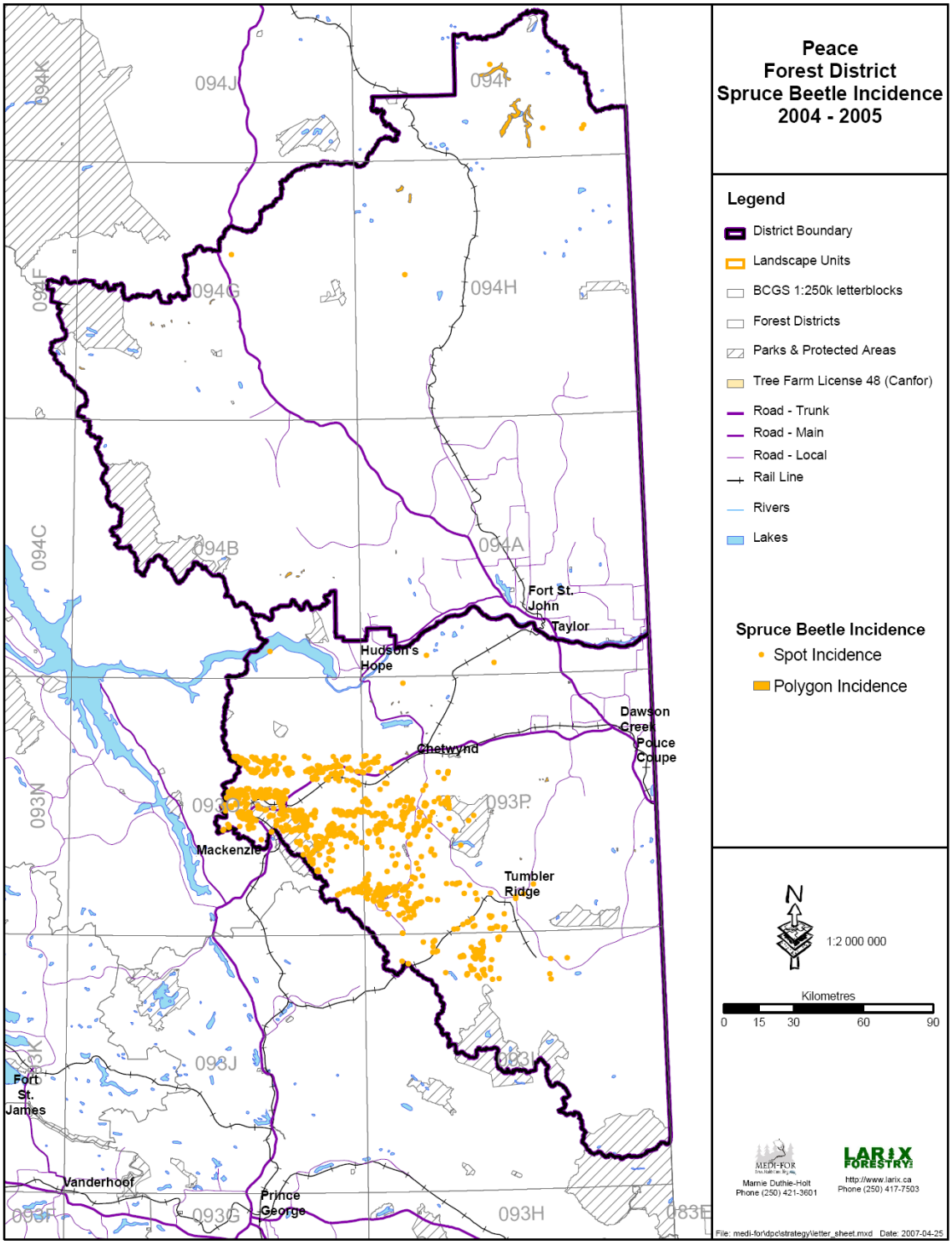

Figure 12. Spruce Beetle incidence from overview data, 2004-2005.

Past Performance and Activities

Detailed Aerial Surveys

In September 2004 after mountain pine beetle was confirmed for the first time in the South Peace, all areas adjacent to the Prince George Forest District were flown and mapped for mountain pine beetle incidence. Detailed aerial survey areas were further expanded in 2005 to cover the expanding populations to the east. The entire Dawson Creek TSA was flown in 2006 and for the first time the southern section of the Fort St John TSA was also flown. The Peace District Forest Health Strategy and Tactical Plan (Duthie-Holt 2007) contain additional details on the 2006 detailed aerial surveys.

Treatments

Aggressive sanitation harvesting and single tree treatments programs have been implemented in the south Peace since mountain pine beetle was first confirmed late in 2004. Table 10 outlines the number of red attacked trees that have been harvested from the fall of 2004 through the spring of 2006.

Table 10. Number of reds harvested in 2004, 2005 and 2006 in the Peace Forest District.

Year	Trees	Hectares
2004		
Canfor- Chetwynd	288	15
West Fraser Mills Ltd.	444	57
BCTS	175	28
Total	***907***	***143***
2005		
Canfor- Chetwynd*	1,223	38
West Fraser Mills Ltd.	150	6
BCTS	9	1
Total	**1,382**	**44**
2006		
Canfor- Chetwynd*	7	1
West Fraser Mills Ltd.	8,971	35
BCTS	20	5
Total	***8,998***	***41***

*It should be noted that the majority of the harvesting accounted for in 2005 by Canfor was actually harvested in 2006. Therefore, Canfor actually addressed more trees than represented by the table since the attack was higher in 2006.

Table 11 summarizes the single tree treatment programs carried out by both West Fraser Mills Ltd. and Canfor – Chetwynd Division in 2004-2005, 2005-2006, and 2006-2007.

Work is ongoing for 2006-2007 and will be completed March 31, 2007. BCTS has not been directly involved with the single tree treatment programs funds have been administered through the DFAM group with West Fraser Mills Ltd. taking the lead for TSA responsibilities and Canfor – Chetwynd administering funds for the TFL48 (Jahn Pers. Comm. 2007).

It should be noted that 2006 was the first year mountain pine beetle was recorded in the Fort St. John TSA therefore, this area has no past MPB performance, however single tree treatments are ongoing and sanitation harvesting will occur where feasible.

Table 11. FIA Funded Single Tree Treatment Summary for the Dawson Creek TSA and TFL48, 2004-2005, 2005-2006, and 2006-2007.

Year	No. Sites	Trees
2004-2005		
Canfor-Chetwynd	86	1,816
West Fraser	582	9,280
Total	***668***	***11,096***
2005-2006		
Canfor- Chetwynd	1,224	28,335
West Fraser	3,021	53,031
Total	***4,245***	***81,366***
2006-2007		
Canfor-Chetwynd	464	66,402
Canfor – Fort St. John	362	3,741
West Fraser	1,742	52,222
Total	***2,568***	***122,365***
Grand Total	***7,481***	***214,827***

Section 9: Harvest Strategy

Objectives of harvest strategy

The Spread Control Overhead Team (SCOT) has directed the Peace Forest District to document their harvest strategy within the district as related to mountain pine beetle management and landscape level hazard reduction. External to the Peace Forest District, there exists some misconception that the large single tree treatment program in the Peace is not being complemented by an aggressive targeted harvesting program.

This strategy also aims to;

1. **Document MPB control efforts over the past 3 years.**
   This is outlined in the Historical Accounts Section under Past Performance and Activities.

2. **Develop priorities to help direct harvesting activities.**
   This is outlined in the Priority Setting and Decision Making Considerations Section under the Priority Ranking Criteria for Harvesting.

3. **Develop a coordinated effort among all stakeholders.**
   This report was development with input from all stakeholders.

4. **To address Land Resource Management Plan (LRMP) and biodiversity values that may be impacted by beetle management activities.**
   This is outlined in the Harvesting Strategy Section under retention.

It should be noted that work is currently being conducted to determine the impacts of mountain pine beetle on the resource objectives identified in the LRMP and biodiversity values so this information is being collated separately (Regnier Pers. Comm. 2007).

Major licensee harvest plans for next 3 years

The majority of harvesting in the next three years is expected to be focused in the salvage zone of the Dawson Creek TSA (Figure 3) and in the southern portion of the Fort St John TSA suppression zone. This corresponds to the area of highest mountain pine beetle infestation in 2006 and also areas of highly susceptible pine.

Currently stands are being prioritized if;

1. Harvesting logistics can be optimized (i.e. having multiple contractors working in one area), and
2. Stands are pine leading (therefore greater than 50% pine).

Figure 13 outlines the current harvest for 2006 and proposed harvest for 2007 and 2008 for the major licensees in the Peace Forest District.

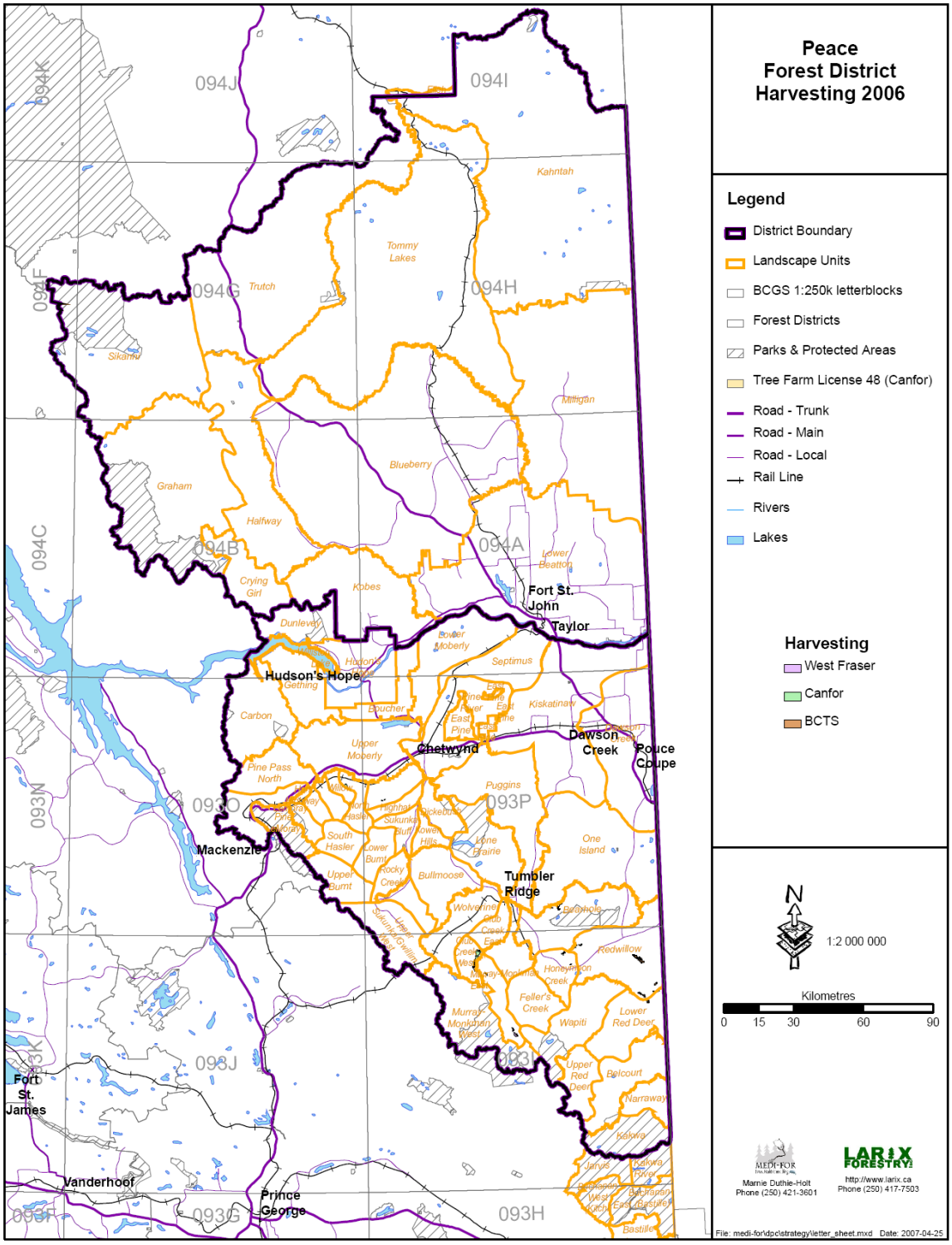

Figure 13. Current and proposed harvesting for the major licensees in the Peace Forest District, 2006.

West Fraser Mills Ltd.

Mountain pine beetle was first found in the Peace in 2004 and since that time, West Fraser Mills Ltd has increased their harvest of pine, from 40 to 70%. Over the past two years, West Fraser has systematically targeted harvesting in geographical areas of pure pine such as the Murray-Monkman, extracting currently infested trees and the highest pine component stands possible (Pate Pers. Comm. 2007). The western, mountainous regions of the TSA generally contain the larger diameter trees and higher proportions of pine and towards the eastern portions of the TSA, average tree size decreases and the economics of harvesting become more constrained. Eastern portions of the TSA also contain a lower percent of pine, making the current 70% pine target unrealistic in many areas in the future. Currently West Fraser has blocks proposed for the 2006-2007 season. However, due to the combined uncertainty of operations under a new Forest Stewardship Plan and tough economic conditions their the ability to produce a 3-year harvest schedule in limited and subject to change (Pate Pers. Comm. 2007).

2006-2007 West Fraser Mills Ltd. will be harvesting cutblocks in three geographical areas (Pate Pers. Comm. 2007);

1. Murray – Barber Creek:	160,000 m^3	90% Pl, 10% Sx
	25,000 m^3	BCTS sales
2. Miekle Creek	60,000 m^3	65% Pl, 20% Sx, 15% Bl
3. Hour Glass Fire	170,000 m^3	59% Pl
Total	*390,000 m^3*	Forest License wood plus
	25,000 m^3	BCTS sales for a grand total of
	415,000 m^3	

2007-2008 West Fraser Mills Ltd. will be harvesting cutblocks in six geographical areas (Pate Pers. Comm. 2007);

1. Murray	240,000 m^3	90% Pl, 10% Sx
2. Miekle Creek	110,000 m^3	65% Pl, 20% Sx, 15%, Bl
3. Moberly	25,000 m^3	65% Pl, 35% Sx
4. Hour Glass Fire	30,000 m^3	59% Pl (approximately)
5. Wapiti	30,000 m^3	23% Pl, 62% Sx, 13 Bl
6. Pine River	70,000 m^3	61% Pl, 27% Sx, 12% Bl
Total	***505,000 m^3***	

Canfor – TFL48 Chetwynd Division

2006-2007 Canfor will be harvesting within their Tree Farm License 48 in three basic geographical areas (Johnston Pers. Comm. 2007);

1. Club Creek: Block 5 of TFL	300,000 m^3	70% Pl, 25% Sx, and 5% Bl
2. Rocky Creek: Block 4 of TFL	100,000 m^3	55% Pl, 35% Sx, 10% Bl
3. Falling Creek: Block 4 of TFL	200,000 m^3	73 % Pl, 22 % Sx, 5% Bl
Total	***600,000 m^3***	

In addition to the areas harvesting in TFL48, Canfor will be harvesting from their small pine NRFL (FL A57332) in Flatbed Creek with a target of 100,000 m^3, 85% Pl and 15% Sx.

2007-2008 Canfor will be harvesting cutblocks in TFL48 in four geographical areas (Johnston Pers. Comm. 2007);

1. Rocky Creek:	Block 4 of TFL	200,000 m^3	55% Pl
2. Falling Creek:	Block 4 of TFL	200,000 m^3	60% Pl
3. Hasler:	Block 4 of TFL	75,000 m^3	60% Pl
4. Carbon:	Block 2 of TFL	75,000 m^3	60% Pl
5. Murray:	Block 5 of TFL	50,000 m^3	70% Pl
Total		***600,000 m^3***	

In addition to the areas harvested within TFL48, Canfor will be harvesting from their small pine NRFL (FL A57332) in the summer 2007 Flatbed creek 50,000 m^3 80% Pl and in the winter 2008 unknown, in the Dawson TSA.

2008/09 harvesting plans are not finalized for either TFL48 or FL57332, however, the focus will be pine leading stands in the TFL and TSA (Johnston Pers. Comm. 2007).

Canfor – Fort St. John

The 2006-2007 harvest schedule mostly reflects a pre-beetle harvest schedule as 2006 was the first year MPB was recorded in the Fort St. John TSA. They are currently re-evaluating their schedule to determine what adjustments may be required to account for the treatment of current infestations. Total harvest volumes will fluctuate depending on market conditions, but are expected to range between 850,000 and 1,200,000 m^3 of conifer annually and between 1,000,000 and 1,300,000 m^3 of deciduous (Menzie Pers. Comm. 2007).

An infested area in Farell Creek, north of the Peace River which was identified during 2006 aerial surveys has been scheduled for harvesting this spring prior to beetle flight (Menzie Pers. Comm. 2007). As well, southeastern portions of both Inga Lake and Blueberry are scheduled for harvest in 2007/2008, targeting 150,000 m^3 of infested and pine leading stands (Menzie Pers. Comm. 2007). The current strategy in the North Peace is to focus primarily on the areas of the greatest known incidence and secondarily to target uninfested pine leading stands.

Currently, surveys and anecdotal information indicate that incidental pine within deciduous dominated stands is where the majority of current mountain pine beetle infestations are being found (Menzie Pers. Comm. 2007). It is not known if this is a result of the geographical dynamics of the long-distance dispersal event (i.e. where the wind dropped them) or if MPB is actively selecting these stands.

British Columbia Timber Sales (BCTS)

The overall objectives of BCTS's harvest plan over next three years include harvesting both mountain pine beetle infested and susceptible stands with an annual volume target of 335,000 m^3 (Jahns Pers. Comm. 2007). The geographic areas targeted for sales will include Fisher Creek, Bullmoose Creek, Red Willow River, Old Wives Mountain, Red Deer Creek and Oetata Ridge. BCTS will also be harvesting deciduous leading stands from Lower Moberly River and Rainey Creek, with an annual volume target of 100,000m^3.

Based on the high number of no bid sales in 2006, there is a high level of uncertainty as to the level of success of future sales. Substantial discussion between BCTS and the major licensees is required to ensure BCTS can prepare a sale schedule that will meet crown objectives and also result in successful timber sales.

Tembec – Chetwynd Pulp Mill

Tembec Chetwynd Pulp Mill will be harvesting on the Alberta Plateau over the next 3 years, almost exclusively in the BWBS biogeoclimatic zone (Braybrook Pers. Comm. 2007). Harvest volumes will average approximately 1,250,000 m^3 of aspen and balsam poplar. It is predicted that incidental conifer will likely account for less than 10% of total harvest volume (Braybrook Pers. Comm. 2007).

Lousiana-Pacifc Canada Ltd.

LP's Oriented Strand Board (OSB) operations will focus on the predominantly deciduous areas around Chetwynd and Dawson Creek. Harvesting will occur in the Lower Moberly, Hudson Hope, Septimus, Kiskatanaw, One Island and Redwillow BMU's. Approximately 15% of the harvested volume will be conifer with about half being pine (Brooks Pers. Comm. 2007).

Development of a Mid-term Timber Supply Strategy

As the mountain pine bark beetle infestation progresses, the Peace Forest District will be challenged with the development of a mid to long-term timber supply and forest reclamation strategy. Currently the district has initiated some ground work for this strategy, however additional analysis is required and it is recommended that a sensitivity analysis be conducted on the TSR3 as a complement to the strategy (Hays-Byl Pers. Comm. 2007).

This strategy should include, but not be limited to, the prioritized harvest of dead timber, dead timber retention requirements, rehabilitation of dead stands that will not be harvested and also address fire hazard reduction. Objectives of the strategy should cover topics such as:

Harvesting

- Identification of dead wood harvest priorities at the landscape level, based upon factors such as stand composition, site index, stand condition, and economic viability.
- Estimation of the shelf-life of dead wood stands.
- Based upon the above, revise the AAC for the dry wood harvest period.
- Retention of coarse woody debris for harvested areas in excess of limits set out by FRPA or by policy on utilization standards to mimic nature in heavily impacted mountain pine beetle areas (Ritchie 2005). Worker safety and fire hazard abatement issues would need to be considered.

Retention

- Throughout mountain pine beetle infested areas in B.C. there is a need to balance the economic rationale for aggressive salvage logging with the need to protect environmental values and meet the increased requirements of retention of infested trees to enhance forest diversity (Kaye 2007). http://www.fpb.gov.bc.ca/special/reports/SR32/Lodgepole_Pine_Stand_Structure_25_Years_after_Mountain_Pine_Beetle_Attack.pdf

- Where larger openings are created during MPB salvage, the level of in-block retention is increased (up to 25% for openings larger than 1000 hectares (http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/stewardship/)

- There will also be requirements for landscape level retention that are over and above standard stand-level retention (wildlife tree patch, wetland and stream riparian zones) and standard old-growth retention.

- Determine criteria for determining landscape level retention in mountain pine beetle impacted BMU's. Criteria could include but are not limited to;
    - examination of landscape connectivity,
    - movement corridors,
    - integrity of ungulate winter ranges and wildlife habitat areas,
    - adjacency to old growth management areas (OGMAs),

  - distribution of forest types,
  - biodiversity objectives,
  - incorporation of other stakeholder groups including guides/outfitters, trappers, First Nation interests, etc.,
  - considerations of large areas that will not be salvaged due to lack of access and other operational constraints (areas such as the Belcourt), and
  - examination of stable hydrological functions (Ritchie 2005; Martin 2006; Timberline 2006).

- Determine criteria for retention of mountain pine beetle damaged stands at the stand level including but not limited adjacency;
  - to wildlife tree patches (WTPs) of both pine and non-susceptible species,
  - within riparian management areas,
  - to wildlife habitat features (WHF) including fisheries or marine sensitive features, mineral licks or wallow, nests of bald eagle, osprey or great blue heron, or species at risk bird, etc.,
  - to non-contributing vegetation types (i.e. NCBR) (Ritchie 2005).

Access and Access Management

- Review current access and deactivation practices in relation to present and future access needs, from the perspective of harvesting, rehabilitation/reforestation, fire suppression, integrity of ungulate winter ranges and other resource users such as guides/outfitters, trappers, recreational users etc.

Rehabilitation

- Development of recommendations for the rehabilitation of those stands and areas that will not be harvested, but currently are included in the timber harvesting land base (THLB).

Safety

- Ensure that operations are consistent with legislation and regulations pertaining to worker and road safety.

Fire Prevention/Suppression

- Incorporate fire prevention/suppression considerations into plans and practices at the stand and landscape level.
- Develop recommendations for fire hazard reduction and access considerations for suppression activities within retention and proposed rehabilitation areas.
- Where possible, incorporate community fire preparedness and suppression plans.
- Outline areas where leaving naturally occurring fires will be acceptable.

Plantation and young natural pine stands

- Develop a process to monitor pine plantations and young natural pine stands (age class <3) for the occurrence of mountain pine beetle.

- Examine the feasibility of using intensive silviculture such as fertilization, brushing or thinning to bring current plantations to harvestable volumes sooner.
- Consideration of both alternate species and planting stock outside current recommended zones in light of both future forest susceptibility and global warming
- Develop guidelines for a silviculture strategy.

Estimate Future Non-Recoverable Losses due to Beetle

The amount of future non-recoverable losses due to mountain pine beetle can only be speculated at this point due to the uncertainty surrounding the level success of currently established populations, the impact of potential future long-distance dispersal events, the success of control programs and finally the rate of MPB spread as it continues to expand into new environments

However, an early analysis conducted for the Dawson Creek TSA in 2005 indicated that the mountain pine beetle epidemic could result in approximately 19,000,000 m^3 pine mortality over the THLB over the next 13 years (Schuetz 2005). These estimates were based on standard spread rates and did not anticipate the mass immigration of beetles that occurred the summer 2006. The AAC for the Dawson Creek TSA (effective June 2005) was 1,860,000 m^3 per year. Table 12 presents a breakdown of estimates of potential non-recoverable losses (NRLs) m^3 per year.

Table 12. Dawson Creek TSA AAC and NRLs partitioned.

Partition	AAC (m^3/year)	Average MPB mortality in m^3/year	Average NRL in m^3/year
Traditional Conifer	878,000 or less	1,731,375	853,375
Small Pine	100,000 or more	719,295	619,295
Leading Deciduous	882,000	-	-
Total	***1,860,000m^3***	***2,450,670 m^3***	***1,472,670 m^3***

Source: Modified from Schuetz (2005).

Despite this huge predicted NRL, the analysis indicates the current AAC for West Fraser Mills Ltd. could be sustained indefinitely because the forest resource is currently under-utilized and capable of withstanding considerable mortality (Schuetz 2005). **However, the level of infestation has changed significantly since the 2005 analysis, and a review of the mid-term timber supply analysis is required to update this information with the current outbreak status.**

Currently, TFL48's Management Plan estimates 54,000 m^3 per year in annual unrecoverable losses (Johnston Pers. Comm. 2007). Hypothetically, if the infestations in the TFL collapsed this year, this estimate would continue to be valid; however, if the beetle infestation continues to expand, the unrecoverable losses will be substantially higher and could be in the range of 5,000,000 m^3 over the next five years (Johnston Pers. Comm. 2007).

Non-recoverable losses have not been evaluated for the Fort St. John TSA due to the short history of beetles in this area, but are currently expected to be quite low given current incidence levels (Menzie Pers. Comm. 2007).

Shelf Life

Shelf life is a controversial term and can vary greatly depending on the product being made (Lewis 2007). Extensive research is currently being conducted throughout British Columbia to evaluate shelf life of mountain pine beetle killed wood to determine how long the wood is economically viable for various products. Lewis (2007) found that trees go through major changes in the first two year post attack, losing most of their moisture. However, the speed of degrade depends on specific site conditions including ground moisture levels. Shelf life should be examined locally to determine the potential impacts in the Peace Forest District.

Loss of moisture in dead trees causes the trees to harden and crack, with approximately 50 percent of trees cracking within the first two years. After the first two years, tree condition remains relatively stable until fungus infects the base and the trees fall down and rot.

Timber being used for products such as wafers for oriented strand board (OSB), wood pellets, or bio-energy has a significantly longer shelf life than timber being used for lumber, wood chips, plywood, and even pulp (Lewis 2007).

Describe Implications of 2006 Fire Situation

The 2006 wildfire season in the Peace saw several large forest fires, particularly in the Tumbler Ridge area. These fires consumed a large amount of timber as outlined in Table 13, some of which is currently being salvage harvested. Approximately 170,000m^3 is being harvested from the Hourglass fire northeast of Tumbler Ridge by West Fraser Mills Ltd. (Pate Pers. Comm. 2007). This volume is significant and is having a negative impact on the salvage of beetle killed timber in the Peace District (Pate Pers. Comm. 2007).

Areas being harvested within the Hour Glass Fire are approximately 59% pine and approximately 10% of stems are infested (Pate Pers. Comm. 2007). Some MPB attack had occurred prior to the fire, which started at the beginning of July, and attack continued through the summer, beetles infesting scorched, fire stressed trees.

In addition to the fires in the Dawson Creek TSA, Canfor Ft. St. John is planning on harvesting approximately 157,000 m^3 of fire salvage wood in 2007. Of this volume, 79,000 m^3 will be harvested through Canfor- Ft St John's forest license and 78,000 m^3 through a BCTS sale (Menzie Pers. Comm. 2007).

Table 13. Fire data for the Peace Forest District in 2006.

Area	Hectares Burned	No. of fires
Dawson Creek TSA	*22,154.10*	6
Fort St. John TSA	*18,439.93*	23
Total Peace District	***40,594.03***	***29***

Describe Implications of Potential Spruce Bark Beetle Outbreak

The last spruce beetle outbreak in the Peace Forest District was in 1992 when 50,943 ha were infested, mostly on the western portion of the Dawson Creek TSA (Figure 9). To determine the potential impact a spruce beetle outbreak would have on the mountain pine beetle salvage program, a simplified spruce susceptibility was conducted, showing the distribution of stands with at least 50% spruce that were age class 6 or greater. The resulting forest susceptibility to spruce beetle is shown in Figure 14. Susceptibly is highest on the western portions of the Ft St John TSA, with extremely high hazard in the Sikani, Graham, and Crying Girl BMU's (Table 14). Total susceptible volume in Fort St. John TSAS40 is 79,076,289 m^3, which is much higher than the 5,475,589 m^3 that is susceptible to mountain pine beetle. A spruce beetle outbreak within Fort St. John TSA would have a substantial impact on the District's ability to address mountain pine beetle salvage as it poses a much greater threat to the forest.

Table 14. Areas and volumes susceptible to spruce beetle in the Peace Forest District, 2007.

BMU	Susceptible area (ha)	Susceptible volume (m^3)*
Bearhole	4,560	761,886
Belcourt	9,559	1,196,500
Blueberry	47,592	10,862,994
Boucher	53	12,239
Bullmoose	15,076	2,558,093
Carbon	191	39,977
Club Creek East	1,130	N/A
Club Creek West	5,462	N/A
Crying Girl	24,134	3,643,898
Dawson Creek	2,286	377,122
Dickebush	2,307	N/A
Dunlevey	2	64
East Pine	286	N/A
Falling Creek	1,329	N/A
Feller's Creek	7,480	894,450
Gething	43	6,987
Graham	140,651	15,457,098
Gulf	981	N/A
Halfway	42,394	6,160,731
Hart Highway	292	N/A
Highhat	2,282	N/A
Honeymoon Creek	3,515	533,972
Hudon's Hope	10,182	2,504,083
Kahntah	32,919	7,799,606
Kakwa	9,699	1,301,279
Kiskatinaw	4,702	862,139
Kobes	26,581	6,011,131
Kowen Hills	2,659	N/A
Lemoray	3,771	N/A
Lone Prairie	9,533	1,574,499
Lower Beatton	11,280	2,626,097
Lower Burnt	6,858	N/A
Lower Moberly	6,023	1,403,009
Lower Red Deer	11,620	1,698,090
Milligan	4,473	910,589
Murray-Monkman East	3,049	475,001
Murray-Monkman Mid	4,336	633,612
Murray-Monkman West	21,661	3,732,978
Narraway	8,153	1,119,102
North Hasler	4,658	N/A

One Island	12,914	2,363,851
Pine LeMoray	0	N/A
Pine Pass North	11,311	2,023,289
Pine Pass South	8,486	1,532,350
Pine River	5,595	1,230,153
Puggins	15,110	2,838,078
Redwillow	10,308	1,590,144
Rocky Creek	3,329	N/A
Septimus	2,767	566,487
Sikanni	94,460	7,891,225
South Hasler	6,886	N/A
Sukunka-Bluff	1,151	N/A
Tommy Lakes	44,060	9,235,226
Trutch	47,366	8,477,693
Upper Burnt	10,719	N/A
Upper Moberly	17,408	3,627,095
Upper Red Deer	9,829	1,665,055
Upper Sukunka/Gwillim East	6,634	N/A
Upper Sukunka/Gwillim West	23,224	N/A
Wapiti	20,115	2,891,079
Westcoast-Caron	1,800	N/A
Williston Lake	0	2
Willow	654	N/A
Wolverine	12,651	N/A
Total	***860,539***	***121,088,953***

*Note: Volume information not available for TFL48 work areas.

The Dawson Creek TSA41 has 42,012,663 m^3 of susceptible spruce, which is 40% of the volume that is susceptible to mountain pine beetle (107,062,017 m^3). Susceptibility is highest along the western portions of TFL48 and the Dawson Creek TSA (Figure 14).

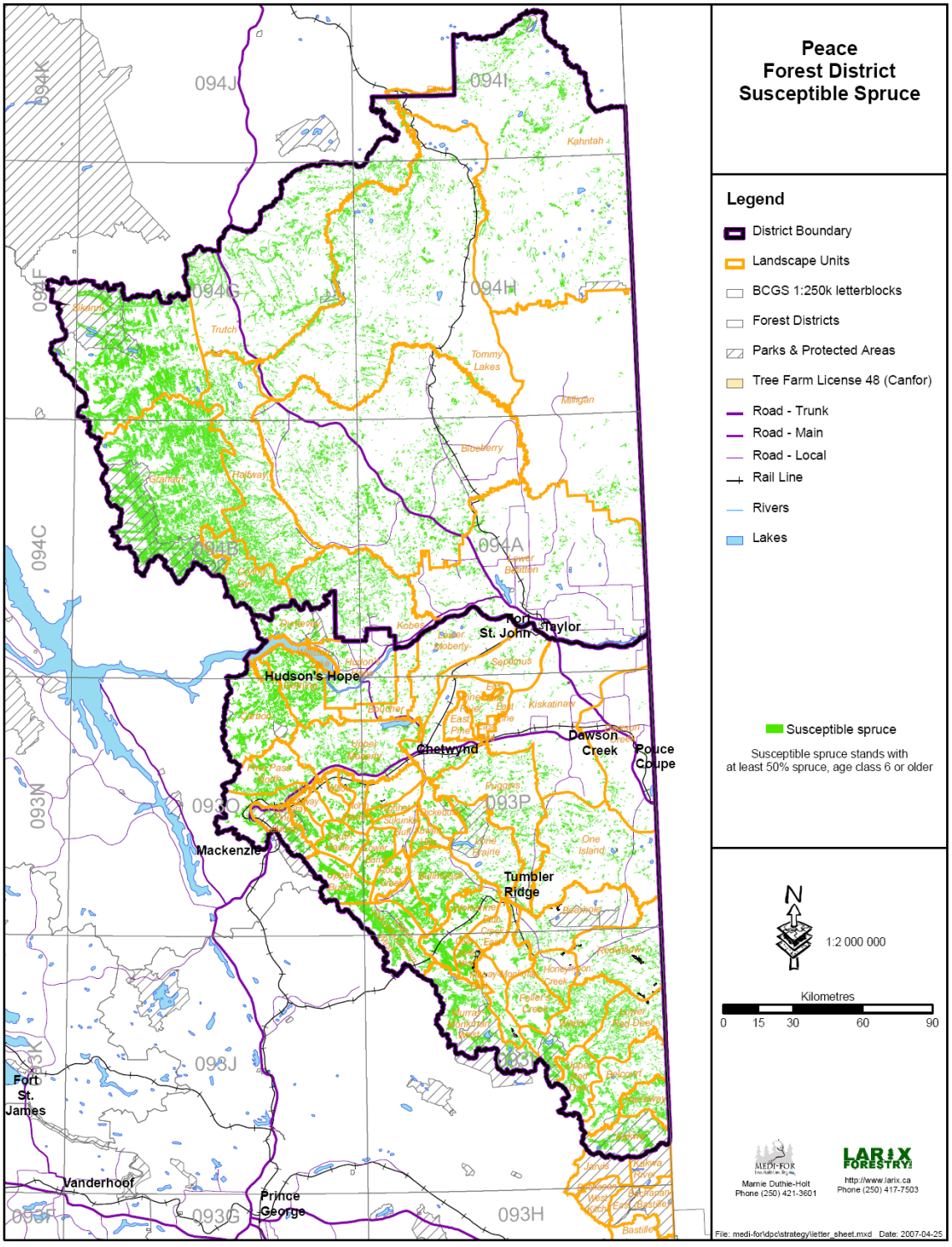

Figure 14. Susceptible spruce stands within the Peace Forest District, 2007.

Small scale salvage, BBR's, intermediate salvage sales (5,000 m^3) and Non-Replaceable Forest Licenses

Small Scale Salvage

The Peace Forest District currently has no small scale salvage operations and there are very limited opportunities in the immediate future due to a lack of both operators and equipment (Johnston Pers. Comm. 2007; Rodine Pers. Comm. 2007). In addition, in many areas the level of infestation is beyond what could be encompassed by a small scale salvage license (Johnston Pers. Comm. 2007). Small scale salvage may be considered in the Fort St. John TSA as infestations within the TSA are still small concentrated patches (Menzie Pers. Comm. 2007).

Bark Beetle Regulation Blocks (BBRs)

Bark Beetle Regulation Blocks were used frequently by Canfor in TFL48 in 2004-2005 (352.2 ha/ 96,965 m^3) and 2005-2006 (172.7 ha/ 47,492.5m^3) and to a lesser extent in 2006-2007 (33 ha/ 9,075 m^3) (Johnston Pers. Comm. 2007). West Fraser only harvested 1,500 m^3 under the Bark Beetle Regulation Block in 2004-2005 (Pate Pers. Comm. 2007; Rodine Pers. Comm. 2007). However, expansion of the beetle populations has led to both companies reverting to larger openings and conventional harvesting to maximize removal of infested and high hazard material.

Intermediate salvage sales (5000 m^3)

Intermediate salvage sales (up to 5000 m^3) are currently a new concept that was piloted in a few districts in the Interior (Rodine Pers. Comm. 2007). This license is not likely to be considered by the Peace Forest District in the immediate future due to the lack of capacity to absorb the additional wood. Changes in workforce, milling capacity and market conditions would be required for this to consider as a viable option.

Non-replaceable Forest Licenses

West Fraser Mills Ltd.

West Fraser Mills Ltd. was awarded two Non-Replaceable Forest Licenses (NRFLs) in 2006, each one with a three year term (Kopecky Pers. Comm. 2007). Each license was for 292,500m^3, for a combined volume of 585,000m^3. These licenses were intended to target 70% pine and volumes were to include as much beetle wood as possible. However, the licenses do not contain a required minimum percent infested pine because at the time they were awarded, the level of the infestation did not warrant such a restriction (Kopecky Pers. Comm. 2007). Currently no harvesting has occurred under these licenses, but blocks are scheduled for 2007-2008 (Pate Pers. Comm. 2007). Since NRFL's are awarded based on a competitive bid process, changes to the terms and conditions of the licenses cannot be made after they are awarded (Kopecky Pers. Comm. 2007).

West Fraser has two additional NRFL's (5 year-terms) that were issued for a small pine profile in 2005 (Kopecky Pers. Comm. 2007). One NRFL is in the Dawson TSA

(A74729) with a total volume of 150,000m^3 and the other one is in the Fort St John TSA (A74730) with a total volume of 125,000m^3. In 2006, the district manger of the Peace Forest District issued a letter to West Fraser stating that there would be allowances to harvest outside of the small pine profile if beetle infested or susceptible stands were being targeted (Kopecky Pers. Comm. 2007). Currently no harvesting has occurred under these licenses but blocks several are currently approved and work is scheduled for 2007-2008 in the Murray targeting approximately 85,000 m^3. The remaining volume is to be harvested in 2008-2009 (Pate Pers. Comm. 2007).

Canfor – Chetwynd Division

Canfor – Chetwynd Division, in a join venture with West Moberly First Nations, was issued a small pine profile (<19.5 m in height) NRFL in the Dawson Creek TSA (A57332) in 2005 (Kopecky Pers. Comm. 2007). Canfor has been harvesting 90% pine stands for two years under this license (Johnston Pers. Comm. 2007). The AAC volume for this NRFL is 100,000m^3 per year for a 20 year term. Some harvesting has occurred under this license. In 2006, the district manger of the Peace Forest District issued a letter to Canfor stating that there would be allowances to harvest outside of the small pine profile if beetle infested or susceptible stands were being targeted (Kopecky Pers. Comm. 2007).

The district has also awarded NRFL's targeting deciduous volumes (Kopecky Pers. Comm. 2007). In the Dawson Creek TSA, Louisiana Pacific Corporation (LP) has a deciduous NRFL (A60064) with an AAC of 348,000m^3 and Tembec has another deciduous NRFL (A70730) with an AAC of 252,000m^3.

Fort St. John TSA40

Fort St. John TSA40 has the following NRFLs.

License	AAC (m^3)	Target	Company
A56771	150,000	Conifer	Canfor – FSJ
A60049	193,000	Deciduous	LP
A60972	69,085	Conifer	Tembec
A60050	1,193,000 – over 10yrs	Deciduous	Tembec

Source: Kopecky Pers. Comm. 2007

Describe Past and Future Mill Capacity

The pine scale returns of both Canfor – Chetwynd Division and West Fraser Mills Ltd. in 2003, prior to the discovery of mountain pine beetle were 40% (Kopecky Pers. Comm. 2007). Since 2004, pine scale returns have increased yearly up to the current target maximum of 70% for both the Dawson Creek TSA and TFL48. Table 15 outlines the pine scale returns by year and company. In the predominately mixed stands of eastern portions of the Dawson Creek TSA, it is expected that the maximum achievable pine scale return is 70%, and mostly likely will be less due to the mixed wood stands present (Kopecky Pers. Comm. 2007).

Table 15. South Peace Pine Scale Returns by Year and Company.

Year	Pine Scale Returns	
	West Fraser Mills & Canfor	BCTS
2003	40%	-
2004	51%	72%
2005	64%	77%
2006	70%	-

Source: Kopecky Pers. Comm. 2007

West Fraser Mills Ltd.

West Fraser Mills Ltd operates a sawmill in Chetwynd, with an annual milling capacity ranging from 770,000 to 810,000 m^3 per year over the last five years (Pate Pers. Comm. 2007).

There is the possibility of adding a third shift to increase mill capacity, however, there are inherent problems with this including the current a lack of qualified people and the increased frequency of mill maintenance associated with milling a high proportion of dead wood (Pate Pers. Comm. 2007).

The mill currently has two processing facilities, separating large and small piece processing. There are two different ways of increasing capacity of the current facilities, the larger piece facility could be modified to process smaller diameter wood or the small piece facility may be modified to run faster. However, there is still the economic requirement of at least 30% large diameter wood to enable the mill to continue operating (Pate Pers. Comm. 2007).

Canfor - Chetywnd

Over the last five years the milling capacity for the Canfor Chetwynd's sawmills averaged 850,000 m^3 per year (Johnson Pers. Comm. 2007).

Future milling capacity for the Canfor – Chetwynd mill are confidential and will not be reported in this document (Johnson Pers. Comm. 2007). Canfor is currently developing a strategy regarding future mill consumption.

Canfor – Fort St. John

Over the last five years the sawmill capacity for the Canfor Fort St. John has been between 850,000 and 1,200,000 m3 per year, with a species profile of 40% pine and 60% spruce (Menzie Pers. Comm. 2007). Changes to future milling capacity in response to beetle activity for the Canfor – Fort St. John is currently unknown as the beetle was only discovered in this TSA in 2006. In addition to this, Canfor has a joint venture with

Louisiana Pacific in an OSB plant in Ft St John and they also operate Taylor Pulp Mills which combine for an additional capacity of approximately 1,200,000 m3 per year (Menzie Pers. Comm. 2007).

Tembec – Chetwynd Pulp Mill

Over the last five years the average capacity of Tembec's Chetwynd Pulp Mill was 500,000 m^3 per year deciduous with less than one percent derived from pine (Braybrook Pers. Comm. 2007).

Future capacity for Tembec's Chetwynd Pulp Mill is targeted at a five percent increase in production which may be achieved as early as 2007. However, this increase would only result in a marginal increase in the amount of pine utilized, up to a possible maximum of 10,000 m^3 per year of pine utilized (Braybrook Pers. Comm. 2007).

Lousiana-Pacifc Canada Ltd.

LP has a joint venture with Canfor- Ft St John in operating an OSB plant in Ft St John, which processes approximately 350,000 m^3 of deciduous a year, with an additional 40,000 m^3 of incidental conifer (approximately 50 percent of incidental conifer will be pine) (Brooks Pers. Comm. 2007).

Volume Pressures from Woodlots, Private lands/agriculture, Oil/Gas/Coal, Municipal Lands, and Community Forest Agreements

Extensive volumes are purchased from woodlots, private and agricultural lands, oil, gas, and coal operations, municipal lands and community forests throughout the Peace Forest District (Table 16). This purchased wood will be a combination of pine and other species, and the pine may or may not be infested. Therefore, this volume could potentially reduce the effectiveness of an aggressive sanitation and high hazard host removal program in the Peace Forest District. Alternatively, this purchased wood may significantly assist the overall mountain pine beetle program in the Peace giving the above listed land owners and various tenures an option to dispose of their infested wood.

Table 16. Capacity of each major licensee to purchase wood in the Peace Forest District, 2007.

Jurisdiction	Licensee	Volume purchased yearly
TSA 41	West Fraser Mills Ltd.	Approximately 140,000 m^3
TFL 48	Canfor – Chetwynd	Min.15,000 m^3 per year, with no upper limit, depending on price of other wood sources
TSA 40	Canfor – Fort St. John	30,000 m^3 from private land owners 30,000 m^3 from woodlots 70,000 m^3 from oil and gas

Source: Pate, Johnston, and Menzie Pers. Comm. 2007

BCTS is also feeling the pressures of the volume influx from the above listed tenures holders including woodlots, NRFLs, and Community Forests which are competing to supply wood to the mills that are near capacity (Jahn Pers. Comm. 2007). Major licensees including BCTS should continue to work cooperatively within the district to sanitize and salvage heavily infested areas first and this may require having BCTS harvest outside of their existing pricing units.

It should also be noted that Tembec - Chetwynd Pulp Mill purchases wood but this is restricted to deciduous timber from the above listed tenure holders (Braybrook Pers. Comm. 2007).

Section 10: Challenges/Impediments Facing the Peace District

Various challenges and impediments in the Peace Forest District limit the amount of mountain pine beetle management that can be conducted. Currently, the largest impediment to sanitation harvesting is economics related market conditions and stumpage rates.

Economics

The main economic challenge related to mountain pine beetle management in the Peace Forest District relates to stumpage rates specifically haul distances (Pate Pers. Comm. 2007). Currently, the furthest south licensees are harvesting is at Stone Lake, which is just south of Tumbler Ridge. Stumpage is negative in many areas, including Club Creek and around 43 kilometre on the Bulley FSR in the Murray-Monkam BMU, making these areas currently uneconomical to harvest regardless of strategies or priorities (Pate Pers. Comm. 2007). Truck shortages also play a role in which areas will be available for harvest and transport given the current operability constraints. Changes in stumpage calculations or allowance of haul differentials could dramatic alter the ability of licenses to address infestations further south in the district.

BCTS No bid sales

Four of eleven Dawson Creek BCTS conifer sales were sold in 2006, located at Salt Ridge, Puggins Mountain, and Oetata Ridge and the Hourglass Fire burn sale (Jahn Pers. Comm. 2007). The rest of the conifer sales were advertised no bids were received. These included 3 sales in the Red Deer and 4 sales in the Old Wives areas of the Dawson Creek TSA. All the no-bid sales contained significant proportions of pine ranging from 84% to 96%, and had varying levels of mountain pine beetle infestation (Jahn Pers. Comm. 2007).

Possible reasons for the lack of bids include high upset prices, long cycle times, small piece size, and the acquisition of NRFL's by both West Fraser Mills Ltd. and Canfor – Chetwynd Division (Jahn Pers. Comm. 2007). A review of the 2006 program is occurring and discussions are ongoing with management to determine how to approach sales for 2007. The next schedules of sales run from April 1, 2007 to March 31, 2008 and include nine sales with blocks at Old Wives, Red Willow, Bear Mountain, Fisher Creek, Bullmoose Creek, Oetata Creek and a block within TFL 48 (Jahn Pers. Comm. 2007). The total volume targeted is 210,365 m^3.

Access Development Challenges

There are currently no access challenges related to engineering or construction for any of the major licensees in the Peace Forest District including West Fraser Mills Ltd., Canfor – Chetwynd and Fort St. John, and BCTS (Pate, Johnston, Menzie & Jahn Pers. Comm. 2007). Canfor – Fort St. John currently has no mountain pine beetle incidence of

significance in inaccessible areas (Menzie Pers. Comm. 2007). Access development is also not applicable to Tembec's Chetwynd Pulp Mill (Braybrook Pers. Comm. 2007).

Access issues related to BCTS contribute to their inability to sell their volume, particularly in remote areas (Jahns Pers. Comm. 2007), however the Red Willow and Red Deer units do not have access development constraints and these areas make up the largest area under existing approved layout volume.

However, challenges associated with development of new access relate to low cost allowances within the current stumpage system, resulting in an over-valuation of the standing timber (Pate & Johnston Pers. Comm. 2007). Licensees feel there should be a re-evaluation of the current stumpage rates to allow accurate timber valuation in the north east, which would allow new access development to address MPB infestations in currently un-roaded areas (Johnston Pers. Comm. 2007).

Take or Pay Issues

Cutting permits issued previous to 2003 could be extended indefinitely. However, permits obtained from 2003 onward have a four-year period in which the volume must be either harvested or full stumpage is paid to the crown for the standing trees and the permit is revoked (Pate & Menzie Pers. Comm. 2007), this system is referred to as "take or pay". Deviations from this or leniencies can be granted by the district manager as long as at the time of the application for the deviation no harvesting had been conducted under the cutting permit in question. The process through which a leniency is granted relates to the argument put forth by the licensee that is based on sound forest management and is exclusive of economic considerations.

However, where leniencies were not granted companies in the Peace Forest District that had non-pine areas under permit in 2003, before the beetles arrived, were required to harvest these permits by 2007. This forced companies to harvest spruce or other low pine component stands in 2006, removing harvesting power from infested and susceptible stands.

Energy Sector/ Workforce/ Operator Availability

All industries in northeastern BC continue to be challenged by both labour and machinery shortages. Continued increases in oil and gas exploration and development, an overall aging population of trade workers and insufficient levels of apprentices seeking training are all contributing to labour challenges. This is particularly prevalent in the forest industry which is not able to compete with wages offered by the oil and gas sector, which continues to drain the already shrinking labour force. A suggestion was made to increase the interest level of potential forestry personnel through job fairs throughout the Peace Forest District (Hays-Byl Pers. Comm. 2007).

This lack of trained and skilled workers could have a negative impact on the management of the mountain pine beetle outbreak in several ways;

1. Lack of sufficient trained and/ or experienced surveyors
2. Lack of fall and burn crews e.g. certified fallers, crew supervisors, quality control personnel
3. Lack of trained/skilled logging equipment operators and log haulers
4. Lack of experienced mill workers
5. Shortage of professional forester and forest technicians
6. Higher prices and limited availability of support services e.g. helicopters, mechanics, crew accommodations, etc.

Topography

The Rocky Mountains were initially thought to provide a natural topographical barrier to the movement of Mountain pine beetle into the Peace from central BC. However, a long-range dispersal event occurred in 2002 and again in 2006. After the initial flight in 2002, mountain pine beetle distribution's was primarily on the western edges of the mountain valleys in the Peace. However, the infestation has spread the east and is into areas of boreal forest. The long-range dispersal flight in 2006 increased the severity of the attack in all currently infested areas and also spread beetles much further north and east into Alberta. A major difficulty in managing beetles in the flatter areas of the boreal forest is the increased uncertainties in direction of spread, infestations no longer follow drainages in a linear predictable fashion. Figure 15 outlines the topography of the Peace Forest District through hill shading, with the mountainous ranges and valleys along the western edge of the district and low lying boreal forest areas to the east.

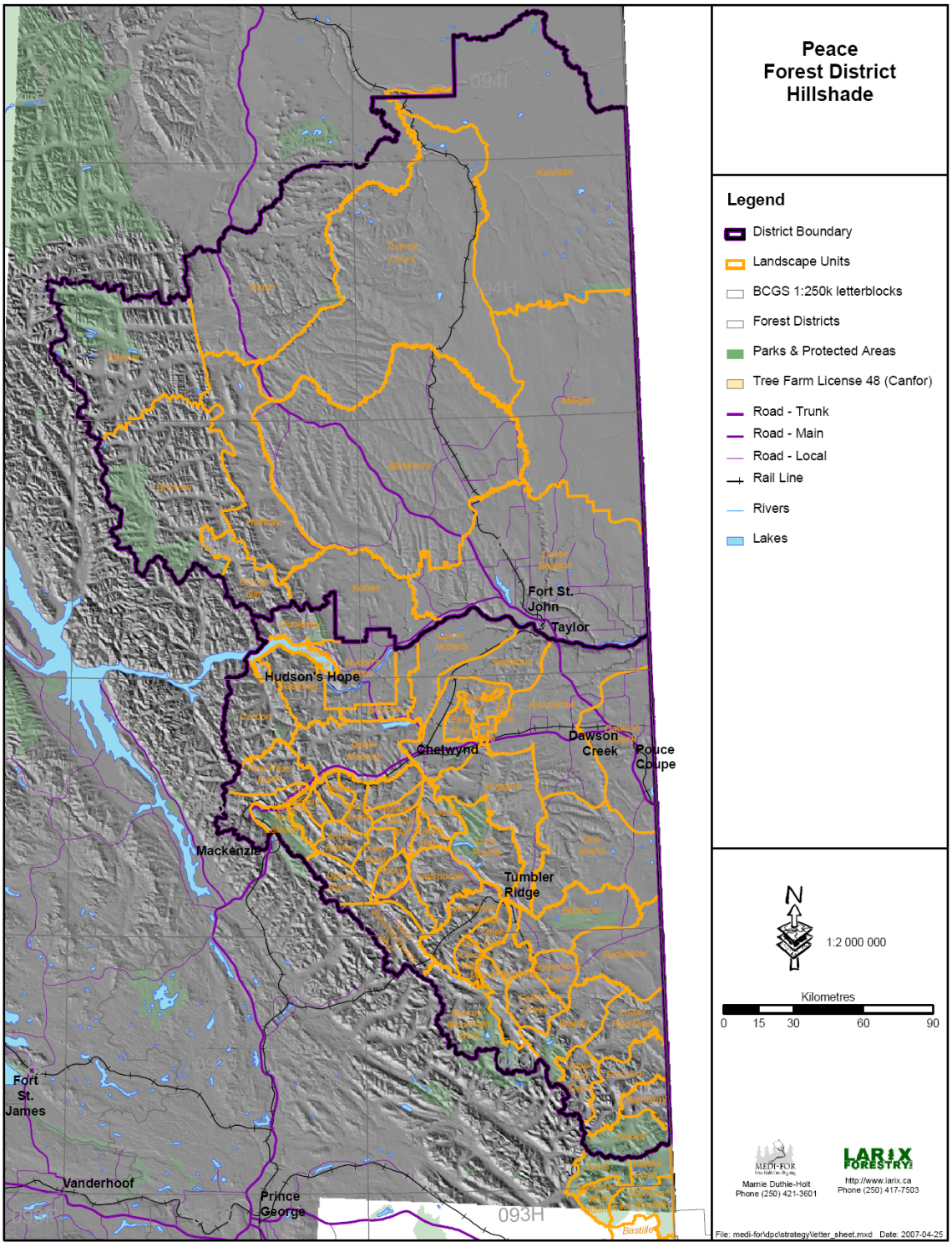

Figure 15. Hillshade map of the Peace Forest District.

Private, Agricultural and Crown Land

Both private and leased land including crown federal, municipal and provincial lands in the Peace Forest District represent significant area, especially along the eastern edge of the district, directly adjacent to Alberta (Table 17). Private and leased land account for only 16 and 15% of the total land base in Dawson Creek and Fort St. John TSAs, respectively. Despite the low proportion of area, these lands seem to have high concentrations of mountain pine beetle attack resulting from a combination of wind patterns dispersing beetles and an apparent attraction to pine shelter belts and mixed wood stands, especially in the Ft St John TSA.

Table 17. Summary of private and crown land areas in Dawson Creek and Fort St. John TSAs.

TSA	Crown Administration*	Area (ha)
TSA 41 (DDC)	Crown Federal (Indian Reserves)	49.89
	Crown Municipal	1,488.62
	Crown Provincial	139,672.73
	Private	341,602.65
TSA 41 (DDC) Totals		*482,813.88*
TSA 40 (DJO)	Crown Federal (Indian Reserves)	1,250.44
	Crown Municipal	710.42
	Crown Provincial	213,239.55
	Private	492,488.80
TSA 40 (DJO) Totals		*707,689.21*
Grand total		***1,190,503.09***

*Note this is the private land/leases only - does not include general crown land.

Agricultural land reserve (ALR) covers 560,759ha (19% of total land base) in the Dawson Creek TSA and 728,160 ha (16% of total land base) in the Fort St John TSA. Infestation on private, ALR or crown lease lands can be an impendent to crown mountain pine beetle suppression programs as private land owners are not legislated or mandated to control mountain pine beetle on their property. There are few incentives and many impediments for private land owners to dispose of currently infested timber on their property and funding sources to help fund control programs on private land are difficult to access.

Two funding sources currently available are outlined in the Innovative Section, however, there should a push to expand current funding and/or develop funding new sources. Alberta is also experiencing infestations in areas of high private land holdings, however, they have recognized this challenge and have dedicated funds through a municipal grant program (Lux Pers. Comm. 2007). Additional details on Alberta's private lands program are available in the Innovative Ideas section of this report.

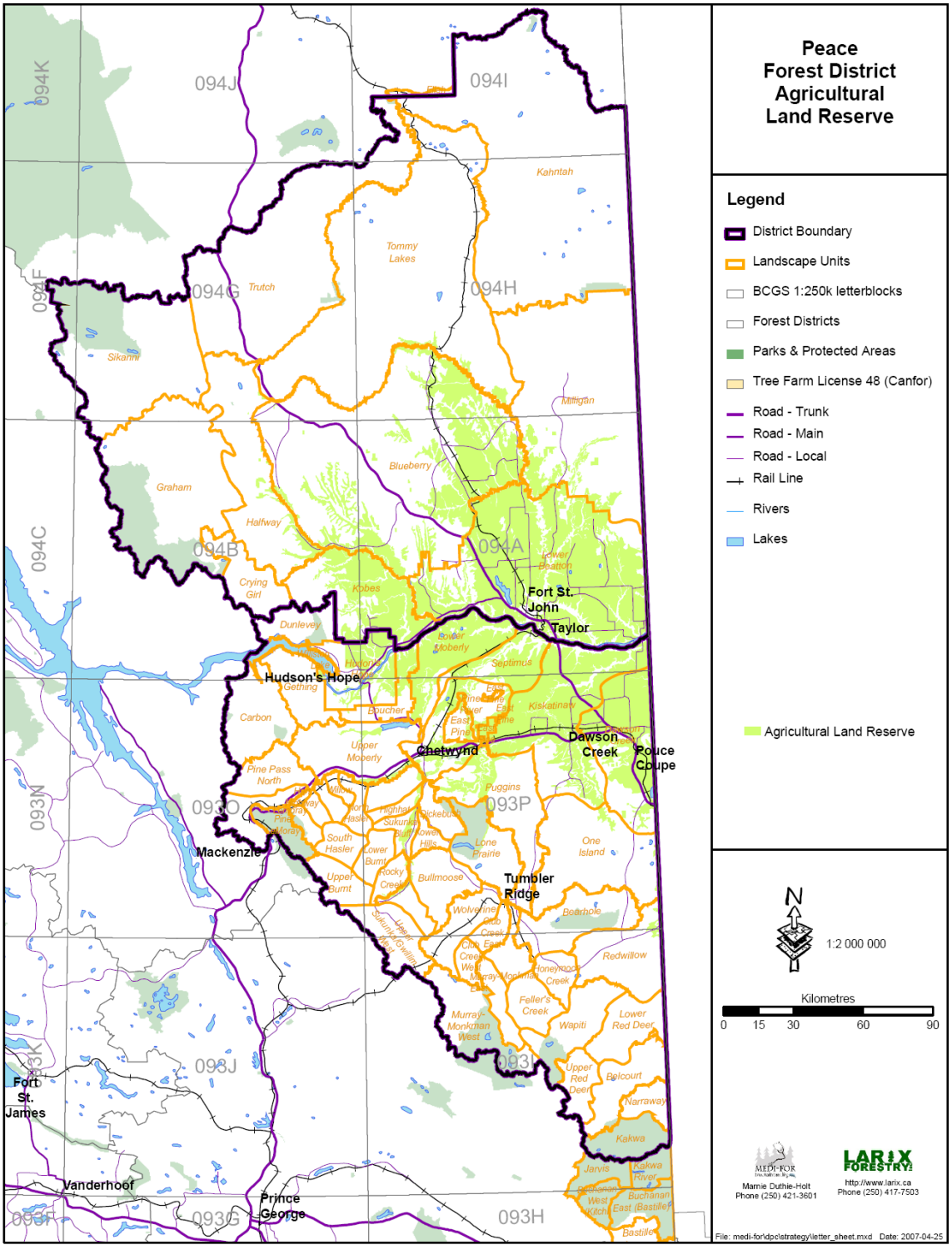

Figure 16. Map of Agricultural Land Base in Peace Forest District.

Visual Quality Objectives

Visual quality objectives (VQOs) are identified to maintain the integrity of visually important features or values. Currently, VQOs restrict the amount of harvesting that can take place along main highway corridors in the Peace Forest District and thus reducing areas where mountain pine beetle sanitation harvesting can occur especially along Highway 97 through the Pine Pass and along Highway 27 from Chetwynd to Tumbler Ridge (Pate Pers. Comm. 2007).

Protection of Caribou Habitat

The Peace Forest District contains both the northern and boreal ecotypes of the woodland caribou. Protection of caribou and caribou habitat is a consideration which is taken into account for both harvesting and single tree treatments when addressing mountain pine beetle attack.

BC's Accounts and Measures for Managing Identified Wildlife (Cichowski *et al.* 2004) outlines the key features of the northern and boreal caribou occurrence, winter diet and seasonal movements which are used to distinguish between the two ecotypes.

The northern population of the woodland caribou is considered of special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), while the boreal population is considered threatened. Both these rankings provide protection for these species under the federal Species at Risk Act (SARA) and within British Columbia, mountain caribou are covered by the Identified Wildlife Management Strategy V.2004, and are a blue listed species. The Peace Forest District has approved Ungulate Winter Ranges (UWR's), proposed Wildlife Habitat Areas (WHA's) and approved General Wildlife Measures (GWM's) for the protection of mountain caribou habitat.

The northern woodland caribou is the only ecotype currently known to be within the Dawson Creek TSA 41/ TFL48. There have been 5 distinct northern ecotype caribou herds delineated within the TSA; Graham, Moberly, Kennedy-Siding, Quintette and Narraway/Belcourt (Cichowski *et al.* 2004). The Fort St John TSA contains the Graham herd of northern woodland caribou and the Chinchaga boreal woodland caribou herd (whose territory continues into Alberta).

Currently, the Dawson Creek TSA 41 (which includes TFL 48) has 553,374 ha in UWR where caribou are listed as the primary species. This area includes both high and low elevation winter ranges; however, the majority of area (304,248 ha) falls within the Redwillow low elevation unit (SPC-009). There is an additional 169,022 ha in WHAs, however there is some overlap with the UWR's. The Fort St John TSA ha 73,637 ha in UWR and 74,871 ha in WHA, however there is substantial overlap between the two. Figure 17 shows the distribution of Ungulate Winter Range (UWR) and Wildlife Habitat Areas in the Peace Forest District.

The Moberly and Quintette populations remain at high elevation year round, staying in the alpine and subalpine, and consequently are not likely to be impacted by MPB or MPB management (Seip Pers. Com. 2007). The Narraway population is much more migratory and spends the winters in lower elevations and travel to the high elevations for their summer habitat. This population is quite susceptible to impacts by both mountain pine beetle and its management. The area of winter range used by this population has been removed from operational treatment programs in 2007 to minimize disturbance.

There is less knows about the population in the Bearhole and Redwillow areas. The winter of 2006/2007 is the first time caribou have been collared from this area. Currently the collared animals are in old growth spruce stands, where they are using arboreal lichens; traditionally low elevation habitats are used for old growth pine stands where the caribou crater for terrestrial lichens (Seip Pers. Com. 2007). It is not known if these populations stay at low elevations during the summer or if they migrate to higher elevations. Additional information on habitat use will be available later this year when the collars are retrieved and that will allow for a better understanding of the potential impacts of MPB management on their habitat.

Activities within UWR are subject to the General Wildlife Measures attached to each unit which can provide restrictions on vehicle access, timber harvesting and silviculture activities (maximum areas of disturbance or timing of activities) and recreation development. The GWM can either specify a maximum area that can be harvested, or specify a minimum level of retention of a particular forest type. Within the Dawson Creek TSA, the Redwillow UWR (SPC-009) specifies a maximum allowable disturbance area of 33% of Crown forested area, where as the Chinook Range (SPC-018) requires a retention of at least 60% of pine leading stands greater than 60 years of age and a minimum 100-year rotation for pine-leading stands. These harvest level restrictions will limit the level of salvage harvesting that can be undertaken in large portions of the TSA.

Ungulate Winter Ranges within the Fort St John TSA are less specific in their requirements, generally listing that primary forest activities will not result in material adverse disturbance of caribou during the period November 01 through April 30 and that primary forest activities will result in the retention of all forest cover. Where as the WHA's have been established within the Fort St John TSA (e.g. Graham, Blue Grave and Schooler Creeks), measures call for no harvesting or access construction.

One of the primary issues surrounding protection of caribou habitat is access management, road construct is a primary concern. Treatment program within existing UWR's or WHA such as current fall and burn operations (heli-assist or conventional) that create small openings with no access construction will have minimal to no impacts on caribou or their habitat (Seip Pers. Com 2007). Where larger scale salvage operations are proposed to address timber values within UWRs or WHAs, substantial collaboration will be required with Ministry of Environment staff to ensure the integrity of habitat. Concerns and recommendations for mountain pine beetle management will be specific to each distinct population due to different habitat use patterns.

The current mountain pine beetle outbreak poses two separate threats to caribou habitat. The direct impact of high levels of mortality in mature pine stands used as winter range and the impact of potential increased levels of salvage harvesting in winter ranges.

Potential impacts of high levels of pine mortality on caribou habitat include:

- ✓ reduced snow interception by forest canopy resulting in increased snow depths within winter range stands,
- ✓ enhancement of arboreal lichen growth in stands with high levels of tree mortality,
- ✓ short-term increased growth of terrestrial lichens in moister moss dominated stands,
- ✓ decreased growth of terrestrial lichens in areas where other shrub species overtake lichen,
- ✓ over the mid-term, as dead stems fall, the stand may become impassible to caribou, and
- ✓ over the long-term, naturally regenerated of thick pine stand are not likely to provide suitable caribou habitat.

There are conflicting reports on the impacts the mountain pine beetle will have on caribou habitat. One review prepared by Davis (2003) outlined potential management options for the Entiako Protected Area anticipates that the if harvesting or fire is not used to decrease the volume and density of dead wood within the protected area there will be a significant physical barrier to caribou movement in the midterm. This analysis and predictions were possible as the majority of mortality within the area has already occurred and there have been substantial studies on the area due to its high value as caribou habitat. Similarly, once MPB has moved through the Peace Forest District, and mortality levels within caribou UWRs and WHAs are known, an analysis can be conducted to determine the impact the mortality will have on the suitability of the UWR and WHAs as caribou habitat.

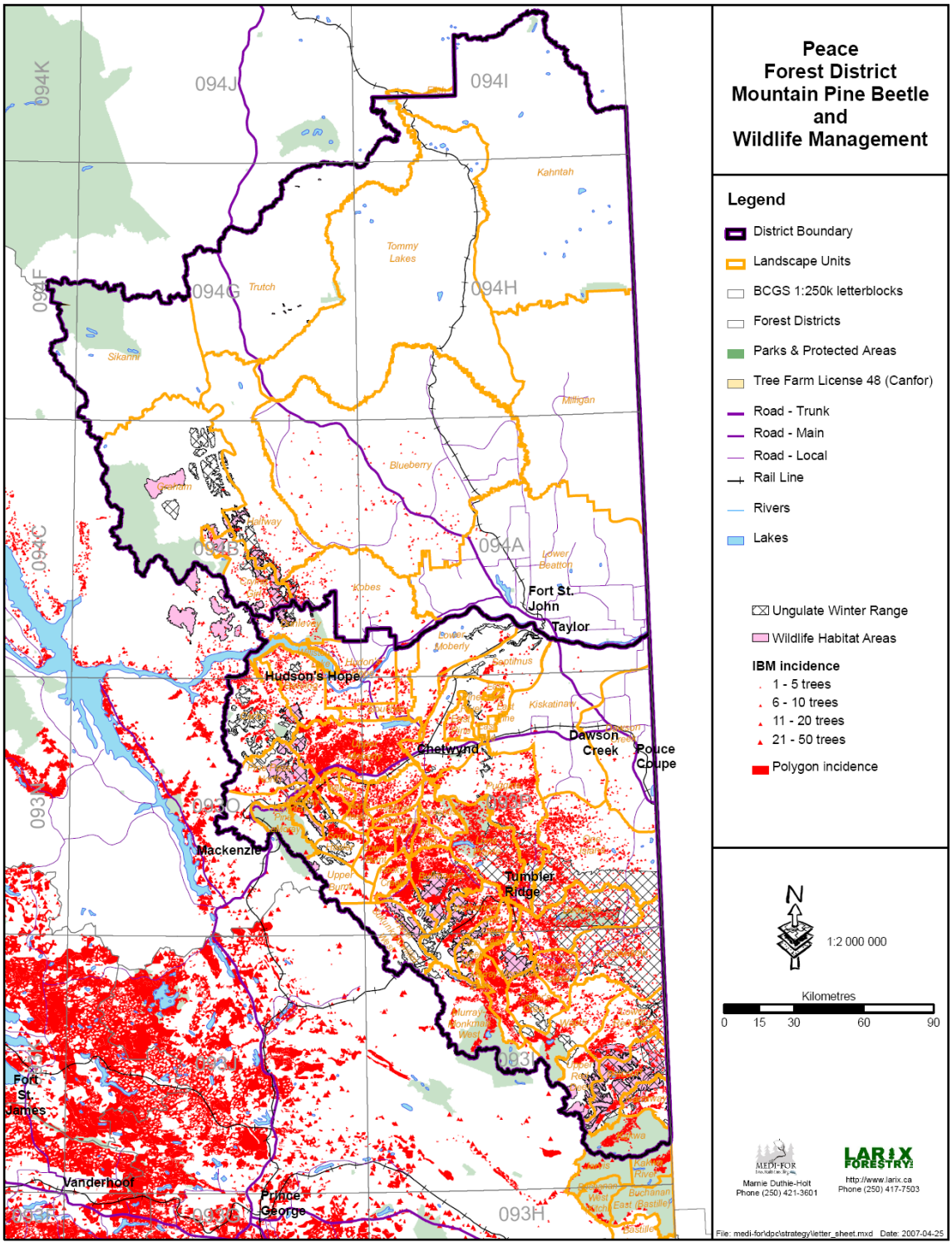

Figure 17. Map of UWR and WHA in the Peace Forest District, 2006.

Ban on Cross Border Wood Transport into Alberta

Import restrictions into Alberta are regulated under the "Timber Management Regulation (164.1 (1))", which states that coniferous logs and other forest products with bark attached cannot be imported into Alberta without approval in writing of the Minister at least 3 months before importing (SRD 2006a). This restriction was implemented prior to the widespread occurrence mountain pine beetle in Alberta and was intended to prevent accidental introductions through log transport.

This ban has minimal to no impact on the capacity for MPB sanitation or salvage operations in the Peace Forest District currently. This could change in the future if there is direction for companies in Alberta to assist with harvesting in the Peace Forest District or if there is direction to transport wood to Alberta mills.

Challenges Associated with Single Tree Treatment Programs

Timing of Funding

It is critical for effective planning that funding for a single tree program, including money for detailed aerial surveys, ground surveys, and single tree treatment is secured early and stays consistent throughout the course of the program. This allows for a program that balances the level of surveys (detailed aerial and ground surveys) according to established priorities, with funding available to conduct the required treatments. As well, planning will allow treatment dollars to be applied in the areas of highest priority as outlined by both this document and the Peace Forest Health Strategy (Duthie-Holt 2007). Changes in funding levels over the course of a program can create problems, resulting in operational constraints overruling strategic direction.

Often operational constraints relate to access issues such as;

1. timing restrictions related to caribou concerns,
2. aligning with priorities in adjacent areas being treated,
3. accommodation of access restrictions for guiders or trappers,
4. tendering of contracts for adjacent areas, and
5. snow depths restricting timing of treatments.

Smoke Management Issues

In 2005-2006, smoke management was a substantial issue in the Rocky Mountain Forest District which resulted in the halting of fall and burn operations during poor venting indices. This has not been the case in the Peace Forest District; however, smoke management could become an issue in the future as control operations move closer to residential areas.

In 2006, the SCOT group recommended that a provincial smoke management policy be developed that specifically addressed issues relating to smoke generated from fall and burn operations. It was anticipated that this would be developed between Ministry of Forest and Range and Ministry of Environment. However, to date this has not occurred and individual districts are applying for burning permits.

The burning of wood debris in British Columbia is governed by the Open Burning Smoke Control Regulation which is a part of the Environmental Management Act. Burning of mountain pine beetle infected debris either in the form of single trees, helicopter piled trees or logging debris could introduce considerable smoke into the environment, depending on the size of treatment sites. As such, there are several legislative issues and approvals that are required.

Open burning (large outdoor fires usually set for land-clearing, construction or forestry operations) is a major source of smoke. The Open Burning Smoke Control Regulation and its Code of Practice are intended to encourage the reduction and reuse of vegetative debris from these operations whenever possible. If open burning is the sole viable option, the regulation allows it only under strict, safe conditions, which are aimed at keeping smoke to a minimum.

The Open Burning Smoke Control Regulation requires burning to be conducted under acceptable ventilation conditions. Open burning can only take place when local air flow will allow smoke to disperse, requiring the ventilation index to be rated as "good" for the day the open burn is started, and "good" or "fair" for the second day of the burn.

Burning can be conducted outside the ventilation index parameters when done under a burn plan or with an exemption approved by the Ministry of Environment. Examples of a burn plan and an exemption are attached as Appendix 18 and Appendix 19.

A Burn Registration Number is required from the Ministry of Forests and Range for any resource management burning. An example of a burn registration number is attached as Appendix 20

Section 11: Communications

A communication plan for the Peace Forest District was developed by the Dawson Creek Forest District and is attached in Appendix 8.

However, a clear definition of roles and responsibility and pathways of communication need to be formalized for all parties involved in spread control programs, including district, regional and branch personnel from the Ministry of Forests and Range, the Spread Control Overhead Team (SCOT), major licensees, stakeholders, FIA Land Base Investment Program, PriceWaterhouseCoopers, and Alberta Sustainable Resource Development (SRD).

In 2005-2006, each Spread Control district including the Peace, Rocky Mountain, Headwaters and Columbia provided monthly updates which were posted for all parties to view. As well, the SCOT team has sent out a cohesive budget letter outlining the allocations of all areas of responsibility broken down by funding source. This information was not readily assessable in 2006-2007. However, this is extremely useful information which should be supplied in the future.

Community liaison (Municipal Councils, Regional District, etc.)

Extensive meetings and public information sessions have been held in the various communities affected by mountain pine beetle operations in the Peace Forest District including Chetwynd, Hudson Hope, Tumbler Ridge, Dawson Creek, and Ft. St. John. Meetings have been conducted by the BC MOF district, lead licensees including West Fraser and Canfor, and contractors coordinating the operational single tree treatment program. Community involvement has also occurred during stakeholder meetings with the inclusion of town council members in 2004-2005 and 2005-2006.

Private Land Owners: Informational Brochure

The Peace Forest District has put together a brochure titled, "What you Should Know About the Mountain Pine Beetle". A copy of this can be found in Appendix 12. The purpose of the brochure is to assist landowners in identifying infested trees on their private property (Coombs Pers. Comm. 2007). During the 2006 mountain pine beetle flight period, the Peace Forest District received numerous phone calls from concerned citizens from Chetwynd, Hudson Hope, Dawson and Ft. St. John. However, many of the calls were people whose backyard-trees were suffering from drought or sequoia pitch moth, *Synanthedon sequoiae*.

Distribution of the brochure was focused on main cities and rural community residences with homes or farms, people living in apartments were excluded. The communities of Dawson Creek, Pouce Coupe and Hudson Hope sent the brochure out in their monthly utility mail-out. The first mail-outs were: January 12, 2007 (rural communities in the North Peace), January 18, 2007 (Ft. St. John, Chetwynd, and Tumbler Ridge) and February 1, 2007 and March 1, 2007 (Dawson Creek) (Coombs Pers. Comm. 2007).

Overall, the response to this brochure has been positive, with concerned citizens using the brochure to identify current attack and calling in to report infestations on their property. There are also plans to update this brochure as mountain pine beetle progress through the Peace (Kopecky Pers. Comm. 2007).

First Nations

First Nations consultations have occurred for all sanitation harvesting and single tree treatment programs in the Peace. This is in compliance with the FIA process for First Nations Information Sharing for the Peace Forest District (Edwards Pers. Comm. 2007).

The general process is as follows:

1. Provide the local MOFR office with a summary of all projects and contact the First Nations Specialist to discuss the proposed activities and determine the information sharing requirements.
2. MOFR District Manager will review the project summaries and email the requirements (notification, information sharing, and consultation) to the licensees within ten working days for each project.
3. Licensees will carry out the information sharing process and provide a summary to the MOFR at completion
4. MOFR will determine if information sharing was adequate.

For the single tree treatment programs in the Peace Forest District, information packages were sent to all bands that had aboriginal interests within the affected area. Packages included current incidence maps and the standards for operations to be completed under the program (Kopecky Pers. Comm. 2007; Savage Pers. Comm. 2007). Meetings were then held with interested parties to discuss any concerns and to provide a venue for suggestions with the licensees and Ministry of Forests and Range.

The following table outlines the sharing requirements for each project type as they relate to mountain pine beetle programs (Edwards Pers. Comm. 2007).

Table 18. Mountain pine beetle sharing requirements with First Nations in the Peace Forest District.

Notification	***Aerial Surveys*** ***Ground Surveys*** Inventory and Monitoring Mapping
Information Sharing	Wildlife Surveys Fill Planting Permanent Road Deactivation Spacing, Brushing Mineral Lick Study (samples)
Consultation	***Mountain Pine Beetle Probing, burning, cut and skid*** Pesticide Spraying Mineral Lick Study (destructive sampling)

Energy Sector

Consultation with the oil and gas sector by Ministry of Forests and Range and Best Management Practices for Mountain Pine Beetle in the Peace Forest District has been outlined for the Oil and Gas Sector as outlined in Appendix 10. Ongoing discussions are occurring with the Ministry of Forest and Oil and Gas Sector and these Best Management Practices are currently being revised to include the North Peace (Kopecky Pers. Comm. 2007).

It is also recommended that these Best Management Practices change the practice of setting traps around felled timber to burning or debarking infested pine trees, as pheromone baited funnel traps could cause additional attack in surrounding stands.

BC Hydro

A draft operational guide for power line timber risk reduction on crown lands has been created to address the huge volumes of dead and dying lodgepole along transmission (18,286 kms) and distribution (55,254 kms) lines across British Columbia (BC Hydro, BC Transmission Corporation, and BC MOF 2007). Both BC Hydro and BC Transmission Corporation (BCTC) manage vegetation located "under wires" and "not under wires" through a risk reduction program. Both dead trees and green pine that maybe be at risk of mountain pine beetle attack are assessed for their potential hazard and removed as appropriate (BC Hydro, BCTC, and BC MOF 2007). Ongoing work is being implemented and will require licensee assistance from the Ministry of Forests (Kopecky Pers. Comm. 2007).

Training

Various training courses for forest managers and operational survey crews have occurred since the arrival of mountain pine beetle to the Peace in 2004. Courses have varied in length from two days to half a day depending on the target audience. Additional courses could be offered as the need arises to target the general public as the issue increases. Additional details on previous courses offered are outlined in the Dawson Creek Forest Health Strategy (Duthie-Holt 2006).

Internal reporting

Internal reporting of operational single tree treatment programs within suppression districts is conducted through an online data tracking system called BeetleTracks. This system can track daily inputs of ground survey and treatment data and produces various reports and can be used to generate spatial data to create various maps. Additional information on BeetleTracks can be found at www.beetletracksca and is outlined in the section below.

Coordination, Information Sharing and MPB activities with Alberta

Mountain pine beetle poses a similar threat to forests in Alberta as it does to forests in British Columbia. Along the eastern slopes of Alberta, there are more than two million hectares of pine forests at risk, worth an estimated $23 billion (Ministry of Forests and Range 2006). Alberta and British Columbia are working together to help minimize damage to susceptible forests on both sides of the Rockies. In March 2005, British Columbia and Alberta signed a five-year, renewable Mountain Pine Beetle Memorandum of Agreement (MOA) for an aggressive spread control program in the Rocky Mountain, Columbia, Headwaters and Peace forest districts (Government of British Columbia and Alberta 2005). The MOA outlines commitments for both aerial and ground surveys of pine forests on both sides of the border, to identify and treat infested trees.

Numerous stakeholder meetings have occurred with representatives from both sides of the border including government representatives, major licensees, and provincial parks personnel from Alberta and BC. As well, members of both sides of the border responsible for spread control activities for mountain pine beetle communicate on a regular basis.

Table 19 outlines the Alberta Sustainable Resource Development Forest Health Group including their titles and contact information.

Table 19. Alberta Sustainable Resource Development Forest Health Contact list and titles.

Person	*Title*	*Email*	*Address/ Phone Number*
Hideji Ono	Manager Forest Health Section	Hideji.Ono@gov.ab.ca	Sustainable Resource Development 8th fl Great West Life Building 9920 - 108 Street Edmonton, AB T5K 2M4 780 422-8801
Dan Lux	Mountain Pine Beetle Coordinator Forest Health Section	daniel.lux@gov.ab.ca	Sustainable Resource Development 7th fl Great West Life Building 9920 - 108 Street Edmonton, AB T5K 2M4 780 644-2246
Erica Lee	Mountain Pine Beetle Specialist Forest Health Section	erica.lee@gov.ab.ca	Sustainable Resource Development 7th fl Great West Life Building 9920 - 108 Street Edmonton, AB

			T5K 2M4 780 644-1813
Mike Maximchuk	Forest Health Officer Lands - Forest Operations	mike.maximchuk@gov.ab.ca	Sustainable Resource Development Main fl Provincial Building 9621 - 96 Avenue Peace River, AB T8S 1T4 780 624-6569
Brooks Horne	Forest Health Officer Lands - Forest Protection	brooks.horne@gov.ab.ca	Sustainable Resource Development 3rd fl Government Centre 131 Civic Centre Road Hinton, AB T7V 2E6 780 865-6969

Albert has also implemented a phone number for people to either report trees infested with mountain pine beetle or if they are looking for additional information. This phone number is 310-BUGS (2847) (http://www.srd.gov.ab.ca/forests/health/index.html).

Table 20 outlines contact information for the main Alberta forest industry representatives who have operating areas along the border with the Peace Forest District.

Table 20. Alberta Forest Industry Mountain Pine Beetle Contacts.

Person	***Title***	***Email***	***Address/ Phone Number***
Pat Wearmouth	Senior Forester	pat.wearmouth@weyerhaeuser.com	Weyerhaeuser Co. Ltd. Bag 1020 Grande Prairie, AB T8V 3A5 780 539-8283
Brian Martell	Woodlands Superintendent	brian.martell@canfor.com	Canadian Forest Products . Grand Prairie Operations 9401-108 Street Postal Bag 100 Grand Prairie, AB T8V 3A3 780 538-7749

A current shortfall in lines of communication between Alberta and BC relates to the timely sharing of survey data and strategy updates. This is an area of improvement which should be addressed prior to the 2007-2008 program year. It is recommended that each province make all survey data, susceptibility mapping, and strategies readily available.

At this time the overall Alberta mountain pine beetle strategy is not available as it is being revised with the results of extensive population sampling (R-values) and overwintering mortality assessments. It is expected that the Alberta strategy will be available September 2007.

Section 12: Innovative Ideas

Funding For Private Land and Land Leases

Private land and land leases accounts for 1,190,503 ha or 15.5 percent of the total landbase in the Peace Forest District. Currently technical support, direction and funds for treatment of mountain pine beetle on these lands are limited, creating significant challenges for the coordination and prioritization of treatments within BMUs that have large areas of infestation on private lands.

One program currently available to assist with tree removal is the **Community Wildfire Protection Plan**. This Program was implemented as a result of recommendations from Filmon's Firestorm 2003 Provincial Review (2006), to assist communities in the development of plans to improve fire prevention and protection in the interface areas (Government of British Columbia 2006).

The Ministry of Forests and Range Protection Program is working in conjunction with the Union of British Columbia Municipalities (UBCM) to provide funding to local governments for fuel management issues (Ministry of Forests and Range 2007b). These plans assess fire hazard around communities and outline how to reduce this hazard, which could be related to the removal of currently infested or dead trees or the removal of high harzard stands. These plans also outline wildfire response, community preparedness, and structure protection planning. If a local government dedicates resources for development of the plan, the UBCM will provide funding up to a maximum of $15,000 (Ministry of Forests and Range 2007b).

Another program which was used extensively in the past was part of the **Federal Mountain Pine Beetle Initiative** - the Private ForestLand Rehabilitation Program funding initiative (Natural Resources Canada 2007). The program aims to protect forest resources on private land through reducing wildland fire hazard, to help reduce impacts on water systems, and decreased impact on wildlife habitat and other non-timber uses of the forest, such as tourism as well as rehabilitating forest lands once mountain pine beetle has damaged the trees (Natural Resources Canada 2007). Funding is provided to assist private landowners with the detection and control of mountain pine beetle and rehabilitating the land back into healthy forests.

In 2005, Alberta implemented a **Municipal Grant Program** which directs funds to private and municipal lands infested with mountain pine beetle (Lux Pers. Comm. 2007; SRD 2006b). Additional details are outline in Appendix 22. Alberta Sustainable Resource Development reviews and processes all grant applications. Currently they have approved funding totaling approximately five million dollars allocated to the following communities for operations in 2006-2007;

1. Municipal District of Crowsnest Pass
2. City of Grande Prairie
3. County of Grande Prairie
4. Saddle Hills County

5. Birch Hills County
6. Municipal District of Greenview
7. Municipal District of Sprit River
8. Municipal District of Peace
9. Municipal District of Fairview
10. Northern Sunrise County
11. Town of Canmore
12. Municipal District of Bighorn
13. Town of Fairview
14. Town of Grande Cache
15. County of Clearhills
16. Town of Peace River
17. Municipal District of Northern Lights
18. Town of Fox Creek
19. Municipal District of Woodlands

Heli-Assisted Fall and Burn

Single tree conventional fall and burn treatments have been used to treat mountain pine beetle in isolated and remote locations, however, there have been discussions about how to increase production levels and minimize costs. An operational trial was conducted by West Fraser Mills Ltd. in combination with FERIC in January 2006 in the Dawson Creek TSA to test the efficacy and cost effectiveness of helicopter assisted fall and burn operations for control of mountain pine beetle populations. The trial proved successful and West Fraser implemented large scale operations in February through to June 2006 and January 2007 to the present. Other areas including Alberta and Headwaters Forest District have implemented heli-assisted fall and burn operations in 2006-2007.

Infested trees are felled using ground crews and are then transported by helicopter to a centralized burn pile location.

Benefits of this operation are;

1. Extended burning window through reduced numbers of burn piles, selection of lower hazard burn pile locations which can allow for fire resources to be on hand during the critical burning window,
2. cost effective – with costs often equivalent to conventional fall and burn for most areas when helicopter access is included in tree rates,
3. high production rates so treatments can be carried out quickly and during optimal treatment windows, and
4. results in less debris within the treated stand as the whole tree is flown to the burn pile whereas conventional fall and burn operations leave branches and upper portions of the tree un-burnt in the stand.

BC Ministry of Environment, Ft. St. John conducted some analysis of site level impacts of heli burn piles within Monkman and Wapiti Parks that were used in 2005-2006

treatments. The report includes recommendations for location and size of future burn piles within parks and proposes some long-term monitoring (Eastman and Polster 2006). The information collected in this analysis has been incorporated into the Best Management Practices for Helicopter assisted burning within parks (Appendix 3).

Mechanical Fall and Burn

Canfor – Chetwynd Division is conducting a trial evaluating the effectiveness of mechanical fall and burn utilizing feller bunchers in March 2007. This will be conducted using two separate contractors; one for each pilot project in different ground conditions and timber types (Layton Pers. Comm. 2007). Operations will use a feller buncher for harvesting and a hoe or button top loader for piling the infested stems. The piles will then be burned and will be evaluated to determine optimal pile size for an effective burn. In addition the sites have been stratified into site conditions and percent infestation to facilitate analysis based on field conditions. A ground crew will be recording data including:

- ✓ Number of stems cut per hour / stratum
- ✓ Number of non infested incidental trees cut / stratum
- ✓ Scaring or damage to left trees and # / stratum
- ✓ Productive and non-productive time
- ✓ Travel time for machinery for moves and access.
- ✓ Transportation, relocation and fueling costs in remote sites

This information will be compiled into a report with recommendations of where mechanical fall and burn is effective and the range of costs expected for treatment. All costs including supervision will be tracked to attribute a cost per tree to the work completed.

Protection with Insecticides

Carbaryl

Short term protection of susceptible pine trees to mountain pine beetle attack can achieved by applying the topical contact insecticide carbaryl (trade name Sevin®). This insecticide is very effective in protecting trees from bark beetle attack. However, due to the high cost and operational considerations, this is an option only for high value trees in urban areas or private lands and is not viable as a stand level treatment. The insecticide may be applied from April to early June depending on location and the bark beetle species being targeted. The insecticide treatment should cover the entire trunk, well into the tree crown to be effective. Carbaryl impregnates into the bark and can remain effective for up to a year. This is often used in conjunction with repellant pheromones such as verbenone for greater levels of protection in urban areas (Phero Tech International 2007).

Neem

Neem is a biological insecticide derived from the neem tree. Depending on the active material isolated, neem extracts are used in everything from toothpaste to insecticides. The insecticidal active ingredient is azadirachtin. BioForest Technologies Inc is currently working with Alan Carroll from the Canadian Forest Service to determine the feasibility of using systemic tree injections of neem for control of mountain pine beetle. While neem is not currently registered for use in Canada, it has shown some potential for killing mountain pine beetle in limited research trials (Duthie-Holt *et al.* 1999; BioForest Technologies 2006). Additional research is required before this is available for operational use.

Flight monitoring

Long-range aerial dispersal of mountain pine beetle crossing the Rocky Mountains from just south Mackenzie along the Parsnip River valley and then along the Pine River valley was examined this past summer. Refer to Appendix 15 for additional details on this study.

Real-time reporting

In 2005-2006 a real time reporting tool was developed by Medi-For Forest Health Consulting and Larix Forestry Consulting titled, "BeetleTracks" to manage operational data for the mountain pine beetle single tree treatment program in the Peace. Additional development work was conducted by West Fraser Mills Ltd. and this program has been expanded to include data from all Spread Control areas within BC including the Rocky Mountain, Columbia, Headwaters, Peace and Mackenzie Forest Districts.

BeetleTracks found at www.beetletracks.ca is a password protected data tracking tool which allows access at various levels to multiple users including planners, administrators, contractors working on the ground and imputing the data, and quality assurance personnel checking field results. Products generated by this tool include real time updates of data from ground surveys, treatments, and quality assurance checks. The database can be used to generate spatial data to create various maps. Another benefit of this tool is the numerous checks and balances built into the system to ensure data integrity.

This tool is continually evolving as suggestions from the end users are made available and has turned into a very powerful tracking tool for budgeting, planning, tracking progress and quality.

Snow storage

Long-term storage of beetle-killed logs has been proposed to help mitigate future falldown or reduce loss in volume or value recovery (Whitehead 2006). Various options have been explored including under water or sprinklers, stored as standing dead and

under insulated snow pack. A study examining the feasibility of storing timber under insulating layers of snow and wood chips is being conducted at Canfor's Grande Prairie logyard (Martell Pers. Comm. 2007).

Currently this option is not being explored in the Peace Forest District because of how our stumpage system works. In BC, stumpage is paid once the trees are cut, however returns to licensees aren't realized until after the final product is delivered. Therefore, if there is a significant time delay between harvest and final processing, the licensee carries too much financial risk. There is also concern over the ability to securing a supply of economically feasible packing material to mix in with the snow (Hays-Byl Pers. Comm. 2007).

Refer to Appendix 15 for additional details on the analysis of storing "green-attacked" mountain pine beetle infested wood under snow pack.

Chipping

Another treatment which is being heavily utilized in municipalities across BC and Alberta is whole tree chipping of infested trees. Industrial mulchers are used to chip trees at a rate of 50 to 100 trees per day at an estimated cost of $40 per tree (Coombs Pers. Comm. 2007). This option could be explored as communities in the Peace become increasingly impacted. Currently areas around Prince George, Grande Prairie, and Fort St. John are utilizing this service and the products could be used for landscaping or bedding for livestock, etc. (Hays-Byl Pers. Comm. 2007).

Value Added Products

Currently there is a limited domestic market for value added products in BC for pine furniture, however this market could be expanded so that wider use of the mountain pine beetle infested wood could be utilized (Hays-Byl Pers. Comm. 2007).

Portable Sawmills

In the Peace Forest District currently there is limited portable sawmills available to deal with the more isolated pine attacked stands. However, the current stumpage rates are precluding external portable sawmills from entering this market (Hays-Byl Pers. Comm. 2007).

Bio-Energy

The bio-energy industry is the initial stages of development in British Columbia. Examination of the potential use of mountain pine beetle killed trees as a bio-energy source is currently being conducted by several different organizations. Increasing demands on traditional energy sources such as hydro-electric power and fossil fuels combine with an increasing supply of available biomass as a result of both fires and insect outbreaks are increasing interest in bioenergy production. However, technologies based on biomass are often more expensive than those based on traditional sources,

which will likely require regulatory and/or economic incentives to implement widespread programs (Stennes and McBeath 2006).

Possible bio-energy products include (McBeath 2005; McGarrity & Hoberg 2005);

1. Wood pellets
2. Co-generation Plants
3. Bio-oil
4. Bio-fuel as a wood-based ethanol.

Possible advantages of using mountain pine beetle killed wood for bio-energy production include a large available source, the wood is already dry, and the ability to utilize the wood beyond the shelf life of other products. It has been stated that the British Columbia forests could produce enough bio-fuel to supply the energy of two Site C hydro-electrical dams (Hamilton 2007).

Capacity is increasing in some of the sectors, mostly in the production of wood pellets, which are then exported to northern Europe (Stennes and McBeath 2006). However, there are some substantial challenges to address before wide-scale implementation of bio-energy programs can take place. The first is the high capital cost investment into facilities combined with a long-term return on the investment when the current supply of material is short term. Decomposition will eventually render the wood useless, even for bio-energy production. Therefore in the interim there is a substantial supply, both from uneconomical stands that are not harvested for alternate wood products and from increased wood waste from processing facilities operating at increased AAC's. However when AAC's drop to pre-beetle or lower levels, and the standing timber has started to decompose, bio-energy facilities will likely not have the fuel resources to operate without additional measures such as dedicated harvest volumes (Stennes and McBeath 2006).

Section 13: Parks

Parks are often established to protect specific resources or feature, making generalized approaches to management options not realistic. Strategic assessment for individual parks must occur prior to bark beetle management to determine potential impacts to resources within the park and what management options are suitable (Hesse Pers. Comm. 2007). Tactics available for use in BC Parks include (BC Park 2001);

- Allowing natural processes to prevail (i.e. do nothing),
- Pheromone baits and traps,
- Individual tree fall and burn on-site,
- Helicopter assisted burning,
- Large-scale prescribed burn, and
- Skid piles and burn on-site with low impact machinery.

Commercial logging and road building is strictly prohibited in protected areas as regulated through the Park Act.

The selection of a management options to control mountain pine beetle within parks depends on a technical and ecological evaluation, and will be influenced by the size of the protected area and infestation risk to neighboring forest lands. The various treatment methods available should be determined through joint decision-making with the Ministry of Forests that takes into consideration protected area values as well as risks to adjacent lands.

A variety of documents outline the acceptable practices related to mountain pine beetle management within Provincial Parks in BC. A sample of these documents has included in this report for reference or is referenced.

1. Park Use Permit Appendix 12
2. Best management practices Appendix 13
3. Treatment options within park boundaries Appendix 13
4. Treatment options adjacent to Parks (BC Ministry of Environment 2005)
5. Wildlife and Aircraft Operation: Assessment of Impacts, Mitigation, and Recommendations for Best Management Practices in the Peace Region (Churchill and Holland 2003)

Detail current infestation levels by Park which is outlined in Table 21.

Table 21. Current infestation levels by Park from the 2006 detailed aerial surveys.

District	Park	No. sites	No. reds	No. faders	Hectares
DDC	Bearhole Lake	242	353	44	61
DDC	Bearhole Lake - (PA)	77	128	7	19
DDC	Butler Ridge	18	22	0	5
DDC	Gwillim Lake	983	1,394	112	247
DDC	Hole-in-the-Wall	1	22,857	0	87
DDC	Kakwa	1,145	107,730	717	464
DDC	Moberly Lake	3	7	2	1
DDC	Monkman	144	1,421,046	1,067	3,358
DDC	One Island Lake	1	1	0	1
DDC	Pine Le Moray	62	358,746	460	663
DDC	Pine River Breaks	3	6	9	1
DDC	Sukunka Falls	2	14	1	1
DDC	Wapiti Lake	200	441	338	51
Parks		***2,881***	***1,912,745***	***2,757***	***4,956***

Hauling and Milling Strategy

Both licensees operating in the south Peace (Canfor - Chetwynd and West Fraser – Chetwynd Forest Industries) have Hauling and Milling strategies which are attached in Appendix 17 and Appendix 18, respectively.

Currently Canfor – Ft. St John is preparing a strategy for 2007 and Tembec and LP has not prepared a strategy as their raw fiber intake is predominately deciduous.

Canfor-Chetwynd and West Fraser do not feel a Hauling and Milling strategy is necessary for 2007 due to the increase in MPB attack throughout their operation areas. This issue will be further discussed with the Ministry of Forests and Range. The specific hauling and milling strategies are not directly approved by the District, but licensees are evaluated on the results (Kopecky Pers. Comm. 2007).

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Section 15: Appendices

Appendix 1. Star Probe and Grid Probe Standards in the Peace 2006-2007.

SCHEDULE A: STAR AND GRID PROBE STANDARDS

PROBING SPECIFICATIONS

Dawson Creek TSA Mountain Pine Beetle Sample Star and Grid Probe Survey

The survey type for isolated spot infestations (up to ~ 50 red trees) should be the "expanding circle" or "star probe" suitably modified as below to increase survey production, e.g. by reducing requirements for ribboning access routes and marking checked trees. If mountain pine beetle populations are found to be more continuous instead of "expanding from the centralized point" then the survey methodology used may be a grid probe. Survey methodology is to be determined by the company. Both survey protocols are described in the MOF Bark Beetle Management Guidebook (1995), at http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/beetle/betletoc.htm.

A 5% sample of the sites surveyed by work area will collect all survey data outlined below or a minimum of 20 sites where possible. These surveys are referred to as "full surveys". The remaining 95% of the surveys will be "mark to cut surveys" focusing on treatment trees collecting information on infested trees and green to red ratios, along with average stand characteristics that the company deems appropriate.

PART 1: GENERAL TERMS AND CONDITIONS

Objective:

1.01 Identification and quantification of Mountain Pine Beetle (IBM) infestations within the Dawson Creek Timber Supply Area.

Definitions:

1.02 In this schedule:

Code 1 and 2 (Green-attack trees) - Means a lodgepole pine that has been attacked by IBM this summer or fall (2006). Trees usually contain fresh pitch tubes, frass, and early instar larvae. Foliage coloration changes may not be visible at this time. Comments are to be noted on the presence of brood only for full surveys.

Code 3 and 4 (One Year Old Attack) – Means a lodgepole pine that has been attacked by IBM the previous summer (2005). Foliage is red and no live beetles are present if the attack is on a one year life cycle. If the attack is on a 2-year cycle then live brood will be present.

Code 5 and 6 (Two or greater Old Attack) – Means a lodgepole pine that has been attacked by IBM in 2004 or previously. Foliage is either red or gray and no live beetles

are present. **Note: These codes will only be used for the full surveys and will not be used during the marked to cut surveys.**

Pitch Out (P/O) - means unsuccessful current (less than 10 pitch tubes with unconfirmed IBM attack) attacked tree shown by external pitch tubes, pitch filled galleries and no brood production. Trees have green foliage. **Note: These codes will only be used for the full surveys and will not be used during the marked to cut surveys.**

Site - means an infestation centre as indicated on maps supplied by the Company.

IBM – means Mountain Pine Beetle.

IBL - means Lodgepole Pine Beetle. No treatment required.

IBI – means *Ips* beetle. No treatment required.

PART 2: STANDARDS OF PERFORMANCE FOR PROBING

2.01 Survey lines will proceed from the point of commencement (POC) towards the potential infestation. Survey lines will proceed as directly as possible, but must run through susceptible timber types if these timber types are within 50 metres of the line of travel. For grid probe surveys the survey will continue for 50 meters beyond the last IBM attacked tree.

2.02 The POC shall be a physical tie point such as a creek, landing, road junction etc. Where this is not possible, the POC must be tied to a feature such as a creek or road junction or heli-pad.

2.03 Ribboning and Establishment:

- Tie the POC to a known survey point or an aerial photo tie such as road junctions, creeks, road, block junction, heli-pad, etc. Mark the POC with **a triple ribboned tree (Yellow and Orange Pest Management)** which states site number(s) (infestation centre IC), date, bearing of first segment of line, crew persons' initials, and company conducting the survey. As well, when possible the POC will state the number of treatment trees.
- Survey lines will be clearly marked with yellow flagging ribbon at intervals not greater than 15 metres. Line junctions will be marked with **three yellow ribbons** and significant bearing changes will be marked with **two yellow ribbons**. Certain areas will contain less line ribboning and will be determined by the company. **Sites surveyed not requiring further treatment (i.e. no current attack found) will not require survey lines to be established. However, if they are established they will not be required to be pulled down.**
- The **IC** (infestation centre) will be marked with a triple **ribboned tree (yellow and orange pest management)**.

  - The top ribbon will label IC#, date, and crew. As well, the internal quality control person will mark their initials and the date once the site has been checked and cleared.
  - The middle ribbon will label tree counts of infested trees (i.e. number of treatment trees and number of various codes).
  - The bottom ribbon will be left blank for the burning crew.
- The IC tree shall not be a treatment tree.
- The IC shall be located by **GPS** and the actual coordinates recorded on the probe card. Positional accuracy must be recorded on the probe card.
- The four cardinal quadrants of the star probe will be measured out and marked for **the full surveys only using a single yellow ribbon at 25m and a double yellow ribbon at 50m.**
- Any straggler treatment trees which are difficult to see from the IC will have a ribbon line hung to them. Ribbon color will be orange pest management.

2.04 Bark beetle star and grid probe cards will be supplied by the Contract Coordinator to tally the status and number of trees found at each infestation site.

However, topographic paper for marking locations of infested trees during grid probe surveys will be supplied by the contractor.

- Information will be collected to completely fill in the attached Ground Survey Field Summary Card and BeetleTracks website including;
- All trees within a **50 metre** radius of the infestation centre for star probes and within 25 m of either side of the grid probe line which will be spaced at 50 m distances must be assessed for beetle activity (codes 1-6, pitch out, 2-year cycle, and multi-attacks, except for surveys aimed only at marked to cut which will instead tally currently infested trees, last year's attack, and stand characteristics including but not limited to percent remaining healthy Pl, species composition, average DBH and height, understory/ windfall levels, amount of dead standing trees).
- Diameters will be taken on one representative treatment tree. This tree will be marked with a D on the bole. Diameters will be taken at breast height using a D-tape.
- Assessment for beetle activity is to be through the use of either **under bark axe checks or visual examination** on 100% of Pl $\geq$ 9.5 cm DBH.
- There will be a maximum of 1 additional sweep in any direction from the centre point of the infestation for a distance of 100 m sweep total. If the infestation extends beyond this then another site will be established.
- Other pest activity,
- Average stand characteristics including estimation of healthy Pl component remaining in the stand, species composition, DBH and height.

2.05 Unmapped trees from detailed aerial surveys:

- Wherever unmapped trees that have been attacked by mountain pine beetle are found along the survey line from 2005 or previous attack and the site is greater than 2 trees or the current attack is at least one tree, a new infestation centre shall be established. This new centre shall be surveyed in the same manner as indicated above and numbered to ensure that there will be no overlap in the current numbering system of the detailed aerial survey. For example each location will be given a unique number with a decimal (i.e. 17-143.1 if the site is closest to I.C. 17-143) and it is the responsibility of the crews to ensure that there will be no overlap of the numbering within an area.
- However, the company may require that infestation centers for unmapped single trees may be established as a separate site depending on management objectives not yet determined.

2.06 All **IBM infested Pl trees with current brood (i.e. code 1 and 2, and code 3 and 4 on a 2-year cycle)** coded trees will be marked with a **single fluorescent orange paint ring** at DBH or higher for fall and burn. In addition to this, a single orange paint vertical line below 30 cm height is to be marked on the treatment trees to ensure adequate treatment if possible dependent on snow levels. It should be noted that code 3 or 4's on a 2-year cycle may need to have a paint circle around where the current brood were located for quality control purposes.

2.07 All code 3 and 4 (on a one year life cycle) coded trees will be marked with an "x" at DBH or higher to indicate no fall and burn treatment is required **for full surveys only.** This requirement will be decided on a site specific basis by the company within the parks and protected areas only.

2.08 All code 5 and 6 trees are to have a single orange paint dot placed on their bole for full surveys **only.**

2.09 Forked trees – a fork below DBH (1.3 metres) shall be considered two treatment trees.

2.10 Pitch-out trees shall be marked with **"PO"** using **fluorescent orange paint** to show that they have been examined **for full surveys.** Also, Lodgepole Pine Beetle and *Ips* infested trees shall be marked with **"IBL"** and **"IBI"** respectively using fluorescent orange paint to show that they have been examined. These markings will be used for full surveys only.

Paint marking of trees as outlined above may be modified in certain areas including within provincial parks.

2.11 The Contractor will be required to submit the following on a daily basis:
A completed *BeetleTracks database* (as provided by the contract administrator) including;

- Survey date
- Contract Number
- **Surveyors**
- Type of survey conducted (i.e. full or mark to cut star or grid probe)
- Access notes
- Access type
- 1:20,000 mapsheet number*
- Aerial incidence number*
- Aerial incidence UTMs and positional accuracy*
- Status of survey (in progress or complete)
- POC UTMs
- heli pad UTMs (if applicable)
- heli pad description (if applicable) (i.e. type of aircraft used, size of heli-pad, time of year sensitivity (i.e. frozen swamp/ lake), natural or created)
- Distance from POC to incidence site (m)
- Bearing from POC to incidence site (degrees)
- Number of sweeps during star probe and direction of sweeps from IC or distance surveyed for grid probes and number of strip lines
- Number and average diameter of all codes (1-6, pitch outs, 2-year cycle, and multi-attacks) (if applicable). Note mark to cut surveys will record code 1, code 3 (either one or two year cycle) only **to obtain number of treatment trees and green: red ratios**
- Average attack height on treatment trees (m)
- Number of forked treatment trees
- Other pests type, number and average diameter of attacked trees **for full surveys only**
- Percent of currently attacked trees with brood present (i.e. code 1 and 2) for full surveys only
- Stand characteristics including percent remaining healthy Pl, species composition, average estimated DBH and height, understory/ windfall levels, amount of dead standing trees
- General comments

*All original field cards such as the probe cards and access notes, as well as digital copies of these are to be supplied to the Quality Control Contractor as specified in the tender package. Grid probe maps will be supplied digitally in the form of shape files as specified in the tender package.

Appendix 2. Recce Probe Standards for the Peace 2006-2007.

Purpose:

Preliminary information indicate that there was an extensive mountain pine beetle flight from west of the Rockies into the Peace in 2006. As a result, it is also suspected that numerous pine stands within the area may have large numbers of current green attack with no associated red attack.

This document establishes procedures for Walkthrough Recce probing in stands, management units or work areas that are suspected to contain varying numbers of green attacked pine with or without associated red attacks.

This method of IBM detection will be utilized to determine the presence and activity levels of the beetle. The process also intends to identify which stands, management units, or work areas would benefit from further conventional treatment methods and which stands or management units are beyond reasonable treatment activities due to funding or resource availability.

Definitions:

Walkthrough Recce Probe – a non systematic preliminary ground reconnaissance conducted by an experienced beetle surveyor in order to determine the presence, location, size and intensity of beetle attack across the stand or management unit prior to the recommendation of any extensive tree marking, probing or management decisions. The configuration and extent of walkthrough recces are site specific decisions usually made by the surveyor. The probing pixel will be 50m long x 10m wide to be included from a representative area within the attacked area.

Walkthrough Recce Probing will determine estimates of:

1. The size (ha.), boundary and pattern of the infestation across a defined stand or management unit. This is to be hand mapped on the mapping portion of the field card(s) and a recreational grade GPS will be used to collect line information along the boundary/extent of the infestation.
2. The incidence, severity and site specifics of the infestation as measured and recorded on an appropriate field card(s).
3. General comments and area of concerns and potential treatment ideas recorded on the field card(s).
4. Data collected will include but not be limited to:
    - Survey type – i.e. recce
    - IC # (Unique recce identifier)
    - Company
    - Date
    - Mapsheet
    - Work area
    - Location description
    - Access type

- Helipad info if present including UTM's
- Transect POC UTM's (Handheld recreational GPS unit)
- Transect POC description
- IC UTMS (and on map)
- Pixel POC UTM's (and on map)
- Aspect
- Estimated percent of pine that are fading
- Recce line bearing
- Estimated area
- Estimated number of current attack (derived from 50*10m pixel)
- Non attacked stems
- Percent attacked (derived from 50*10m pixel)
- Avg. stand height
- Avg. stand diameter (D tree mapped)
- Slope %
- Avg. stand composition (percent pine, spruce, balsam and deciduous)
- Estimated stems per ha (derived from 50*10m pixel)
- AOC's (areas of concern like: reserves, CMT's, Access, treatment considerations, etc.)
- Hand drawn map of pixel and infestation on map portion of field card(s) and shape files of polygon boundary

Methodology:

Areas of low attack will be primarily surveyed using the Star Probe Ground Survey method. The POC and IC will be established and then the 50 m quadrants measured. If current attack levels extend beyond 100m from IC or there are greater than 40 attacked trees in a second sweep from the IC, survey methodology will switch to 'recce/ extent surveys' as outlined in this document.

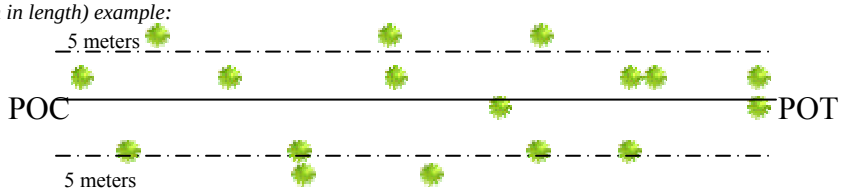
The only changes to the previous star probe methodology are the tolerance for 10% missed treatment trees by site, and the switch to the "recce/extent" survey methodology triggered by greater than 40 attacked trees in a second sweep from the IC threshold. Missed treatment tree tolerance may be changed in certain work areas depending on the overall treatment target objectives.

1. A POC will be placed at a photo tie point, heli-pad, or other infestation center. The POC will be located in the field with three ribbons (yellow and orange pest management). The following information will be written in permanent marker on the ribbon:

    Date
    Crew Initial
    Company
    Infestation Center Number (IC#)
    Direction of line

2. The transect line will be ribboned no further than 15m spacing. Bearing change stations will be accompanied by a second yellow ribbon with the new bearing, IC# and total distance from POC written in permanent marker on the ribbon.
3. The infestation center (IC#) will be set up in the same manner as a star probe with 3 sets of ribbons (yellow and orange pest management). Then 50m will be measured in each of the cardinal directions. **If current mountain pine beetle attack continues beyond 100m from IC, or there are greater than 40 attacked trees within a second sweep from the IC the surveyor will switch to using the recce survey method to complete the survey of the infested area (procedure described below)**.
4. The recce survey will be used to delineate the boundary of the majority of attack. The boundary containing the infestation will be ribboned in orange pest management. There will be a 10% tolerance for missed treatment trees outside the boundary of the attack within 10m.
5. The surveyor will be looking for beetle activity within the stand. When activity is noted, the surveyor will complete a documented pixel sample (grid) probe of 10m width by 50m length within the attacked stand. This sample should be in a representative area of the infested stand. In addition the surveyor will complete the required field card(s). Information on the stand level will be included from the pixel such as avg. stand diameter, avg. stand height, etc.

Pixel sample (50m in length) example:



In the above figure only the trees within the 5 meter each side area of the transect would be tallied for the sample length (Sample length is 50 meters).

If the walkthrough survey describes the infestation as restricted to only a limited area then the approximate extent should be identified and mapped. This will generally be under 3 ha's in size.

If the infestation covers the entire stand it will generally be over 3 ha's in size and the extent will be the stand or type boundaries, and is impractical to locate these extents in the field and should be noted on the map portion of the field card. An estimate of hectares of attack and percent infested will be recorded.

Appendix 3 Best Practices for Spread Control Operations within Parks-Peace Region, 2006.

FINAL DRAFT

Best Practices for Spread Control Operations within Parks-Peace Region

Ministry of Environment
Environmental Stewardship Division
Peace Region
2006

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1.0 Introduction

BC Parks is responsible for the protection and management of natural and cultural resources found within British Columbia Parks and Protected Areas (PPA's). This includes the protection of representative and special natural ecosystems, species, features and phenomena; and the preservation and maintenance of recreational values (BC Parks Conservation Program Policies).

Mountain Pine Beetle (MPB) spread control operations (survey and treatment) have the potential to impact recreational and conservation values within Peace region parks. The best practices (BMP's) outlined herein are an initial step to identifying and mitigating impacts of MPB survey and treatment to PPA's values. This is a working document, and the results of future impact assessments will feed into revisions.

2.0 Purpose/Scope

This document has been developed for government staff, forest licencees and their contractors to provide a common understanding of mitigating the impacts of MPB survey and treatment operations within PPA's in the Peace Region (including Kakwa). The intent is to identify the minimum standards below which Parks and MOE staff must be consulted. Monkman, Wapiti, and Kakwa Parks are presently receiving a high level of operations in response to the MPB infestation and the BMP's were developed primarily with these parks in mind. However, these BMP's are applicable to all Peace Region PPA's and may be adapted to other jurisdictions. This BMP document forms one of the conditions under the existing Park Use Permit for Peace Region Parks.

This document is not a replacement to, nor summary of, existing permits, memoranda of understandings (MOU), nor to applicable legislation. All BC Parks Conservation Program Policies apply to spread control activities. This includes the *impact assessment process* for operations within PPA's to identify known and potential impacts to park values and ensure all impact mitigation strategies are employed. Further information can be found on the MOU between Ministry of Forests (MOF) and Ministry of Environment (MOE): *Memorandum of Understanding with Ministry of Forests-Mountain Pine Beetle (Bark Beetle Management in Parks and Protected Areas)* (http://wlapgww.bcgov/esd/ppa/pa_cons/pa_cons.htm).

Provided herein is the best current information on managing impacts and will be revisited as new information becomes available. This document identifies:

- Known and potential park values at risk from spread control operations
- Known and potential impacts to park values from spread control operations
- Objectives for impact mitigation for survey and treatment operations in PPA's
- Best practices for communication, and survey and treatment operations in PPA's

3.0 Background

BC is presently experiencing an MPB epidemic in lodgepole pine forests. Since 2004, Peace Region MOFR, forest industry and BC Parks have been engaged in MPB spread control operations in an attempt to prevent the eastward spread of MPB into boreal forests. The MPB infestation will pose many challenges for managing safety, and recreational values in Parks, however MPB is a natural process and in most cases MPB alone does not pose a risk to Park values.

In 2005 the level of MPB infestation in PPA's (Kakwa, Wapiti and Monkman) in the eastern foothills increased dramatically, as did the operations to treat the infestation.[1] During the winter of 2005/06, spread control operations reached levels that could result in short and long-term adverse impacts to park values. In addition, a new treatment technique (helicopter yard and burn) was employed that changed the dynamic of how PPA's could be impacted.

Given the present and forecasted levels of MPB infestation, spread control operations are anticipated to occur for several years within southern Peace Region PPA's. Hence, while recognizing the need to undertake spread control activities, BC Parks must meet its mandated objectives of protection and conservation. This requires spread control operations to be conducted in a manner that prevents and/or mitigates impacts to Park values.

3.1 MPB Spread Control Activities

The two primary MPB spread control activities are survey and treatment. Surveys for MPB infestation occur during late summer and throughout the fall and prioritize treatment areas. Surveys include:

1. **Aerial detection surveys.** Red and fading attack trees are identified by aerial surveys within a broader survey area where the infestation is suspected to occur. Timing of aerial surveys is generally in the late summer/early fall when the previous years infected trees turn red. In the Peace region, helicopters are used for aerial surveys.
2. **Ground surveys.** Ground based surveys identify trees with current attack (green attack) at locations where red attack trees have been identified. Surveys are conducted in the fall through winter and into spring if required, after aerial detection surveys.

Treatment operations occur subsequent to ground surveys. Generally treatment operations occur through winter and potentially into early spring depending on fire hazard. Treatment operations include:

1. **Fall and burn (FB).** This is the conventional technique of manually falling and burning individual infected trees, and is commonly used in remote areas.

[1] As of September 2006, MPB infestation has dramatically increased in Gwillim and Bearhole Parks and spread control operations in these Parks are anticipated to increase significantly.

2. **Helicopter yard and burn (HYB).** (also known as helicopter assisted fall and burn, or helicopter pile and burn). This is a recently developed treatment technique used in remote, high infestation areas. Green-attack trees are manually felled and subsequently flown to a central location for burning, with some locations having over 2000 trees per pile. Burn locations are generally less than 700 metres from source green attack for operational and cost efficiencies.

   Burn locations have been separated into general terrestrial and aquatic ecosystem types. Aquatic sites are defined as sites where waterbodies or aquatic values could potentially be impacted. Terrestrial sites where fire is a part of the natural disturbance regime are considered most resilient to large scale burning. Sites include:

   - **Forests sites** (terrestrial) generally occur within infested forests, and are expected to be the most resilient to burning of large numbers of trees. Felling uninfected trees and non-target species may be required to create burn site openings.
   - **Dry Ridges sites** (terrestrial) may be forested or contain only mosses and lichens on bedrock. These sites are characterised by thin soils, and as a potential burn site are only known in Monkman Park at present.
   - **Wetland/Riparian sites** (aquatic) have high conservation values and limited spatial representation in mountainous and foothill PPA's. Timing and the number of trees to burn are key considerations for mitigating the impacts to wetland/riparian sites. Advantages of wetlands as burn sites are that no clearing of forest is required, and are preferred for operational reasons. Two wetland types have been distinguished:
     - **Rich nutrient** wet sites are characterized by a dominant shrub layer (e.g. Alder), and are found on toe slopes, seepages and wetlands.
     - **Poor nutrient** wetlands are characterized by sphagnum, pine, black spruce and scattered sedges and shrubs, and are found in depressions and low slope landscapes. Soil chemistry is controlled by sphagnum, which is destroyed under intense fire.
   - **Floodplain sites** (aquatic) are high bench vegetated or non-vegetated floodplain with alluvial substrate. Use of floodplain sites needs to be considered carefully as water quality, fish, and fish habitat may be impacted by hydrocarbons and other materials left from burning. Timing and the number of trees to burn are key considerations for mitigating impacts to floodplain sites.

3. **Other Spread Control Activities.** Other options for spread control operations include pheromone baiting, tree removal (Appendix II), and pesticide (Monosodium Methanearsenate) treatment can be considered with consultation with regional BC Parks and MOE staff. Additional discussion on other options

can be found in the Pine Beetle Management Program Strategy for Parks and Protected Areas (see Resources).

4. **Abandon.** Abandoning spread control is an option if one or more of the following apply:
    - **a.** Forests outside of Parks are not being treated;
    - **b.** There is little benefit to working forests outside of Parks;
    - **c.** The infestation is beyond the resources of spread control;
    - **d.** There is negative impact to Park values;

3.2 Park Values at Risk

Peace Region PPA's are managed primarily for undisturbed wilderness and unique features of the Rocky Mountains, foothills and plateaus regions. These PPA's provide protection for vegetation communities, fish and wildlife populations and associated habitat, and unique features such as fossils. In addition, PPA's provide both backcountry wilderness experiences and front country recreational use associated with park facilities (e.g. developed campsites and vehicle access).

Park values that may be directly or indirectly impacted by MPB spread control operations include:

1. Recreational Values:
    a. South Peace PPA's contain backcountry trails for wilderness hiking and camping experience (Monkman, Kakwa, Wapiti, Pine Lemoray Parks); and front country trails, campgrounds and facilities that receive relatively high use (Monkman, Gwillim, Pine Lemoray). The undisturbed wilderness character of the backcountry and scenic vistas of these PPA's are key recreational values. Kinuseo Falls in Monkman Park is major attraction that receives a relatively high amount of visitation.
    b. Visual/ aesthetic values. Viewsheds un-marred by human activity are an important value associated with the wilderness experience provided by these parks.

2. Conservation Values.
    a. Wetlands/Riparian: Wetlands represent a small proportion of area within the mountain and foothill PPA's compared to forests. Wetlands are aquatic ecosystems where soils are saturated year round, and hydrophilic vegetation communities are predominant. Within the province, MacKenzie and Moran (2005) describes five wetland types and multiple sub-groups, each with unique soil and nutrient regimes, and specially adapted plant communities. Riparian or 'flood' ecosystems include transition regions between waterbodies (wetlands, lakes, watercourses) and forests. Values within wetland and riparian areas include biodiversity, water quality and stream ecosystem function, and wildlife habitat. Certain wetland/ riparian ecosystems are sensitive to changes in water and nutrient

levels and can be slow to recover from disturbance (e.g. poor nutrient bogs).

b. Soils and Vegetation: Soils and vegetation provides wildlife habitat and contributes to the visual and recreational values of the park. One of the management objectives for vegetation in Monkman Park is to protect rare, endangered or sensitive plant communities and prevent the establishment of non-native species (Monkman Master Plan 1994).
c. Wildlife: The majority of lands within Peace PPA's has not been impacted by humans, and thus provide an important refuge of wildlife habitat. Critical life periods and associated habitat for wintering, spring (calving, kidding, lambing) and rutting are of primary concern. Wildlife of primary concern in south Peace PPA's are caribou (mountain and northern ecotype), mountain goat, bighorn sheep, deer (mule and white-tailed), elk, moose and migratory waterfowl (Table 1).
d. Water Quality: Maintaining the quality of water resources in the PPA's is a key objective.

Table 1. Key Wildlife of Concern and Known Seasonal Occurrence in South Peace PPA's*

	Parks					
Wildlife	**Monkman**	**Wapiti**	**Kakwa**	**Gwillim**	**Bearhole**	**Pine Lemoray**
Woodland Caribou (northern and/or mountain ecotype)**	summer/fall	summer/fall	year round	NA (rare occurrences)	year round (sporatic)	year round (wintering in high elevation)
Deer (white-tailed and/or mule)	summer	summer/fall	summer/fall	summer/fall	year round (sporatic)	summer
Rocky Mountain elk	summer	summer/fall	summer/fall	year round	NA (rare occurrence)	summer
Moose	summer (uncommon in winter)	summer/fall	summer/fall	year round	year round	summer
Mountain goat	year round-high elevation	year round-high elevation	year round-high elevation	year round-low and high elevation***	NA	NA
Bighorn sheep	NA	NA	year round	NA	NA	NA
Migratory waterfowl (swans)	spring migration	unknown	NA	spring migration	spring/ summer (nesting)	NA

* There is limited documentation on occurrence and habitat use by these wildlife in Parks. Key wildlife may be encountered outside the expected season.

**Caribou within these parks are designated as threatened under the federal Species at Risk Act (SARA). Mountain ecotype are only found in Monkman Park (Parsnip herd).

***Low elevation goats are found in pine forests along canyon habitat on major tributaries to the Murray River. These goats are more at risk to disturbance from spread control operations.

3.3 Impacts of MPB Spread Control Activities

Recreational Values:

- Fall and burn and helicopter yard and burn treatment on and around trails, campgrounds and other recreational features leaving permanent or semi-permanent footprint within view[2]; Heli burn can be an asset in removing MPB infected stems from trails, campgrounds, view sites etc. Parks will have to do this anyway as far as a dangerous tree removal program once the trees are dead.
- Auditory and visual disturbance of treatment operations in high use areas[3] during visitor season. Park visitation in Kakwa Park occurs in throughout the winter, whereas in the other PPA's most usage starts in April, though PPA's generally open May 1 and close after the September Labour day long weekend. Interesting comments re. Kakwa Park. The winter usage in the Park is mainly snowmobiles which generate considerable "auditory" disturbance.
- Potential for trails or campgrounds to be temporarily shutdown due to safety concerns during visitor season; Trails and campgrounds will probably be temporarily shut down anyhow due to snags/dangerous trees even if there is no treatment activity.
- Debris (flagging, hip-chain, paint) left over from surveys.

Conservation Values:

- Disturbance of wildlife can result in increased energy expenditure and force movement into low quality habitat during critical wintering and spring periods. Treatment operations occur predominantly during critical wildlife wintering periods, spring calving/lambing/kidding periods, and potentially around breeding and migrating waterfowl concentrations. We need to discuss with BCE in relation to Bearhole Park and Kakwa. Should we be advertising treatment contracts in these Parks or turn our survey data over to them so they can manage treatments?
- Helicopter yard and burn sites located in aquatic and terrestrial vegetation communities sensitive to physical disturbance (e.g. rock outcrop, wetlands, riparian) may result in long term or permanent degradation of sites.
- Contamination of aquatic ecosystem from fuel and oil spillage from chainsaws, residual accelerant, and residual survey and operations debris; Very low risk. There is a minimal amount of accelerant used to burn piles. We can address this in our contract.
- Impacts to soil and vegetation community from burning large numbers of trees, resulting in establishment of invasive species, or shifts in plant communities. Nutrient loading, for example, is a concern in poor nutrient bogs; Is this still the case if we burn on a snowpack or frozen ground? Need to see Andrea Eastham report and recommendations.

[2] Note: Park permit applies to Park improvements such as trails, campgrounds, and other infrastructure.
[3] Kinuseo Falls and Campground in Monkman Park is an example of a high use area

- Long term loss of soil and vegetation[4] and post burn erosion on helicopter yard and burn sites; Really? Has this happened?
- Repeat burning (seasonally and annually) and cumulative impacts to re-used sites, particularly burn sites with high conservation values (e.g. wetlands/riparian)

In general terrestrial burn sites are considered least risk for negative impacts compared to aquatic burn sites. Agree, but they do present a larger risk of escape and wildfire depending on the season of burn. I see minimal impacts on aquatic sites if they are used during winter conditions with an adequate snowpack.

4.0 Mitigation Objectives during MPB Spread Control Activities

The following objectives will mitigate adverse impacts to PPA recreation and conservation values during MPB spread control activities:

- conduct operations (e.g. timing, selection of burn locations) such that native soils and vegetation will recover to native seral and climax vegetation communities over a short period of time;
- prevent impacts to unique vegetation communities, and species at risk (red and blue listed species);
- prevent invasive plant species from becoming established in disturbed sites;
- prevent the introduction of contaminants to watercourses;
- minimize short and long-term operational impacts to front country and backcountry recreational values;
- prevent impacts to critical wildlife habitat and limit disturbance to key wildlife during critical periods.
- minimize disturbance footprint.

5.0 Best Practices for Spread Control Operations

5.1 Planning and Communication with regional Ministry of Environment (MOE) Staff

- Contact MOE (BC Parks-Area Supervisor, and Ecosystem Biologist) prior to commencement of surveys and treatment to discuss **high level plan** (survey and treatment effort) and subsequent **operational plan** (equipment used, timing, operation options and limitations, disturbance footprints and mitigation techniques) for surveys and treatment. MoE requires an operational plan to conduct a *pre-impact assessment* to ascertain if proposed activities and associated BMP's will mitigate impacts to park values. Attempting to set up a meeting with BC Parks and Biologist to do this. Describe what the operational plan contains.
- Operators can identify alternate measures to meet the objectives outlined in this document in the **operational plan**.

[4] Ridge top/rock outcrop sites are considered to have the lowest soil and vegetation resiliency to burning regardless of timing.

- If the proponent is unclear regarding what park values could be at risk and/or objectives and measures in this BMP's can not be met, consult Peace Region MoE staff.
- Provide biweekly updates concurrent with spread control operations in PPA's. Updates include: survey effort (where, when), infestation (updated numbers, hotspots etc.), treatment efforts (where when), upcoming benchmarks, short term plans, and wildlife observations (wildlife sighting forms can be found in the Aircraft BMP document - see below for link). OK, what format would they like to to be in, personal contact, e-mail etc. and to whom?
- Report to regional park staff any significant changes to an operational plan prior to commencing activities.
- Subsequent to the conclusion of the spread control program, provide regional Parks staff results of heli/ground survey, treated trees for all PPA and mitigation measures that were employed.
- Additional communication strategies can be developed from pre-operations meetings.
- Conduct pre-operation and tailgate meetings to ensure field crews are aware of and understand the expectation of operations in PPA's.

5.2 Timing

- All operations should be planned with critical wildlife habitat and timing windows in mind. Additional information on key species and critical habitat can be obtained from the MOE ftp site (see Resources for link) and/or regional MOE ecosystem biologist staff. Critical timing windows for fish and wildlife can be found in Appendix I Could be a limiting factor in Bearhole Park.
- Avoid planning treatment operations in front country areas of PPA's during visitor season;
- Plan operations for frozen ground conditions and periods of greater snowpack in order to mitigate impacts to soil and vegetation. Sites with high conservation and/or recreational values are priority for frozen ground treatment.

5.3 MPB Surveys

- Helicopter activities should follow Aircraft Best Practices with regard to minimizing disturbance of wildlife (see Resources for link).
- All ground survey material (flagging, hip-chain etc.) must be removed from the park unless **specified via a park permit amendment, or pre-approved by the Park Area Supervisor**. Options may include biodegradable flagging, flagging removal, alcohol based paints, low impact paint colours, and alternatives to hip-chain filament.

5.4 Manual Falling Best Practices (from Best Management Practices for Tree Removal in Parks and Protected Areas, see Resources)

- Always respecting worker safety, fallers should be especially cautious to fall the trees in a direction which causes the least impact to the understory plant

community, residual trees and other sensitive ecosystem components, such as streams and riparian areas.

- Chainsaws should be kept in good working condition and free of oil and fuel leaks.
- Chain oil should be vegetable based for operations near waterbodies (streams, lakes, wetlands).
- Fuelling of chainsaws should take place in designated fuelling areas outside of riparian areas and other critical ecological features (e.g. wetlands).

5.5 Treatment Best Practices (Fall and Burn, and Helicopter Yard and Burn)

5.5.1 General

- No burning on or adjacent to recreational trails. Keep burn piles out of visual range of trails and viewscapes. Table 2 outlines recommended setbacks.
- Operations (identified in an operational plan) near park facilities, campgrounds and trails must be discussed with BC Parks (or designate) prior to treatment activities.
- Non-native plant species may become established at disturbed sites. Field crews should be aware of the concern to prevent carrying non-native seed (in helicopters, on clothing etc) into PPA's. What is this about??
- No burning of garbage or plastics in burn piles. Collect this material (i.e. flagging, field crew garbage) for subsequent appropriate disposal. (does not include removing flagging or trapped chokers from treatment trees piled for burning where safety is an issue).
- Conduct a post burn inspection and, if required, cleanup of site to remove garbage, survey and treatment debris.

5.5.2 Helicopter Yard and Burn

- Objective is to have zero impact on surface vegetation and soils in sensitive ecosystems (wetland, rock outcrop, floodplain), and limit the amount of burn debris.
- Select potential helicopter yard and burn sites during non-frozen conditions to assess values. Wetland/riparian or other non-forested burn sites to be utilized under non-frozen conditions may require more detailed pre-impact assessment. Impossible to do. We do not get our survey data until late fall/early winter. Presently there is 6-7 feet of snow in some areas.
- **Select burn** sites that have low risk to conservation and recreational values, and are resilient to fire. Table 2 outlines the limits to acceptable practices, above which BC Parks, or designate, must be contacted and details on mitigation actions are to be provided.
- The priority for burn site selection is in forests, however alternates can be used in cases where safety or logistical constraints prevent use of forested sites, or where conservation or recreational values are at greater risk;

- Avoid placing burn sites in critical habitat (e.g. mineral licks, nest trees, game trails, wildlife habitat features). MOE staff, or resources listed below, can provide information on known areas of critical habitat;
- Do not re-use aquatic sites within a season, unless other conservation or recreational values are at greater risk in alternate sites.
- Consider minimizing the following when determining the number of trees to burn in sensitive sites:
    - burn footprint,
    - impacts to soil and aquatic substrate
    - number of anticipated repeated burns

Table 2. Best Practices for Helicopter Fall and Burn Site Selection**

Best Management Practices for Helicopter Fall and Burn Site Selection					
Helicopter yard and burn locale	**Timing**	**Priority use**	**Accelerant**	**max # of trees**	**Setbacks**
Forests/Terrestrial (preferred burn site)	any (frozen ground preference)	1	any	any	30 metres from waterways (otherwise considered Floodplain or Wetland site); 100 metres from trails
Floodplain (vegetated high bench floodplain);	non-frozen ground	3	propane torch; no petroleum based accelerant	less than 200 per site	NA
	frozen (snowpack preferrably >1m)	2	propane torch; no petroleum based accelerant	less than 200 per site	NA
Wetland/Riparian	non-frozen ground	avoid	NA	NA	NA
	frozen ground (requires snowpack >1m)	2	propane torch; no petroleum based accelerant	any	NA
Rock outcrop* (xeric)	frozen/non-frozen ground	avoid	NA	NA	NA
*soils will be lost and recovery will be long term					

Note: All applicable legislation, including the Water Act and federal Fisheries Act, still applies

5.6 Other Treatment Options

- Presently only the spread control options discussed above are being used in Peace PPA's. Other treatment options (e.g. tree removal) must be discussed with regional MoE staff prior to their use.

6.0 Resources

MOE Information Page: http://wlapgww.bcgov/esd/ppa/pa_cons/pa_cons.htm

Contains: Parks Mountain Pine Beetle Program Strategy.
Tree Removal Guidelines for Parks and Protected Areas
Pine Beetle Management Program Strategy for Parks and Protected Areas Memorandum of Understanding with Ministry of Forests-Mountain Pine Beetle

MOE Peace ftp site:
ftp://ftpprg.env.gov.bc.ca/pub/outgoing/Peace_Region_Wildlife_Values/

Contains Aircraft BMP's and other documents on wildlife values

BC Parks Conservation Program Policies

http://www.env.gov.bc.ca/bcparks/conserve/consprog.html

BC Parks Impact Assessment Process

http://www.env.gov.bc.ca/bcparks/conserve/impact/impact.html

7.0 References

Blackwell, B.A. and Associates. 2005. Mountain Pine Beetle Management Strategy and Assessment Framework Updates for Monkman Provincial Park. Ecosystem Section, Ministry of Environment. 9pp.

MacKenzie, W.H. and J.R. Moran. 2004. Wetlands of British Columbia: a guide to identification. Res. Br., B.C. Min. For., Victoria, B.C. Land Manage. Handbook No. 52.

Ministry of Environment, Lands and Parks, BC Parks. 1997. BC Parks Conservation Program Policies. (http://www.env.gov.bc.ca/bcparks/conserve/consprog.html)

Peace Liard District, Northern B.C. Region. 2004. Master Plan for Monkman Provincial Park. Ministry of Environment, Lands and Parks. Prince George. 96pp.

Appendix I. Peace Region Selected* Terrestrial and Aquatic Fish and Wildlife Timing Windows**

	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
Terrestrial												
Bison				15	-	-	15					
Caribou *Northern and Boreal*	15	-	-	-	-	-	15			15	15	
Rocky Mt Elk	15	-	-	15	15	-	15					
Moose					15	-	15					
Bighorn/Thinhorn Sheep	15	-	-	15	15	-	15				15	15
Mt Goat	15	-	-	15	15	-	15				1	31
Trumpeter Swan				1	-	-	31	31				
Aquatic (sport fish)												
Spring Spawners			31	-	-	-	15					
Fall Spawners	-	-	-	-	-	15		31	-	-	-	-
Both Spring and Fall Spawners	-	-	-	-	-	-	15	15	-	-	-	-

** the selected aquatic and terrestrial wildlife are species of primary "management concern" in the Peace Region.*

*** based on a 12 month calendar year, ranks animal sensitivity (temporal and/or life stage) to particular industrial activities.*

Low Risk	Timing restrictions would not normally apply. Where ground conditions permit, plan spread control activities within these timeframes.
Caution	Spread control activities may proceed subject to review by the Ministry of Environment, BC Parks staff. Operators should avoid spread control activities during these timeframes, if not, additional mitigation measures may be required.
Critical	Spread control activities are not appropriate during this timeframe. Aerial supported activities should adhere to the Aircraft BMP's. In the event that working within a critical window is unavoidable, a rationale, mitigation and a monitoring plan must be developed for review by the Ministry of Environment, BC Parks staff.

Appendix II. Glossary

Conservation Values: Comprised of natural features, including the land, water, and atmosphere, their mineral, vegetable, and other components, and the flora and fauna on or in them. Key values include, but are not limited to, biodiversity, fish/wildlife, fish/wildlife habitat, species at risk, unique vegetation communities, cultural and physiographic features.

Park Values: Conservation, cultural and recreational values.

Recreational Values: Features that promote or attract the use and enjoyment of, and relaxation in, the natural environment. Recreational values include conservation, visual, and aesthetic values.

Tree Removal (helicopter or ground): Tree removal may be considered as a treatment option where there is a benefit to the park (e.g. through impact mitigation), and there is sufficient time to plan operations. No new road creation and no clear-cutting or large scale openings will be considered. Certain PPA's have restrictions on mechanized ground access. Any ground operations that may result in improved mechanized access into PPA's will not be supported by BC Parks. Planning and permitting requirements and best practices are outlined in Tree Removal Guidelines for Parks and Protected Areas.

Wildlife Habitat Features:

- a fisheries sensitive feature
- a significant mineral lick or wallow
- a nest of a bald eagle, osprey, or great blue heron
- any other localized habitat feature that the Minister of Water, Land and Air Protection considers to be a wildlife habitat feature (see list below).
    - Large stick nests (non-specified species)
    - Sharp-tailed Grouse leks
    - Ungulate natal areas
    - Grizzly bear ground dens
    - Black bear den trees
    - Snake hibernacula
    - Bat hibernacula and maternity roosts
    - Hot springs
    - Non-classified wetlands and ephemeral ponds

Appendix 4. Attractant Baiting Information for Mountain Pine Beetle.

Situations where attractant baiting can be used for Mountain Pine Beetle;

1. **Post-treatment mop up after falling and burning or harvesting.** This tactic can be used to mop up residual beetles not removed by the treatment. You will know where they are, and unless the removal was by falling and burning in a remote area, or heli-logging, you will likely have road access to go get them.

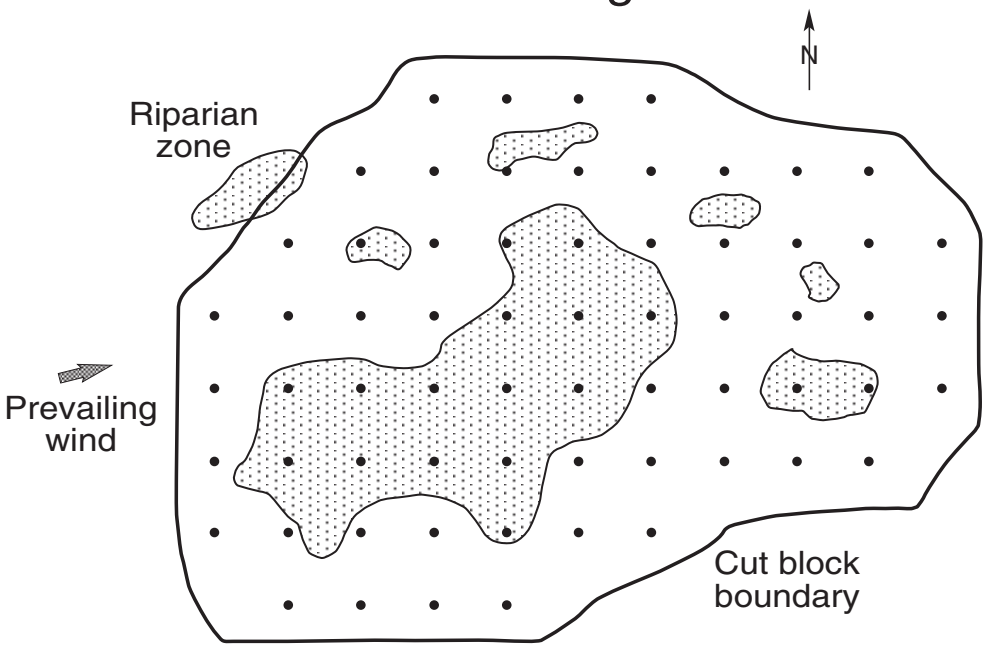
2. **Survey.** This is the Alberta survey method for use when populations are too low to be caught reliably in traps. I really like this method, and I think that it should be used at the fringes of the attack area east of the Rockies, and also beyond the furthest known infestation, just to see if there is something out there that was missed by other survey methods. It is also more reliable than trapping in determining the onset of the seasonal flight and attack period. Bait trees can be located next to roads so that access for post-flight removal of infested trees is assured.

3. **Pre-harvest treatment, when there is no obvious problem.** This tactic can be used when openings are planned, and attack outside of the planned openings would be unwelcome. I'd recommend it for new rights-of-way, ski hills, subdivisions etc. The idea is that you have a good chance of sucking beetles from the general area into the block or corridor that is going to be removed. There is a lot to be gained, and not much to lose.

4. **Containment and concentration.** The figure below is a conceptual figure for this tactic, wherein a 50 x 50 m grid of baited trees (four baits per hectare) is superimposed on an infested area, and a cutblock boundary is drawn around the baited area. It could also be applied within an already established cutblock, but there is always a chance that the infestation extends beyond the established boundary. Regardless, any beetle emerging within the baited area will doubtless come fairly close to a baited tree, and will be drawn upwind to it. This is the containment component. Beetles from outside (I figure up to 75 m, and we have evidence for this), or that are flying through the area, may also be concentrated within the baited block. Little knots of concentration also occur around each baited tree. In the figure, there is the hope that beetles in the infested patch that extends into the untouchable riparian zone will also be drawn into the baited grid.

In all cases it is important to bait well before the first expected flight, and to remove the infested trees well before the next flight in the following year (Pers. Comm. John Borden, Phero Tech Inc. February 2007).

Grid Baiting



Shaded areas represent infestation as identified by probing or walkthroughs.

Dots represent baited trees at 50 m centres.

Borden, Grid baiting fig

Appendix 5. Repellant Baiting Information for Mountain Pine Beetle.

Repellant Bating

As with most herbivores, there is an optimal density range of individuals on an exhaustible food resource. If beetle densities on a single tree are too high, mortality can result from within-tree competition for limited breeding and feeding space. The host tree is a finite food resource that can be over exploited by too many beetles. The earliest arriving beetles attract others in order to initiate mass attack and overcome the trees defenses. However, after a sufficient number of beetles have successfully attacked a tree and the tree has reaches its maximum capacity, beetles emit another chemical complex called anti-aggregating pheromone in order to repel and redirect incoming beetles. Anti-aggregation pheromones communicate to incoming beetles that the tree is full. Flying beetles will then search for other host trees, often selecting trees adjacent to those already mass attacked.

Three main anti-aggregation pheromones have been identified for mountain pine beetle including;

1. verbenone (4,6,6-trimethlybicyclo[3.1.] hept-3-en-2-one),
2. *endo*-brevicomin (endo-7-ethly-5-methly-6,8dioxabicyclo [3,2,1] octane), and
3. frontalin (1,5-dimethyl-6,8-dioxabicyclo [3.2.1] octane.

Verbenone is considered the principal anti-aggregation pheromone component derived from three sources; female beetles, autoxidation of host terpenes including α-pinene, and microorganisms (yeasts) growing in established galleries. There is some question whether verbenone is a regulator of breeding pair density to reduce intraspecific competition on suitable hosts or an indication of host quality.

Endo-brevicomin produced by males also has an anti-aggregation effect and frontalin is a multifunctional pheromone, being a repellent at high concentrations and attractive at low concentrations.

Pherotech has commercially produced a Mountain Pine Beetle Repellant, called the No Vacancy Pack - MPB, which can be used to protect pines from attack by the mountain pine beetle. They also recommend extra protection by applying the product to insecticide-treated trees.

Application of repellent pheromones must be completed before the beetles emerge to attack non-infested trees. At low elevations, the mountain pine beetle emerges in May through September with the peak flight in July. Therefore, depending on the location, it is recommended that the verbenone pouch be attached in May and again in July to protect against mountain pine beetle attack. It is also recommended to check with a consultant for the correct timing in your area.

The verbenone pouch should be placed on the north or shady side of the tree as high as the applicator can reach. For high value trees two packs may be used and should be placed as high as the applicator can reach on the shady side of the tree.
http://www.pherotech.com/main.jsp?p2=fullnews.jsp&new=1151516160000&tofu=

Appendix 6. Peace Forest District Tactical Plan, 2006-2007.

Spreadsheet 1. BMU Activity and Funding.

Spreadsheet 1. 2006/07 Submission - BMU Activity and Funding --- FINAL

								Surveys					Treatments								
								Detailed Air[7]		Ground			Fall & Burn		MSMA		Other		Baits[10]	
Region[1]	District	BMU Name	Priority[2]	Ranking[3]	Bark Btl Sp.[4]	Park?[5]	Strategy[6]	ha	$	sites[8]	$/site	$	trees	$/tree[9]	$	trees	$	ha	$	#	$
RNI	DDC	Bearhole	2	17	IBM	1	Suppression	77,632.19	$19,408.05	1,014	$800.00	$811,200.00	15,086	$151.25	$2,281,661.88						
RNI	DDC	Belcourt	2	14	IBM	0	Suppression	28,463.97	$7,115.99	157	$850.00	$133,450.00	382	$156.75	$59,878.50						
RNI	DJO	Blueberry	1	5	IBM	0	Suppression	233,414.04	$58,353.51	195	$905.00	$176,475.00	10,704	$200.00	$2,140,820.00						
RNI	DDC	Boucher	2	29	IBM	0	Suppression	17,635.41	$4,408.85	323	$0.00	$0.00	8,910	*$0.00*	$0.00						
RNI	DDC	Carbon	2	32	IBM	0	Suppression	35,567.79	$8,891.95	412	$0.00	$0.00	810	*$0.00*	$0.00						
RNI	DJO	Crying Girl	1	7	IBM	0	Suppression	42,620.74	$10,705.19	235	$761.90	$179,046.50	298	$200.00	$59,600.00						
RNI	DDC	Dawson Creek	2	23	IBM	1	Suppression	12,999.28	$3,249.82	61	$850.00	$51,850.00	79	*$100.00*	$7,900.00						
RNI	DJO	Dunlevey	1	6	IBM	1	Suppression	21,570.39	$5,392.60	67	$923.00	$61,841.00	84	$287.88	$24,181.92						
RNI	DDC	East Pine	2	25	IBM	0	Suppression	2,973.56	$743.39	119	$0.00	$0.00	113	$0.00	$0.00						
RNI	DJO	Graham	1	11	IBM	1	Suppression	91,041.48	$22,760.37	5	$837.37	$4,186.85	8	$290.99	$2,327.92						
RNI	DDC	Gething	2	31	IBM	0	Suppression	40,463.40	$10,115.85	541	$0.00	$0.00	521	$0.00	$0.00						
RNI	DJO	Halfway	1	8	IBM	1	Suppression	100,173.85	$25,043.46	142	$761.90	$108,189.80	195	*$318.00*	$62,010.00						
RNI	DDC	Honeymoon Creek	2	19	IBM	0	Suppression	19,478.21	$4,869.55	794	$800.00	$635,200.00	12,978	$125.40	$1,627,441.20						
RNI	DDC	Hudson's Hope	2	30	IBM	0	Suppression	17,010.20	$4,252.55	759	$0.00	$0.00	805,778	$0.00	$0.00						
RNI	DJO	Kahntah	1	1	IBM	1	Suppression	47,428.00	$11,857.00	0	$900.00	$0.00	0	*$250.00*	$0.00						
RNI	DDC	Kakwa	2	12	IBM	1	Suppression	8,673.77	$2,168.44	0	$900.00	$0.00	0	$158.40	$0.00						
RNI	DDC	Kiskatinaw	2	24	IBM	1	Suppression	16,848.71	$4,212.18	117	$800.00	$93,600.00	116	*$120.00*	$13,920.00						
RNI	DJO	Kobes	1	6	IBM	0	Suppression	43,791.87	$10,947.97	269	$837.37	$225,252.53	1,966	$318.05	$625,361.72						
RNI	DDC	Lone Prairie	2	22	IBM	1	Suppression	25,243.73	$6,310.93	825	$850.00	$701,250.00	1,192	*$130.00*	$154,960.00						
RNI	DJO	Lower Beatton	1	3	IBM	1	Suppression	30,175.15	$7,543.79	11	$905.00	$9,955.00	1,130	$114.50	$129,385.00						
RNI	DDC	Lower Moberly	2	28	IBM	0	Suppression	92,590.41	$23,147.60	205	$885.31	$181,488.55	113	$100.00	$11,300.00						
RNI	DDC	Lower Red Deer	2	15	IBM	0	Suppression	54,735.21	$13,683.80	559	$900.00	$503,100.00	14,868	$148.50	$2,207,898.00						
RNI	DJO	Milligan	1	2	IBM	0	Suppression	96,966.86	$24,241.72	0	$761.90	$0.00	0	$200.00	$0.00						
RNI	DDC	Narraway	2	13	IBM	0	Suppression	17,943.61	$4,485.90	164	$850.00	$139,400.00	255	$156.40	$40,392.00						
RNI	DDC	One Island	2	20	IBM	1	Suppression	189,042.67	$47,260.67	1,609	$850.00	$1,367,650.00	2,285	*$130.00*	$297,050.00						
RNI	DDC	Pine River	2	26	IBM	0	Suppression	41,253.11	$10,313.28	188	$0.00	$0.00	789,984	$0.00	$0.00						
RNI	DDC	Puggins	2	21	IBM	0	Suppression	112,610.14	$28,152.54	2,199	$800.00	$1,759,200.00	7,726	*$130.00*	$1,004,328.00						
RNI	DDC	Redwillow	2	16	IBM	0	Suppression	67,011.68	$16,752.92	819	$800.00	$655,200.00	28,266	$176.00	$4,974,868.80						
RNI	DDC	Septimus	2	27	IBM	0	Suppression	4,577.40	$1,144.35	277	$712.00	$197,224.00	103	$100.00	$10,300.00						
RNI	DJO	Sikanni	1	10	IBM	1	Suppression	45,620.92	$11,405.23	0	$837.37	$0.00	0	*$250.00*	$0.00						
RNI	DJO	Tommy Lakes	1	4	IBM	1	Suppression	267,953.87	$66,988.47	0	$761.90	$0.00	0	$750.00	$0.00						
RNI	DJO	Trutch	1	9	IBM	1	Suppression	180,478.44	$45,119.61	0	$761.90	$0.00	0	$750.00	$0.00						
RNI	DDC	Wapiti	2	18	IBM	1	Suppression	35,048.65	$8,762.16	277	$850.00	$235,450.00	16,642	$139.70	$2,324,873.43						
Total							-	2,119,238.7	$529,809.68	12,343	$680.36	$8,230,209.23	1,720,592	$ 180.42	$18,060,498.36		-		-		

Notes:

1. Region - Each region should consider submitting regional-level projects that encompass resources for admin (some beetle-related travel) and support for data base development and maintenance. Costs for these should be relatively minor. Aerial overview costs will be reserved by FPB for later disburseme
2. Priority - derived from discussions with Peace DFAM group March 2007.
3. Ranking - derived from discussions with DFAM group March 2007.
4. Bark Btl Species - there should be a separate BMU for each bark beetle species. Ie, if a BMU has both mountain pine beetle and fir beetle, there will be two BMU's entered with the same name - each dealing with the specific bark beetle. Enter "IBM" if mountain pine beetle; "IBD" if Douglas-fir beetle; "IBS
5. Park? - Enter a "1" if Park-related activities are included in the BMU plan. Activities and costs for the BMU should reflect BOTH Park and MoF needs for the BMU (see further notes, etc., on Spreadsheet 3). Enter "0" if there is no Park within the BMU.
6. Strategy - Please only include BMU's within Aggressive Management Zones that have an assigned strategy of SUPPRESSION
7. Detailed Air - as noted above, this refers to detailed, operational-level surveys only in SUPPRESSION BMU's. Aerial Overview costs will be included in FPB submission.
8. Number of sites derived from detailed aerial surveys.
9. $/tree taken from 2006/07 actual rates.
10. Baits - costs for baits should include any special costs associated with placement (ie, if baits are not placed in conjunction with other activities).
11. Other lump sum to include overwintering mortality assessments, risk rating, etc.

These BMUs were included as suppression for detailed aerial surveys only.

Spreadsheet 2. Infestation Status.

Spreadsheet 2. 2006/07 Submission - Infestation Status Description - FINAL

						Data Elements					
Region	District	Work Area	Bark Btl Sp.[1]	Park?[2]	Strategy[3]	G:R Ratio[4]	# Red Trees[5]	# Green Trees[6]	# Spots[7]	Sus. Area (ha)[8]	Total BMU Cost ($)
RNI	DDC	Bearhole	IBM	1	Suppression	8.90	1,695	15,086	1,014	77,632.2	$3,112,290
RNI	DDC	Belcourt	IBM	0	Suppression	1.00	382	382	157	28,464.0	$200,444
RNI	DJO	Blueberry	IBM	0	Suppression	40.70	263	10,704	195	233,414.0	$2,375,649
RNI	DDC	Boucher	IBM	0	Suppression	18.00	495	8,910	323	17,635.4	$4,409
RNI	DDC	Carbon	IBM	0	Suppression	1.00	810	810	421	35,567.8	$8,892
RNI	DJO	Crying Girl	IBM	0	Suppression	1.00	298	298	235	42,820.7	$249,352
RNI	DDC	Dawson Creek	IBM	1	Suppression	1.00	79	79	61	12,999.3	$63,000
RNI	DJO	Dunlevey	IBM	1	Suppression	1.00	84	84	67	21,570.4	$91,416
RNI	DDC	East Pine	IBM	0	Suppression	1.00	113	113	119	2,973.6	$743
RNI	DJO	Graham	IBM	1	Suppression	1.00	8	8	5	91,041.5	$29,275
RNI	DDC	Gething	IBM	0	Suppression	0.20	2,606	521	541	40,463.4	$10,116
RNI	DJO	Halfway	IBM	1	Suppression	1.00	195	195	142	100,173.9	$195,243
RNI	DDC	Honeymoon Creek	IBM	0	Suppression	10.50	1,236	12,978	794	19,478.2	$2,267,511
RNI	DDC	Hudson's Hope	IBM	0	Suppression	101.00	7,978	805,778	759	17,010.2	$4,253
RNI	DJO	Kahntah	IBM	1	Suppression	0.00	-	-	0	47,428.0	$11,857
RNI	DDC	Kakwa	IBM	1	Suppression	31.00	-	-	0	8,673.8	$2,168
RNI	DDC	Kiskatinaw	IBM	1	Suppression	1.00	116	116	117	16,848.7	$111,732
RNI	DJO	Kobes	IBM	0	Suppression	5.30	371	1,966	269	43,791.9	$861,582
RNI	DDC	Lone Prairie	IBM	1	Suppression	1.00	1,192	1,192	825	25,243.7	$862,521
RNI	DJO	Lower Beatton	IBM	1	Suppression	56.50	20	1,130	11	30,175.2	$146,884
RNI	DDC	Lower Moberly	IBM	0	Suppression	1.00	113	113	205	92,590.4	$215,936
RNI	DDC	Lower Red Deer	IBM	0	Suppression	12.60	1,180	14,868	559	54,735.2	$2,724,682
RNI	DJO	Milligan	IBM	0	Suppression	0.00	-	-	0	96,966.9	$24,242
RNI	DDC	Narraway	IBM	0	Suppression	1.00	255	255	164	17,943.6	$184,278
RNI	DDC	One Island	IBM	1	Suppression	1.00	2,285	2,285	1,609	189,042.7	$1,711,961
RNI	DDC	Pine River	IBM	0	Suppression	144.00	5,486	789,984	188	41,253.1	$10,313
RNI	DDC	Puggins	IBM	0	Suppression	2.90	2,664	7,726	2,199	112,610.1	$2,791,681
RNI	DDC	Redwillow	IBM	0	Suppression	17.10	1,653	28,266	819	67,011.7	$5,646,822
RNI	DDC	Septimus	IBM	0	Suppression	1.00	103	103	277	4,577.4	$208,668
RNI	DJO	Sikanni	IBM	1	Suppression	0.00	-	-	0	45,620.9	$11,405
RNI	DJO	Tommy Lakes	IBM	1	Suppression	0.00	-	-	0	267,953.9	$66,988
RNI	DJO	Trutch	IBM	1	Suppression	0.00	-	-	0	180,478.4	$45,120
RNI	DDC	Wapiti	IBM	1	Suppression	36.90	451	16,642	277	35,048.6	$2,569,086
Total						-	32,131	1,720,592	12,352	2,119,239	$26,820,517

Notes:
dealing with the specific bark beetle. Enter "IBM" if mountain pine beetle; "IBD" if Douglas-fir beetle; "IBS" if spruce beetle
if there is no Park within the BMU.
3. Strategy - Please only include BMU's within Aggressive Management Zones that have an assigned strategy of SUPPRESSION

4. An unbiased estimate from closest area where both red and green trees are present. Note italized numbers are estimates. Areas where IBM has not been surveyed to date were given a G:R ratio of 1:
5. Actual reds - derived from detailed aerial surveys.
6. Number of grfeens- total of recorded reds from detailed aerial surveys mulitpled by G:R ratio.
7. Total number of attack polygons, regardless of size, taken from 2006 detailed aerial surveys.
8. Susceptible area in BMU (>0). The total of all areas identified as >0 using Shore/Safranyik or equivalent for IBM.

MOF Infestation status

Spreadsheet 3. Parks Related Activities and Costs.

Spreadsheet 3. Parks-related Activities and Costs[1]

				Surveys						Treatments											
				Detailed Air			Ground			Fall & Burn			MSMA		Other		Baits		
Region[2]	TSA	Work Area	Bark Btl Sp	ha	$	sites[3]	$/site	$	trees[4]	Rate	$	trees	$	trees	$	#	$	Total Park Cost ($)
RNI	DDC	Bearhole Lake	IBM	12,704.79	$ 3,176	242	$800	193,600.00	3,142	$ 151.25	$ 475,182		$ -					$ 671,958
RNI	DDC	Bearhole Lake PA	IBM	5,053.73	$ 1,263	77	$800	61,600.00	1,139	$ 151.25	$ 172,304		$ -					$ 235,167
RNI	DJO	Beatton	IBM	329.21	$ 82	0	$905	-	-	$ 114.50	$ -		$ -					$ 82
RNI	DJO	Beatton River	IBM	265.61	$ 66	0	$905	-	-	$ 114.50	$ -		$ -					$ 66
RNI	DJO	Buckinghorse River Way	IBM	35.89	$ 9	0	$762	-	-	$ 750.00	$ -		$ -					$ 9
RNI	DJO	Butler Ridge	IBM	6,840.07	$ 1,710	18	$923	16,614.00	22	$ 287.88	$ 6,333		$ -					$ 24,657
RNI	DJO	Cecil Lake ER	IBM	129.50	$ 32	0	$905	-	-	$ 114.50	$ -		$ -					$ 32
RNI	DJO	Charlie Lake	IBM	97.62	$ 24	0	$905	-	-	$ 114.50	$ -		$ -					$ 24
RNI	DJO	Clayhurst ER	IBM	501.14	$ 125	0	$905	-	-	$ 114.50	$ -		$ -					$ 125
RNI	DJO	Ekwan Lake PA	IBM	1,741.98	$ 435	0	$900	-	-	$ 250.00	$ -		$ -					$ 435
RNI	DJO	Graham-Laurier	IBM	99,422.76	$ 24,856	0	$837	-	-	$ 290.99	$ -		$ -					$ 24,856
RNI	DDC	Gwillim Suppression area	IBM	5,563.67	$ 1,391	983	$850	835,550.00	1,394	$ 130.00	$ 181,220		$ -					$ 1,018,161
RNI	DDC	Kakwa	IBM	12,859.85	$ 3,215	1,159	$900	1,043,100.00	5,563,074	$ 158.40	$ 881,190,922		$ -					$ 882,237,237
RNI	DDC	Kiskatinaw	IBM	54.48	$ 14	0	$800	-	-	$ 120.00	$ -		$ -					$ 14
RNI	DDC	Kiskatinaw River PA	IBM	237.64	$ 59	0	$800	-	-	$ 120.00	$ -		$ -					$ 59
RNI	DJO	Milligan Hills	IBM	7,827.95	$ 1,957	0	$762	-	-	$ 200.00	$ -		$ -					$ 1,957
RNI	DDC	One Island Lake	IBM	58.92	$ 15	1	$850	850.00	1	$ 130.00	$ 130		$ -					$ 995
RNI	DJO	Peace River Corridor	IBM	2,517.52	$ 629	0	$905	-	-	$ 114.50	$ -		$ -					$ 629
RNI	DJO	Pink Mountain	IBM	97.63	$ 24	0	$762	-	-	$ 318.00	$ -		$ -					$ 24
RNI	DJO	Redfern-Keily	IBM	80,619.83	$ 20,155	0	$837	-	-	$ 250.00	$ -		$ -					$ 20,155
RNI	DDC	Rolla Canyon ER	IBM	42.99	$ 11	0	$850	-	-	$ 100.00	$ -		$ -					$ 11
RNI	DJO	Sikanni Chief Canyon PA	IBM	4,706.70	$ 1,177	0	$837	-	-	$ 250.00	$ -		$ -					$ 1,177
RNI	DJO	Sikanni Chief Falls PA	IBM	798.55	$ 200	0	$837	-	-	$ 250.00	$ -		$ -					$ 200
RNI	DJO	Sikanni Chief River ER	IBM	2,172.65	$ 543	0	$837	-	-	$ 250.00	$ -		$ -					$ 543
RNI	DJO	Sikanni Old Growth	IBM	1,439.45	$ 360	0	$837	-	-	$ 250.00	$ -		$ -					$ 360
RNI	DJO	Sudeten	IBM	4.64	$ 1	0	$762	-	-	$ 200.00	$ -		$ -					$ 1
RNI	DDC	Swan Lake	IBM	81.92	$ 20	0	$850	-	-	$ 100.00	$ -		$ -					$ 20
RNI	DJO	Taylor Landing	IBM	0.99	$ 0	0	$905	-	-	$ 114.50	$ -		$ -					$ 0
Total Parks				**218,508.14**	**$ 61,552**	**2,480**	**$847**	**$ 2,151,314**	**5,568,772**	**$ 196.76**	**$ 882,026,091**	**0**	**$ -**	**0**	**0**	**0**	**$0.00**	**$ 884,238,957**

Notes:

1. Those BMU's identified on Spreadsheet 1 as containing activities related to parks should be listed on this sheet with park-specific activities and funding needs identified.
2. Region - Each region should consider submitting regional-level projects that encompass resources for admin (some beetle-related travel) and support for data base development and maintenance. Costs for these should be relatively minor. Aerial overview costs will be reserved by FPB for later disburs
3. Number of sites derived from 2006 detailed aerial surveys.

Appendix 7. Peace Forest District Forest Health Strategy, 2006-2007.

Forest Health Strategy and
Tactical Plan

Peace Forest District

Final
March 2007

For: BC Forest Service, Peace Forest District

Contact Person: Tracy Coombes
BC Forest Service
Peace Forest District
9000 17 Street
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(250) 784-1200

By: Medi-For Consulting Ltd.

Contact Person: Marnie Duthie-Holt
c/o Medi-For Consulting Ltd.
3133 53rd St. South
Cranbrook, BC V1C 7A3
(250) 426-8581

District Manager Endorsement

APPROVED BY:

_____ _____

District Manager Date

Prepared by: Marnie Duthie-Holt
March 31, 2007

Summary
The Peace Forest District situated in the north-eastern section of BC is a very diverse forest district containing two timber supply areas (Fort St. John TSA40 and Dawson Creek TSA41), a tree farm licensee (managed by Canfor TFL48), as well as extensive parks, protected areas, and ecological reserves, and private land and various leases. This area of the province relies heavily on forestry and has multiple forest health issues.

The main forest health concern currently in the Peace Forest District is the mountain pine beetle which was first detected in 2004. Since that time populations have expanded rapidly with a large long range dispersal event in 2006. Detailed aerial surveys recorded 10.2 million reds totaling 37,830 hectares of attack in 2006. Active management of the mountain pine beetle has occurred since its detection in 2004 including aggressive harvesting and a large single tree treatment program. The district has been broken down into Beetle Management Units (BMUs) with each one assigned a control strategy ranging from salvage to suppression. A total of 34 suppression Beetle Management Units were identified in the Peace Forest District and have been ranked to allow for limited funds to be allocated in a logical manner.

Other forest health factors of concern include spruce beetle, western balsam bark beetle, lodgepole pine beetle, *Ips* bark beetle, and deciduous forest health factors including aspen-poplar twig blight, forest tent caterpillar, and large aspen tortrix, as well as two main immature forest pests such as western gall rust and warren's root collar weevil. The management objective of these forest health factors is monitor as these pests are not actively being managed.

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INTRODUCTION

The Peace Forest Health strategy follows the guiding principles set out in the provincial forest health strategy. It should be stressed that this strategic plan is a living document and that it is subject to annual reviews and modifications. The Peace Forest District Forest Health Strategy was developed in consultation with all Defined Forest Area Management (DFAM) members.

The Peace Forest District Forest Health strategy also;

- ✓ Identified the known forest health factors in the district
- ✓ Provides links to specific strategies and tactics that apply to those forest health factors
- ✓ Identifies and justifies any deviations from currently available pest management practices (Forest Practices Code Guidebooks, etc.)

Implementing a forest health strategy can augment and stabilize the timber supply of a TSA by increasing the success of regeneration practices, increasing the productivity of immature stands, and decreasing losses of mature timber. These benefits imply a reduced risk to silviculture investment and a more stable planning environment, both of which are important to the Ministry of Forests and timber industry. In addition, ecologically appropriate forest health practices will reduce the risk of wildfire associated with widespread timber mortality, improve public safety in multiple use areas, and lower the risk to non-timber resource values. Establishment of a proactive framework emphasizing the early detection of forest health problems and the prompt implementation of scientifically sound solutions will allow members of the DFAM to take full advantage of potential benefits. It will do this by ensuring that expenditures of resources are necessary, efficacious, and cost effective.

This strategy provides a framework to co-ordinate and guide forest health activities and should be considered as an outline for Best Management Practices within the District. The current focus of forest health activities is pest control, which only accounts for portion of the potential activities. A comprehensive Forest Health strategy should incorporate the principles of integrated forest health management to effectively manage the interactions between forest practices and forest health agents impacting on resource objectives, and apply ecologically sound techniques for the protection and enhancement of resource values.

"Integrated Forest Health Management" (IFHM) is a variant of the recognized approach to pest management known as Integrated Pest Management (IPM). The principles of IPM have been slightly modified within a forestry context to produce the principles of IFHM. These principles can be summed up as:

- ✓ Know the land-base and resource management objectives;
- ✓ Manage from an ecological perspective;
- ✓ Don't make the situation worse; and
- ✓ Practice adaptive management.

Geographic Description

A general description of the Dawson Creek and Ft. St. John Timber Supply Areas (TSAs), TSA 41 and TSA 40, respectively, are found in the Timber Supply Review (TSR) Report (BC MOF 2002) and Land Resource Management Plan (LRMP) (BC MOF 1997). These areas are also outlined in Figure 1.

Fort St John TSA 40 covers approximately 4.6 million hectares which is bisected by the Alaska Highway. The planning area can be roughly described as two major areas: east of the Alaska Highway which is flatter terrain and part of the extensive Alberta Plateau extending all the way from the B. C. - Alberta provincial boundary; and west of the highway where the terrain becomes increasingly more rugged as part of the Rocky Mountain Foothills. The southern boundary of the plan area is the Peace River; the northern boundary is shared between the Fort St. John and Fort Nelson Forest Districts (BC MOF 1997).

Dawson Creek TSA 41 covers approximately 2.3 million hectares and is located in east–central British Columbia of which about 60% is productive forest land (BC MOF 2002). Spruce and pine are the dominant coniferous tree species and aspen is the main deciduous tree species. The TSA is bounded by the Peace River on the north, the Alberta provincial border on the east, and to the west and south by the Rocky Mountains. Major drainages that flow into the Peace River through the TSA include the Pine, Moberly, Sukunka, Murray and Kiskatinaw rivers (BC MOF 2002).

Both the Dawson Creek and Ft. St. John TSAs are administered by the Peace Forest district office located in Dawson Creek. Tree Farm License 48 belonging to Canadian Forest Products Ltd. (wherein referred to as Canfor- Chetwynd) is located within the southern portion of the Peace Forest District which is also referred to as the South Peace. This Strategic Plan applies to the Dawson Creek and Ft. St. John TSAs only. It excludes Tree Farm Licences 48, parks, ecological reserves, woodlots, private land, Indian Reserves, and municipalities that are located within the boundaries of the Peace Forest District. Figure 2 outlines the operating areas of West Fraser Mills Ltd. - Chetwynd, BCTS, Canfor – Chetwynd's small pine licensee within TSA41, and Canfor – Fort St. John within TSA40. The hectares represented by each operating area are listed in the table below.

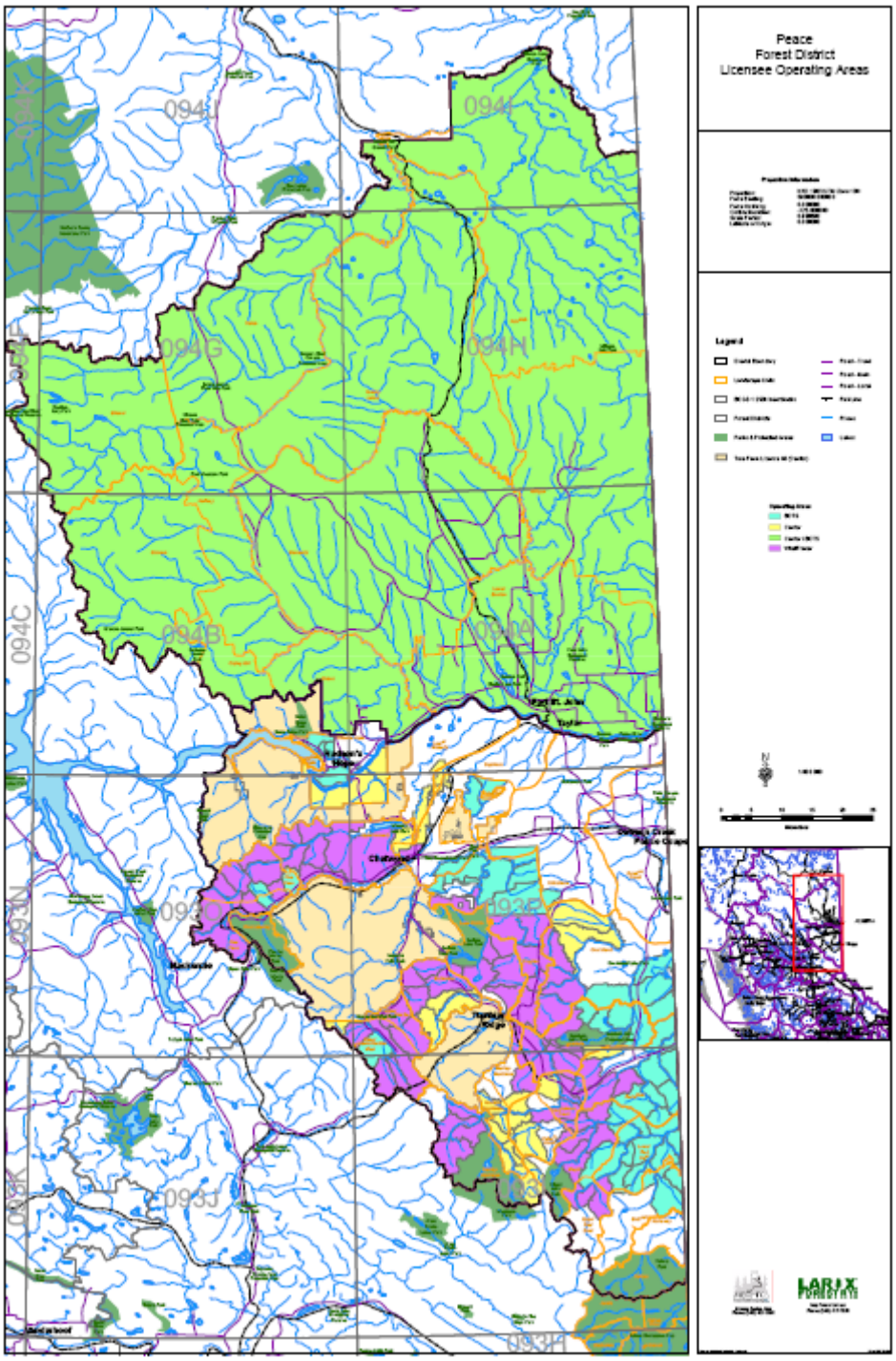
Table 1. Breakdown of operating area hectares for each major licensee in the Peace Forest District.

Licensee	**Area**
BCTS (DDC)	397,218.57
Canfor (DDC)	217,989.06
Canfor (TFL48)	651,112.85
Canfor / BCTS (DJO)	4,676,637.12
West Fraser Mills	648,287.30
Total	***6,591,244.90***

Figure 1. Map of Peace Forest District including Dawson Creek and Fort St. John TSAs (BC).

Source: http://www.for.gov.bc.ca/mof/maps/regdis/ndpc.htm

Figure 2. Operating areas for the major forest licensees in the Peace Forest District (2006).



Source: Stafford Shuman, Northern Interior Region Stafford.Shuman@gov.bc.ca .

OBJECTIVES AND REQUIRED ACTIONS

Five main objectives have been identified for an effective forest health strategy. Even though these five objectives have been outlined for all forest health factors these currently apply mainly to mountain pine beetle in the Peace Forest District because of the magnitude and severity of this pest, as well, its management objective which is suppression. All other forest health factors were designated as monitor management objective.

These objectives include;

Maintain a detection program for damaging agents over the landbase.

- ✓ *This is measured by performance measure 1 (Survey and Detection) as outlined below*.

Assess current and future stand and landscape level hazard and risk from detected damaging agents, including the impacts of forest management practices on resource values.

- ✓ *This is measured by conducting hazard (which is usually appropriate for up to five years unless major updates to timber typing has occurred) and risk rating (on a yearly basis) for applicable forest health factors including mountain pine beetle.*

Identify significant pest risks to resource values and identify appropriate management strategies and tactics, while considering constraints and limitations imposed by other resource management imperatives.

- ✓ *This is measured by listing, outlining known extent, and ranking priority forest health agents, as well as assigning control strategies and tactics for each one on a yearly basis.*

Implement mitigating strategies and tactics based on scientifically sound, forest health management practices.

- ✓ *This is measured by performance measure 2 (Treatment) as outlined below.*

Evaluate results of forest health management practices over the short and long-term and modify practices accordingly.

- ✓ *This is measured by performance measure 3 (Plan Achievement) as outlined below.*

The Ministry of Forests has defined three main performance measures to evaluate the effectiveness of bark beetle management since this is the main focus currently in the province. These performance measures are what will be used to evaluate the five objectives identified above. These performance measures include the following to monitor the implementation of bark beetle management within an identified management unit. *It should be noted that defined performance measures have not been identified for other non-bark beetle forest health factors.*

SURVEY & DETECTION: Area (ha) and % of susceptible forested land base that has been surveyed and where existing infested areas have been identified, evaluated, and assigned a management strategy.

This measure relates to the implementation of consistent, standardized annual aerial overview surveys and, to some extent, detailed aerial surveys. This statistic is expected to provide a measure of the effectiveness and efficiency of survey efforts in detecting and evaluating bark beetle incidence and intensity.
High levels of performance in this area mean that survey is complete and effective in identifying potential problem areas. Also, performance in these areas is indicative that specific situations will be assigned some level of management (including "do nothing"). Outcomes of management over management units will also be partially evaluated through comparisons of successive annual overview surveys.

TREATMENT: % of currently infested trees (can also use volume, ha or sites to track but must be reported in tree units) removed, treated, or otherwise abated, annually prior to the beetle flight period (does NOT include areas baited where no other action was carried out).

This measure will provide information on the level of successful implementation of management efforts to meet area specific objectives. This is a measure of the proportion of critical infested material that is addressed and that will contribute to reducing subsequent infestation levels. Information within this performance measure will include an estimate of the number of infested trees addressed through management. Such measures will reflect commitments to deal with both large-scale outbreaks and with small, spot, incipient infestations.

The abated trees should be expressed in relation to the total amount of attacked material (currently infested or old, dead, salvable) that exists within the management unit.

Abatement implies that the target volume is treated or otherwise dealt with such that it is removed from contributing to further infestation increases or expansions. Therefore, "non-removal" prescriptions such as baiting stands to hold beetle populations in place but not destroy beetle populations will not be included in this measure.

PLAN ACHIEVEMENT: % of each strategy that has been achieved.
This is intended to be a measure of the degree to which assigned strategies in specific management areas have been completed. This measure is an overview of progress/implementation while the Performance Measure #2 should measure specific accomplishments within a management area that has an identified strategy.

Along with the objectives, the actions required to effectively implement these objectives have been identified in this forest health strategy.

ACTIONS

Maintain a detection program for damaging agents over the landbase

The entire district was flown and mapped using standard aerial overview survey protocols in 2006. The aerial overview surveys are conducted in a fixed wing aircraft at low flight line intensities on topographic or orthographic maps at 1:100,000 or 1:250 000 scale. The aircraft is flown at altitudes of 500 to 1,000 m at speeds of 80 to 90 knots. The accuracy of these overview surveys is sufficient for historical trends (increasing, decreasing, or static), gross area affected, and general damage location. These surveys also delineate areas where detailed surveys are required. Aerial overview surveys using fixed wing aircraft have been conducted in the Peace on a yearly basis by the BC Forest Service since 1999. Previous to this they were conducted by the Canadian Forest Service by Forest Insect and Disease Survey (FIDS) rangers. All forest health agents were located determining their extent and location. The following figure outlines the locations of all of these forest health factors.

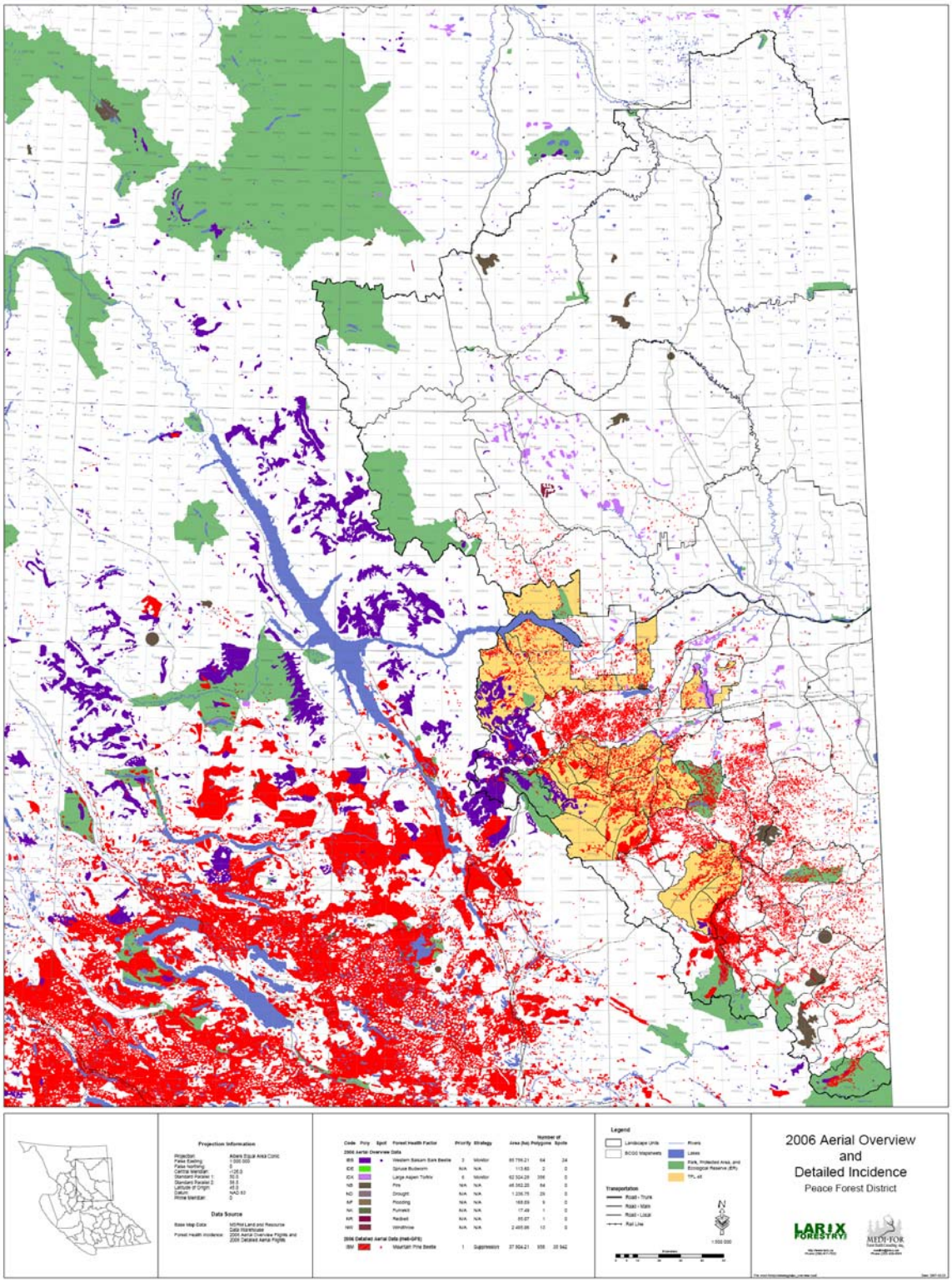


Figure 3. Map outlining locations of all forest health factors in the Peace Forest District from Aerial Overview Surveys (2006).

As well, the majority of the 2 TSAs (Dawson Creek TSA 41 and Ft. St. John TSA 40) were flown and mapped with helicopters and GPS equipment using detailed aerial survey protocols (http://www.for.gov.bc.ca/hfp/forsite/fhdata/detailed_digital_stds.htm). Detailed aerial surveys mainly targeted mapping mountain pine beetle incidence for groups of 1-50 trees and polygons of light, moderate or severe attack. A map of the areas flown in 2006 for detailed aerial surveys located in Appendix 2 and the breakdown of hectares surveyed by work area is outlined in Appendix 3. Shape files of the detailed aerial surveys are supplied to the Peace Forest District and Northern Interior Region on a yearly basis for historical tracking.

At this point it is difficult to track location, extent and severity of plantation pests or other pests not tracked consistently by the aerial overview surveys. This is an area where improvements could be made for the future if all parties involved supplied their data sets to a central data warehouse.

Further detection of mountain pine beetle was carried out by way of ground surveys.

LISTING AND KNOWN EXTENT OF PRIORITY FOREST HEALTH AGENTS IN THE DISTRICT

A complete listing of forest health agents in the district recorded by the aerial overview surveys, along with a description of their status is included along with comparisons with previous year's incidence and infection levels is located in Table 2. It should be noted that information on immature forest health factors are not included since this data is not available. As well, information on cattle impacts also has not been included because this information is also not available.

Table 2. List of forest health factors (FHF), historical levels and current status outlined as hectares for (2001-2006).

SUM OF AREA (ha)*		YEAR						
CODE	FHF	2001	2002	2003	2004	2005	2006	Total
-	Unknown		1,486.10					1,486.10
AD	Deer				0.3			0.3
AP	Porcupine		0.5	1				1.5
DLV	Aspen-poplar twig blight		2,739.90	856.8	4.2			3,600.90
IBB	Western balsam bark beetle	41,426.20	27,881.50	93,434.00	122,817.40	106,756.30	55,442.06	447,757.46
IBM	Mountain pine beetle	67.6	93.6	0.5	17,852.20	15,611.10	29,580.10	63,205.10
IBS	Spruce beetle	585	3,205.40	4,768.90	477.3	232		9,268.60
IDB	2yr cycle budworm	1,515.80						1,515.80
IDF	Forest tent caterpillar	19,026.40		56.3				19,082.70
IDK	Northern tent caterpillar				871.6			871.60
IDX	Large aspen tortrix			110,087.20	252,595.80	6,945.30	56,671.00	426,299.30
NB	Fire		107.5	194.1		64.9	38647.34	39,013.84
ND	Drought						1236.75	1,236.75
NF	Flood	875.7	247.9	1,023.10	40.1	329.5	157.06	2,673.36
NK	Fumekill						17.49	17.49
NR	Red belt			1,204.70		13,816.10	85.07	15,105.87
NW	Windthrow			46.5	61.1	7,362.70	2,418.86	9,889.16
Total	-	*63,496.80*	*35,762.40*	*211,673.00*	*394,719.90*	*151,117.90*	*184,255.73*	*1,041,025.73*

*Dawson Creek TSA 2001-2005, Peace Forest District 2006 – Aerial Overview Data.

MATURE CONIFEROUS FOREST PESTS

Mountain pine beetle, *Dendroctonus ponderosae (IBM)*

Mountain pine beetles history in the Peace Forest District has been limited to the last couple of years, with the first flight from the Prince George Forest District in 2002. This beetle was not detected until 2004 when attacked trees started to fade. An aggressive beetle management program has followed this detection including sanitation harvesting in conjunction with pheromone baiting, BBR (bark beetle regulation) emergency blocks, susceptibility rating, and an extensive ground surveys and single tree treatment program in 2004 to 2007.

Currently the overall strategy for mountain pine beetle is suppression throughout the Ft. St. John TSA 40 and a combination of suppression, holding and salvage in the south Peace as represented by the Mountain pine beetle strategies map in this report. Strategies are subject to change based on current survey results. Once the suppression units are flown using detailed aerial surveys in the fall of 2007 this strategy may change again as more information becomes available. Additional details of the history of mountain pine beetle in the Peace Forest District are located in a separate section.

Spruce beetle, *Dendroctonus rufipennis (IBS)*
Historically spruce beetles have been an issue in the Dawson Creek TSA, with the last major outbreak recorded in 1999-2000. Previous to this there was an extensive outbreak in 1981 to 1982 mainly associated with seismic line development. The previous outbreak collapsed after a cold snap in 1982. As well, over 30,000 hectares of attack was recorded in 1992 on the east slopes of the Rocky Mountains in the District Creek Forest District (now South Peace) and in 1993 the attack reduced to 10,000 hectares (Wood & Van Sickle 1992 & 1993).

Currently populations are endemic. However, this pest has had extensive economic effects in the past and has a wide range of tools to deal with it. Some of the available tactics include; overview and detailed aerial and ground surveys, single tree treatments of conventional trap trees, total disposal of all felled spruce within a quarter mile of any road or pipeline crossing, fall and burn, fall and peel, and pheromone baiting, sanitation/salvage harvesting, and high hazard host removal. In addition to attack by endemic spruce beetle spruce trees in the Peace Forest District as also being hit incidentally by mountain pine beetle. To date no mountain pine beetle attack has resulted in successfully brood production in spruce trees, but as the mountain pine beetle incidence increases in the Peace Forest District this should be monitored. The overall strategy for spruce beetle is monitor.

Western balsam bark beetle, *Dryocetes confusus (IBB)*
Western balsam bark beetle causes significant mortality of alpine fir in BC and accounts for up to 90% mortality in the northern sections of the Dawson Creek TSA specifically in the Pine Pass- Upper Moberly BMUs. In addition to these areas, western balsam bark beetle is present at various attack levels throughout the district mainly restricted to high elevations above 1,350m, with endemic populations present in most balsam stands in the district.

However, populations of western balsam bark beetle are often not recorded accurately during aerial overview surveys because of the scattered nature of attack over susceptible host types and the level of management currently employed against this bark beetle. These variants in surveys could account for the large discrepancies in damage recorded in the aerial overview surveys over the last six years including the decrease in incidence in 2006.

Despite the large incidence of this pest, it is not managed extensively in the Dawson Creek TSA partially due to the fact that western balsam bark beetle has not moved into merchantable stands. Western balsam bark beetle attack has been restricted to stands greater than 1,350 meter elevation and harvesting has stopped on average at 1,250 meters elevation (Pate Pers. Comm. 2007). Areas will be salvaged where feasible to address infestations and it is realized that the damage caused by this pest will affect future TSR calculations. The overall strategy for western balsam bark beetle is monitoring.

Lodgepole pine beetle, *Dendroctonus murryanae (IBL)*
Lodgepole pine beetle on its own has never resulted in an outbreak, given the very slow nature of its spread capability. As lodgepole pine beetle does not pose significant risk to the resources, treatment of this beetle is not considered worth the investment. However, within the last three years it has been noted that lodgepole pine beetle populations could be used as an indicators of expansion of mountain pine beetle or mountain pine beetle infestations were interspersed with lodgepole pine beetle and were misidentified and should therefore be monitored closely and ground confirmed. Numerous red pine trees identified during the detailed aerial surveys on the leading edge of the mountain pine beetle attack have actually been ground confirmed as Lodgepole pine beetle and mountain pine beetle has been recorded to co-occupying trees with Lodgepole pine beetles when at endemic populations. This is true again in 2006/2007 as the mountain pine beetle progresses further north into the Ft. St. John TSA. The overall strategy for Lodgepole pine beetle is monitor.

Ips bark beetle, *Ips pini (IBI)*
Ips beetles usually attack weakened, dying, or recently felled trees and fresh logging debris. Large numbers of *Ips* may build up when natural events such as ice storms, wildfires, and droughts create large amounts of pine suitable for the breeding of these beetles. If such events occur they should be dealt with by salvaging blowdown and harvesting infested trees where located. As well, *Ips* beetles have been noted in association with leading edge mountain pine beetle attacks and mountain pine beetle fall and burn control efforts. The overall strategy for *Ips* beetle is monitor.

MATURE DECIDUOUS FOREST PESTS
All mature deciduous forest pests were ranked equally low in the Peace Forest District. Louisianan-Pacific Corporation and Tembec Corp. each have deciduous licenses with their operating areas covering the entire Dawson Creek TSA and Canfor – Fort St. John has a deciduous license within the Fort St. John TSA; however little management to date has been directed towards the listed mature deciduous forest pests.

Currently, monitoring will be implemented for aspen-poplar twig blight, *Venturia* spp. (DLV), forest tent caterpillar, *Malacosoma disstria* (IDF), and large aspen tortrix, *Choristoneura conflictana* (IDX). The only pest recorded during the aerial overview surveys was large aspen tortrix in 2006. The overall strategy for all of these forest health factors is monitor.

PLANTATION PESTS
Two main plantation pests were identified in the Peace Forest District.

Western Gall Rust, *Endocronartium harknessii (DSG)*
Western gall rust damage is usually restricted to young trees with heavy infections causing stunted or malformed trees, which are predisposed to breakage by high winds or heavy snow loads (Ziller 1974). This disease seldom kills older trees but can kill young trees with main stem infections.

The area south of Tumbler Ridge has experienced total plantation failures as a result of this pest. Tactics targeted to reduce impacts of this pest include planting mix or non-host species, increasing stocking levels, and changes to block design to decrease wind movement.

The distribution of western gall rust is widespread throughout BC (Ziller 1974). It occurs at high levels in the Peace Forest District however, its exact distribution is not known.

Warren's root collar weevil, *Hylobius warreni (IWW)*

Warren's root-collar weevil, feeds in the cambium of the root-collar area on young to mature pine and spruce, causing characteristic black, crusty pitch masses in the soil and growth reduction or mortality (Duncan 1986). Damage is caused by the larvae which construct galleries beneath the bark resulting in resin flow at the root collar (CFS 2003). Mortality occurs when galleries completely encompass the tree or when the weakened trees become vulnerable to windfall or snowpress (CFS 2003; McLean 2002). On larger trees, roots instead may become completely girdled and repeated attacks can result in growth loss and increased susceptibility to disease including tomentosus root disease (UNBC 2002), but rarely cause mortality.

Numerous plantations throughout the central interior have experienced mortality levels in excess of 10%. To date limited tactics has been utilized against this forest health factor in the Dawson Creek TSA. The overall control strategy for warren's root collar weevil is monitor. Available tactics include overstocking plantations and planting non-host species in known effected areas.

District Ranking of Forest Health Factors

The ranking or prioritization of forest health factors and BMUs is a valuable exercise when resources are limited. Ranking improves implementation of the bark beetle management strategies prescribed by more efficiently allocating resources.

Forest health factors in the Peace Forest District were ranked according to the following criteria.

- ✓ Collective knowledge of district forest health specialists and DFAM members;
- ✓ Known or suspected impacts to forest resource values;
- ✓ Availability of operational detection and treatment methods;
- ✓ Costs and benefits of applying detailed detection and treatment activities;
- ✓ Overall level of knowledge about the hazard and risk zones;
- ✓ Distribution of pest and current incidence levels;
- ✓ Resources required to obtain missing information necessary for management of the pest.

Allocation of funding and resources will be based on this ranking (Table 3).

Table 3. Ranking of Forest Health Factor by Potential Impact on Forest Management Activities and Specific Management Objective (Peace Forest District 2006).

FHF		**Ranking***	**Management Objectives****	**Tactics (Measures) ***	
				Available	**Committed to by DFAM Group**
Mature Forest Pests					
IBM	Mountain pine beetle	1	S	1-10, 12 (excluding 6)	1-10,12 (excluding 6), 14
IBS	Spruce beetle	2	M	1-10, 12	1-3, 5-10, 12
IBB	Western balsam bark beetle	3	M	1-8, 10	1, 2, 8
IBL	Lodgepole pine beetle	4	M	1-8, 10	1, 2, 4
IBI	*Ips* bark beetle	5	M	1-8, 10	1, 2
DLV	Aspen-poplar twig blight	6	M	1	1
IDF	Forest tent caterpillar	6	M	1, 11	1
IDX	Large aspen tortrix	6	M	1, 11	1
Immature Forest Pests					
DSG	Western gall rust	7	M	12, 13, 17	12, 13, 17
IWW	Warren's root collar weevil	7	M	12, 13, 17	12, 13, 17

* Ranking 1-5 are considered priority - deciduous and plantation pests have been included but are not considered priority. Note: all deciduous pests were ranked equally at a level 6, and plantation pests were ranked the lowest at 7.

** Management Objectives: S= Suppression/ Prevention, H= Holding, G= Salvage, M= Monitor, P= Protected Areas

*** Tactics (Measures): 1=aerial overview surveys, 2= detailed aerial surveys, 3= ground surveys, 4= fall and burn/ helicopter assisted burning/ mechanical assist burning, 5= fall and peel, 6= conventional trap trees, 7= sanitation harvesting (in conjunction with pheromone baiting), 8= salvage harvesting, 9= hazard and risk rating, 10= high hazard host removal, 11= *B.t.k.* sprays (high value stands), 12= pre and/or post harvesting monitoring, 13= overstocking, 14= verbenone anti-aggregation pheromones, 16= genetically resistant stock, 17= planting off site species.

Forest health factors, which are recorded from aerial overview flights but were not ranked because they are abiotic factors which cannot be managed, are outlined in Table 4.

Table 4. Abiotic Forest Health Factors (Peace Forest District 2006).

FHF	**Forest Health Factor**
NB	Fire
ND	Drought
NF	Flooding
NK	Fumekill
NR	Red belt
NW	Windthrow

MOUNTAIN PINE BEETLE

Mountain Pine Beetle History in the Peace

Mountain pine beetle (IBM) (*Dendroctonus ponderosae*) is the most serious forest insect pest in BC and most damaging agent of mature lodgepole pine in North America.

Mountain pine beetles are currently in the outbreak phase of the infestation cycle throughout much of their range in British Columbia (Eng *et al.* 2004). Additional description of mountain pine beetle outbreak stages is included in Appendix 1. Previously it was thought that mountain pine beetle could not survive east of the Rocky Mountains in the Peace Region of BC due to the minus forty isotherms. The Peace Region was considered to be north of climatic range of this beetle (Safranyik 1974) (Figure 4). However, in 2002 a flight of mountain pine beetle successfully came over from the Prince George Forest District into the western valleys in the Peace and mountain pine beetle has continued to move eastward. Mountain pine beetle presence was not confirmed until February 2004 (in TFL48) as infested pine trees were slow to fade. An additional large long range dispersal event occurred in 2006, which has resulted in extensive infests along the western edge of the Peace Forest District and north into the Ft. St. John TSA40, as well as further east than had been recorded previously into Alberta. The delineation of the flight east and north will be an ongoing process as additional data becomes available. However, preliminary information is included in Figure 5. Additional immigration may continue on an annual basis until the central interior populations have crashed, presumably around 2008 (Eng *et al.* 2005).

Aerial and ground surveys confirmed the presence of mountain pine beetle and a wave of control strategies and tactics have continued since that time including but not limited to those outlined in the following table.

Table 5. Tactics applied to manage Mountain pine beetle in the Peace Forest District, 2004-2007.

Activity	Timeframe
Planning	
Formation of Peace Region MPB Working Group	Summer 2004
Peace Forest District incorporation into the EBBMA (Emergency Bark Beetle Management Area)	Fall 2004
Development of Mountain pine beetle management strategy for the Dawson Creek TSA, later updated to include entire Peace Forest District in 2006-2007	November 2004 March 2005 March 2006 March 2007
Mountain pine beetle stand susceptibility modeling	March 2005
Mountain pine beetle stand susceptibility modeling revised with climate suitability (Dawson Creek TSA only)*	October 2006
Development of web based database for tracking all activities	April 2005 - present
Development of comprehensive strategy for the Peace Forest District	March 2007
Surveys: Aerial and Ground	
Aerial overview surveys conducted by MOF	Yearly since 1999
Detailed aerial helicopter GPS surveys	September 2004, 2005, 2006
Measle mapping detailed aerial surveys	August – September 2005
Preliminary ground recces	July 2004
Preliminary ground surveys	September 2004, 2005, 2006
Full scale ground surveys	December 2004 – May 2005 September 2005 – May 2006 September 2006 – March 2007
Treatments Harvesting	
Sanitation harvesting combined with pheromone baiting where appropriate	April 2004 – present
Treatments: Single Tree	
Full scale conventional fall and burn program	December 2004 – May 2005 December 2005 – June 2006 January – March 2007
Full scale helicopter assist treatment program	January 2006 – June 2006 January – March 2007
Mechanical fall and burn trial	March 2007

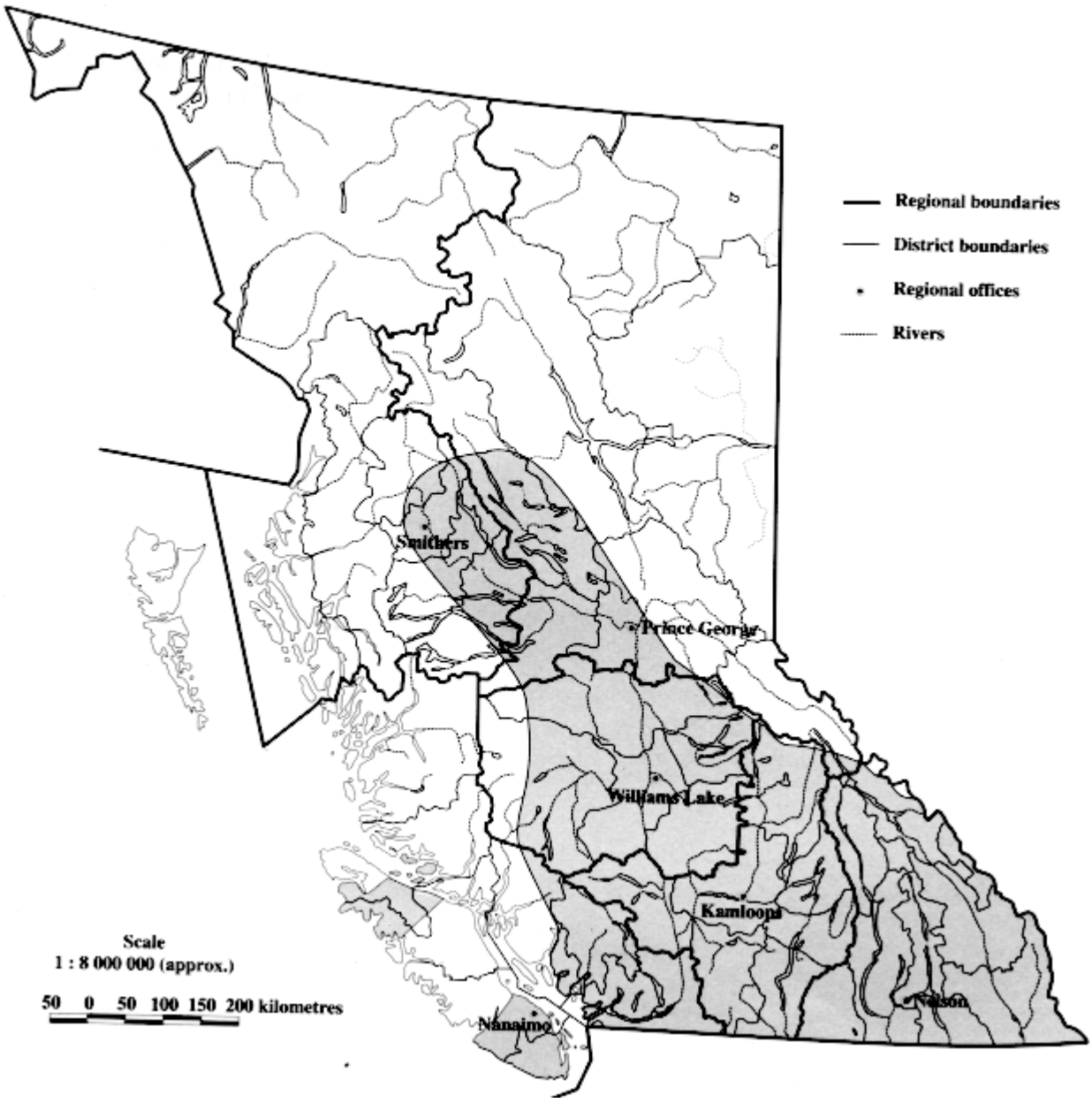
*Note: Mountain pine beetle stand susceptibility using the location factor should be re-run for the Fort St. John TSA in the near future.

A cooperative Peace Region working group was formed including;

- ✓ local licensees (West Fraser Mills Ltd., Canfor - Chetwynd and Ft. St. John, and BCTS),
- ✓ BC Forest Service staff at the district and regional level,
- ✓ BC Parks staff at the district level and branch level,
- ✓ Alberta Sustainable Resource Management staff and
- ✓ Adjacent Alberta licensees including Canfor and Weyerhaeuser, Grande Prairie.

This group has worked cooperatively with West Fraser Mills acting as the lead licensee to communicate the program milestones and strategies up until last year (March 2006) when the Peace Forest District took on this role.

Figure 4. Predicted potential distribution of mountain pine beetle in BC.



Source: http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/beetle/figure1.htm (accessed March 2006).

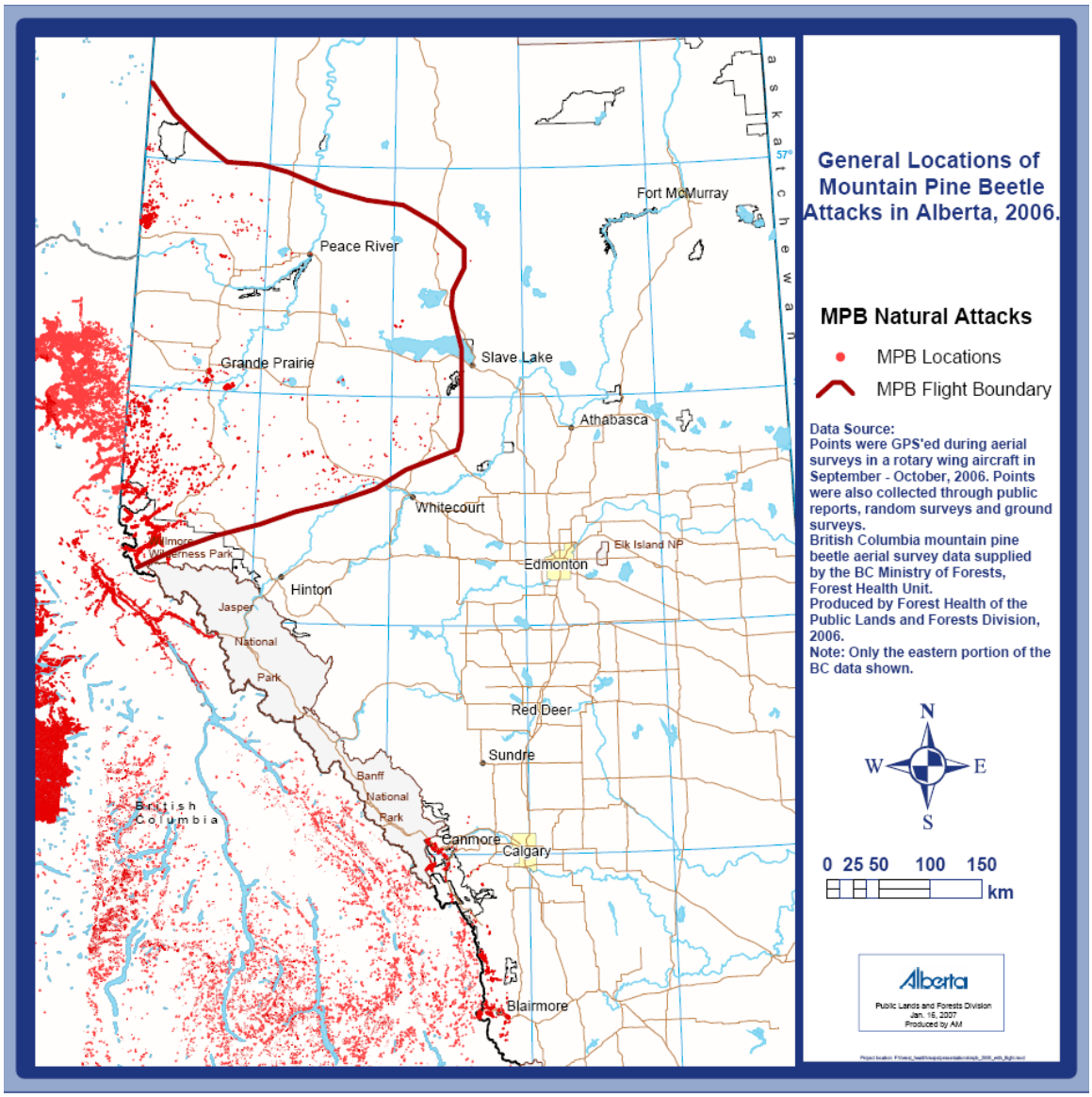


Figure 5. Predicted long range dispersal of Mountain pine beetle into Alberta in 2006. Source: Dan Lux, SCOT meeting Prince George, BC. February 6, 2007.

Susceptibility Rating

It should be noted that the assessment of current and future stand and landscape level hazard has been assessed only for mountain pine beetle since this is the most significant pest in the Peace Forest District.

Stand level susceptibility rating for mountain pine beetle was generated by Medi-For Forest Health Consulting in 2005 (Duthie-Holt 2005) for the South Peace, Dawson Creek TSA 41, parks, and TFL48. This information is considered valid for up to five years or up until there has been a major update to the forest cover inventory. Canfor also conducted susceptibility rating for the Fort St. John TSA 40 in 2006. The results of these susceptibility ratings are located in Table 6 and Figure 6.

Mountain pine beetle susceptibility rating

The standard Shore and Safranyik hazard-rating model for mountain pine beetle was used (Shore and Safranyik 1992). The model used the following factors to analyze the susceptibility rating using information from the VRI database;

- ✓ percentage of susceptible pine basal area,
- ✓ age factor,
- ✓ density factor, and
- ✓ location factor.

Table 6. Mountain pine beetle susceptibility hectare breakdown by class for the Peace Forest District, using the original location factor for the mountain pine beetle susceptibility model (October 2006).

Hazard Category	**Hazard Class**		**Area**
0	Nil	0	5,475,589.21
1	Low	>0-20	1,203,516.36
2	Mod.	>20-40	386,544.91
3	High	>40-60	298,001.21
4	Extreme	>60-80	230,411.16
5	Very extreme	>80-100	81,781.62
Total			***7,675,844.46***

Additional details by Beetle Management Unit are located in Appendix 4.

An updated susceptibility map for the entire Peace Forest District is included in Figure 6.

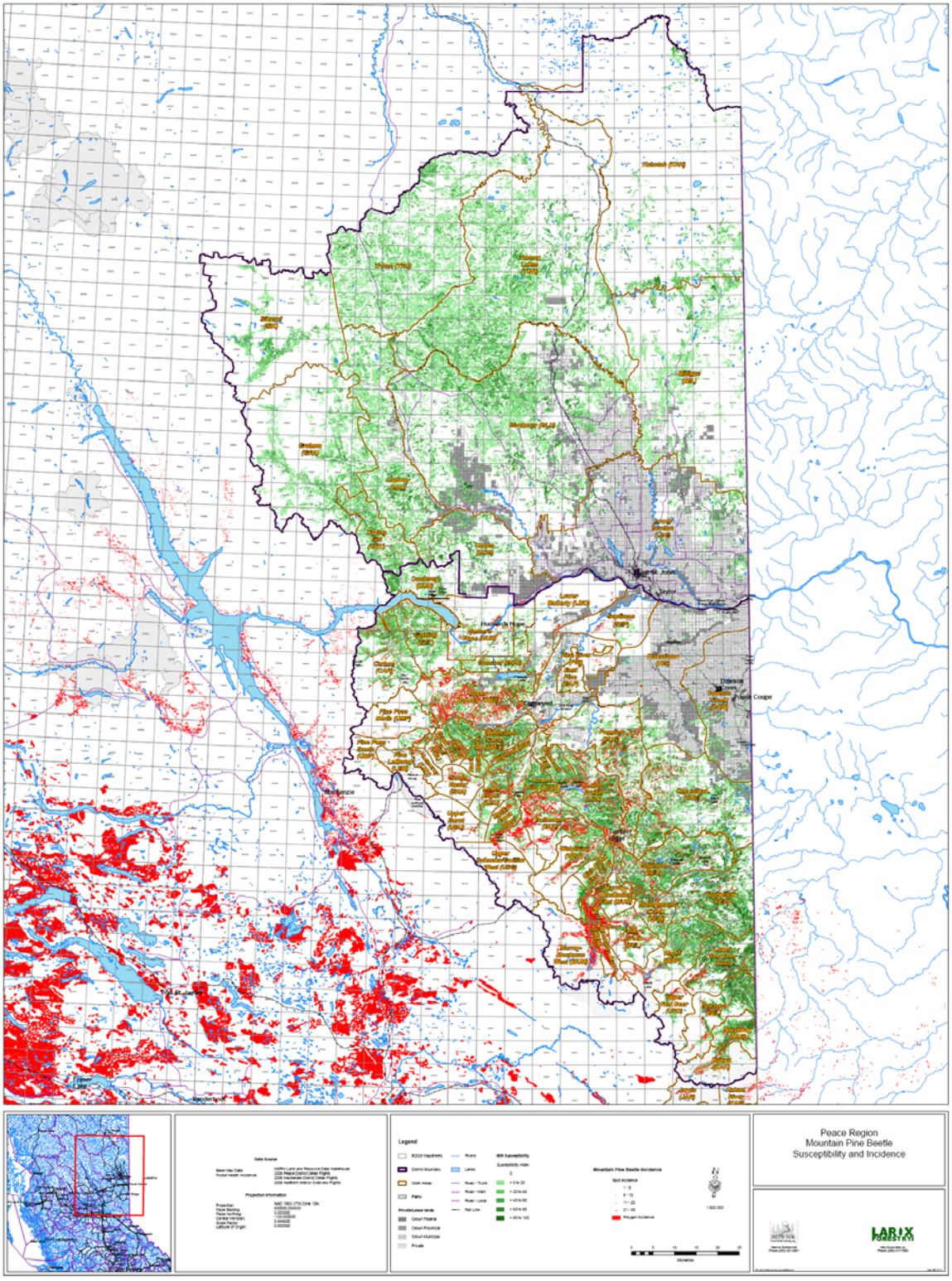


Figure 6. Map of 2006 mountain pine beetle incidence and mountain pine beetle susceptibility for the Peace Forest District (October 2006).
Note: Susceptibility model used included location factor.

Priority Forest Health Factors Strategies

It should be noted that only mountain pine beetle has been assigned control strategies by Beetle Management Unit and given a relative ranking within the Peace Forest District since this is the most significant pest identified.

Beetle Management Unit Boundary Delineation

Beetle Management Unit (BMU) boundaries were established as the defined area for developing management strategies to deal with bark beetles. This delineation has been changed from the original Landscape Unit boundaries to work area boundaries since operational this boundaries were difficult to work with. Work areas are outlined in the following map and identify an area where specific beetle management strategies can be applied (Figure 7).

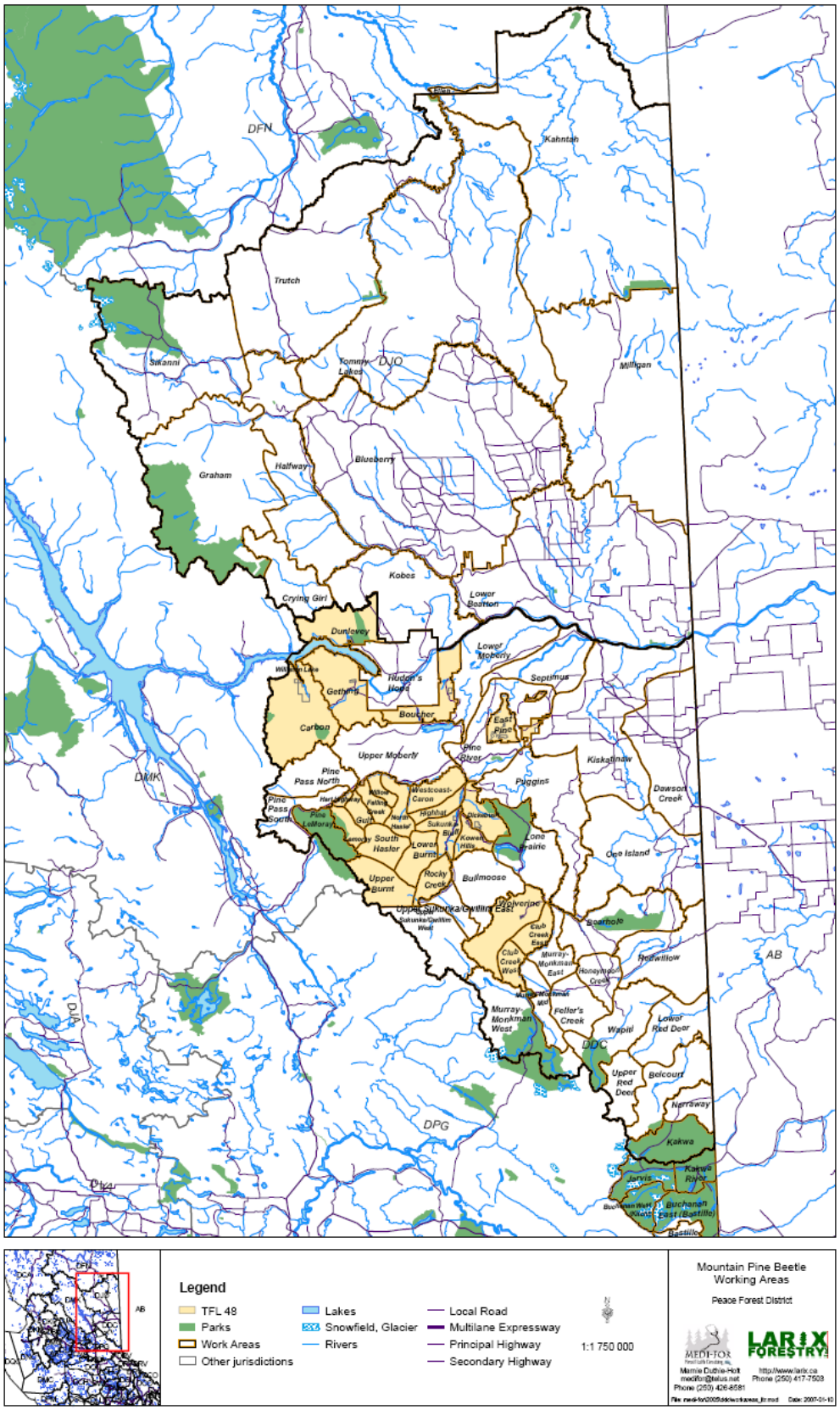


Figure 7. Work area map of the Peace Forest District, 2006.

Assigning Control Strategies
Beetle management control strategies are broad approaches that have specific objectives. The strategy chosen for a BMU should remain in place for as long as the objectives are being met or until additional resources become available to allow a more aggressive strategy to be implemented. However, situations change from year to year, and therefore strategies must be reassessed on an annual basis.

There are four broad strategies that can be used to address bark beetle infestations in a BMU (Table 7). Selection of the relevant strategy is based upon the forest health issues in the area, the stated integrated resource management objectives, and the expected impact of beetle activity in adjacent management areas.

The strategies include the following:
- ✓ Suppression/ Prevention
- ✓ Holding Action
- ✓ Salvage
- ✓ Monitor

S - Suppression/ Prevention (80-100% target of current infestation): This is the most aggressive strategy. It is selected when the infestation status is such that aggressive direct control actions are expected to keep an area at low level of infestation. Areas are lightly infested, and resources for direct control or harvesting and milling capacities equal or exceed the amount of infestation. The intent of the strategy is to reduce or keep the outbreak to a size and distribution that can be handled within "normal resource capability".

H – Holding (50-79% target of current infestation): The intent of this strategy is to maintain an existing outbreak at a relatively static level. It is a delaying strategy until adequate resources are available or access created that allowed for a more aggressive approach, or to reduce overall loss while waiting for a killing climatic event. This is appropriate in areas with chronic beetle infestations that are too large to deal with using single tree treatments or where access is poorly developed for directed harvesting.

G – Salvage (0-49% target of current infestation): Applied to areas where management efforts would be ineffective in substantially reducing the beetle populations and subsequent levels of damage. Such areas have extensive outbreaks covering a large proportion of susceptible stands. The objective in this case is to salvage affected stands and minimize value loss. This strategy may also apply to areas containing small volumes of pine or areas where the pine is marginally economic - that is, where control is not worth the effort that would be expended and the objective is to salvage whatever values are there.

M - Monitor: This strategy is applied to areas where management efforts would be ineffective in substantially reducing the beetle population and subsequent levels of damage, or where there is no short term (less than 5 years) possibility of salvaging dead timber. This may be due to management constraints such as wilderness area, Park, or

ecological reserve, or because access cannot be put in place before substantial merchantable degradation of the dead material occurs.

Selection of a management option depends on both a technical and ecological evaluation and is also dependent on protected area size and relation of the infestation to neighboring forest lands. Treatment method is determined through joint decision-making with the Ministry of Forests that takes into consideration protected area values.

Table 7. Provincial control strategies and associated objectives for beetle population removal (2006).

Strategy	% of current infestation to treat[1]	Comments
Suppression/ Prevention	>80	Address all current attack within 2 years, stand proofing, other actions. The intent is to "control" the outbreak in that area and stop spread.
Holding	50-79	Address the largest proportion of the new infested material, at least close to the rate of expansion. The intent is to maintain beetle populations at a level that can be dealt with annually without huge expansion.
Salvage	<50	The priority is to salvage timber previously attacked to minimize value loss. Relevant in areas where suppression or holding actions are no longer appropriate or feasible.
Monitor/ Protected Areas	0	No action is required beyond monitoring and recording. This is most appropriate in Parks and Ecological Reserves and in inoperable areas where the outbreak has peaked, salvage is not possible, and there is no chance for any mitigation of further loss.

[1]Based on estimates from most current annual aerial overview. On a provincial scale annual aerial overview data is used as the basis for % current infestation to treat, however after discussion with Tim Ebata and Robert Hodgkinson it was decided to use detailed aerial survey data in Peace Forest District as this was the most accurate data available.

Control strategies are subject to review and modification based on changes in infestation levels, access, and other higher level plans. A yearly review will include an assessment of the success of the plan and how it may be improved in order to better meet the goals and objectives stipulated.

Selecting the appropriate strategy or combination of strategies, for a given area is based on a number of factors including the:

- ✓ beetle species,
- ✓ stand susceptibility,
- ✓ extent and distribution of the beetle infestations both current and historical,
- ✓ expected impact of the beetle within the particular area and surrounding areas,
- ✓ land use objectives and non-timber resource values within the area,
- ✓ stage of the beetle outbreak,

- ✓ strategies of adjacent beetle management units including Alberta, and
- ✓ accessibility.

Beetle Management Units (BMUs) cannot be considered in isolation, as each will have an effect on the beetle situation of its neighbor. Therefore, the strategy selected for a BMU must be compatible with those taken in adjacent units.

Table 8 outlines the parameters for allowable adjacent control strategies.

Table 8. Adjacent BMU Control Strategy Evaluation.

Assigned Strategy/ Adjacent Strategies	Suppression/ Prevention	Holding	Salvage	Monitor, Abandon, Park, N/A
Suppression	ǒ	ǒ		
Holding	ǒ	ǒ	ǒ	
Salvage		ǒ	ǒ	ǒ

Rationale for Ranking BMUs
The rationale for ranking BMUs for mountain pine beetle is outlined in this section. The outlined criteria are used to prioritize BMUs when funds are limited.

In order to prioritize the funds for single tree treatments the following rationale will be implemented:

First, explore all harvesting opportunities and net these areas out of the single tree treatment areas
Apply funds in the suppression BMUs only

Priority One – North Peace (*Fort St. John TSA 40; parks and protected areas)*
Leading edge attack and recent history as highest priority overall in the district
Overall east to west and north to south priority to correspond to areas adjacent to Alberta

- ✓ Kahntah
- ✓ Milligan
- ✓ Lower Beatton
- ✓ Tommy Lakes
- ✓ Blueberry
- ✓ Kobes and Dunlevey
- ✓ Crying Girl
- ✓ Halfway
- ✓ Trutch

- ✓ Sikanni
- ✓ Graham

Priority Two - South Peace *(Dawson Creek TSA 41; parks and protected areas, and TFL48)*

- ✓ Overall south to north and east to west priority
- ✓ This corresponds to adjacency to Alberta, boreal forest, and susceptible stands high priority
- ✓ It is unknown at this time what the strategy will be for Alberta in 2007-2008 as they are in the process of conducting population sampling and overwintering mortality assessments and will define their management priorities in September 2007.
- ✓ Target the leading edge of attack on the eastern border of the TSA
- ✓ Determination of average number of "reds" per site to get an idea of absolute magnitude of attack

- ✓ Kakwa
- ✓ Narraway
- ✓ Belcourt
- ✓ Lower Red Deer
- ✓ Redwillow
- ✓ Bearhole
- ✓ Wapiti
- ✓ Honeymoon Creek
- ✓ One Island
- ✓ Puggins
- ✓ Lone Prairie
- ✓ Dawson Creek
- ✓ Kiskatinaw
- ✓ East Pine
- ✓ Pine River
- ✓ Septimus
- ✓ Lower Moberly
- ✓ Boucher
- ✓ Hudson's Hope
- ✓ Gething
- ✓ Carbon
- ✓ Williston Lake

Discussion with stakeholders has been implemented and will continue as additional survey data becomes available to ensure that the priorities are consistent with currently collected data.

A visual representation of the mountain pine beetle strategy for 2007-2008 broken into suppression, holding and salvage is shown on Figure 8. Figure 9 outlines the treatment priorities as presented February 6, 2007 in Prince George to the SCOT group.

The difference between the two maps is that the treatment priorities map outlines goals based on funding levels and the mountain pine beetle strategies maps is to be used to determine as a base where the detailed aerial surveys should be conducted in 2007.

It should also be noted that twelve of the above listed Beetle Management Units (BMU) have been partitioned into multiple management objectives to align with the current mountain pine beetle levels. The portion of the BMU in suppression is what is being referred to in the ranking list. Details are located in Table 9.

In the coming year, harvesting should be focused in the areas of highest beetle concentrations and susceptible pine. If conditions are similar to 2006-2007 this will be focused in the "salvage" mountain pine beetle strategy areas within the Dawson Creek TSA 41 and TFL 48 and in suppression area the southern portion of the Fort St. John TSA 40.

It should be noted that despite the term "salvage" being used as a management objective this is not related to only salvage harvesting but instead related to the level of management realistically achieved for this area which would range from 0-49% of the current mountain pine beetle populations.

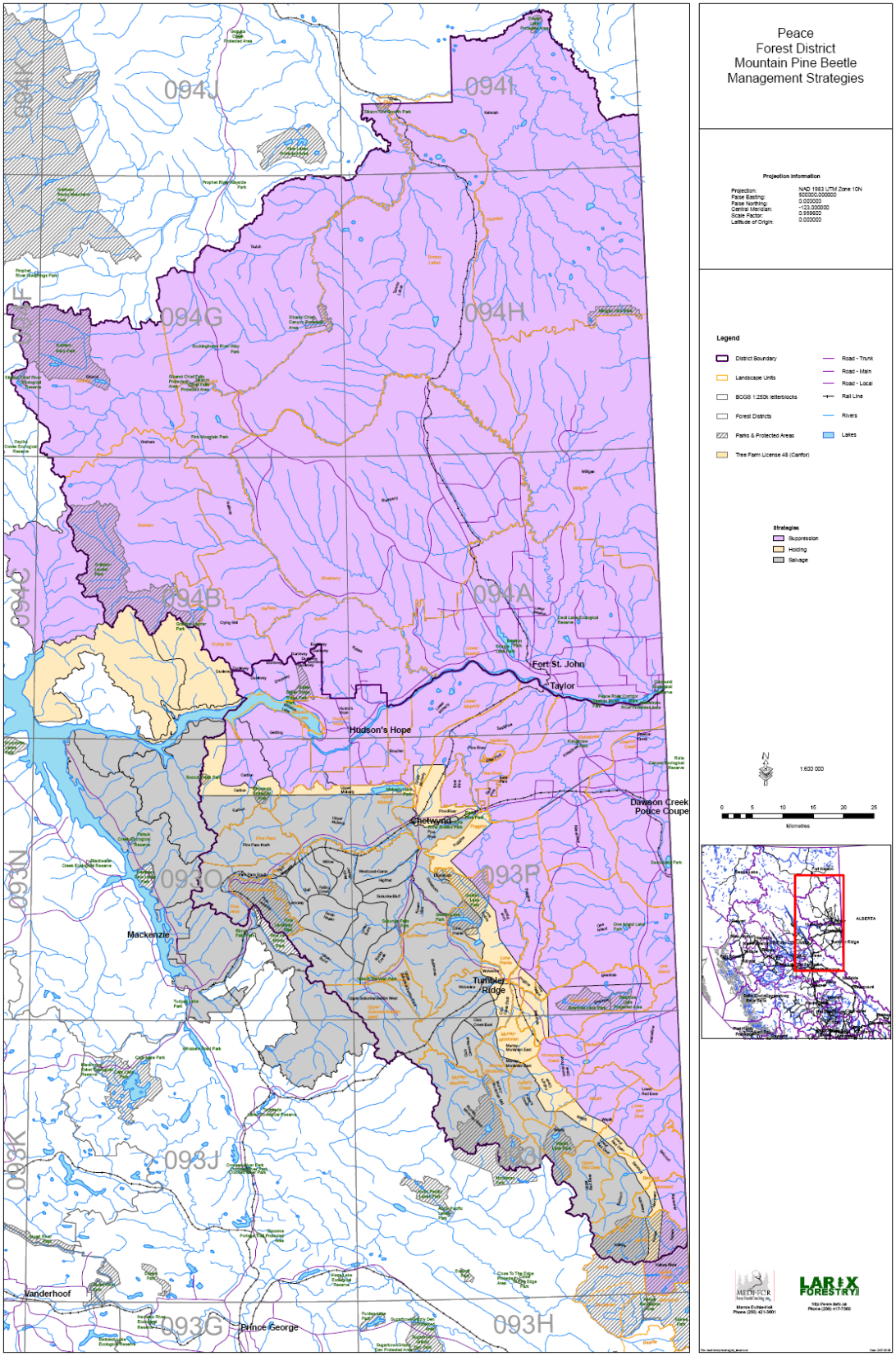


Figure 8. Mountain pine beetle strategy for the Peace Forest District, 2007.

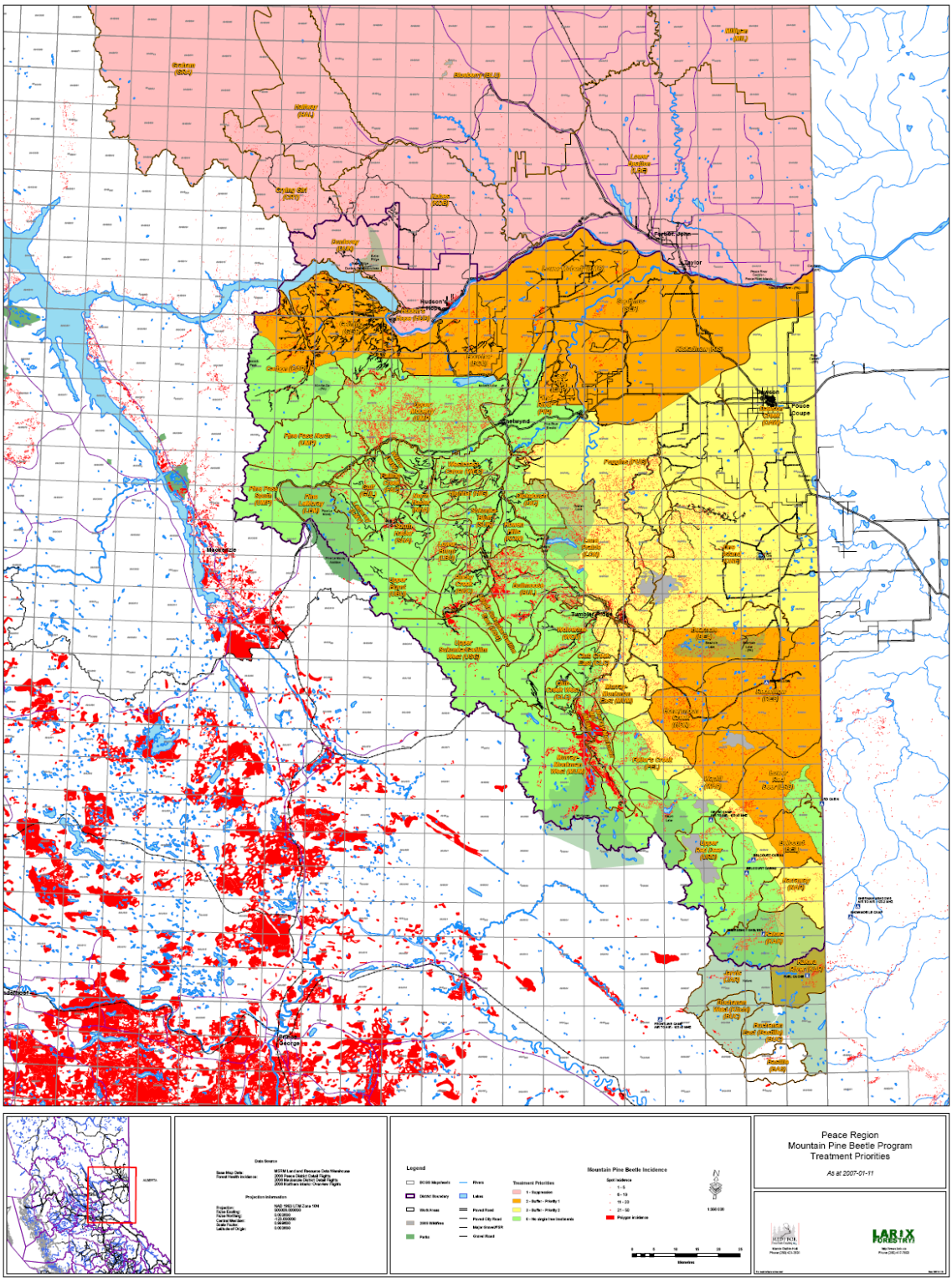


Figure 9. Treatment priority map for the Peace Forest District (2006-2007). As presented February 6, 2007 to the SCOT group in Prince George.

Constraints

Major constraints identified as possible impediments to forest health management in the Dawson Creek TSA are identified below. These constraints include impacts on other resources, administrative requirements and economic factors.

Access. Access is quite variable throughout the Peace Forest District, with extensive roads in some areas mainly related to oil and gas activity and no access in other areas (specifically in the southern portion of TSA41).

Parks, Protected areas, and Ecological Reserves. See Appendix 5 for additional details.

Wildlife (WHA). Caribou management area, along with concerns with moose, elk, mountain goats, big horn sheep, and grizzly bear. See Appendix 6 for additional details.

First Nation Issues. Peace Moberly Track.

Guide outfitters and trappers.

Adjacency issues with bordering forest districts including Mackenzie and Prince George. Both areas have known large mountain pine beetle populations. Adjacent areas in Alberta are also experiences high levels of attack in 2006.

OGMA. To date line work for OGMA are not available but they will be identified and included in future planning, as 15% of the OGMAs will have a fixed spatial component with the other 85% being aspatial.

Other land users including oil and gas, coal mines, and private land.

Visual Quality Objectives (VQOs). Visual quality objectives are associated with adjacency to parks, lakes, rivers, and highways.

Recreation including hiking, camping, boating, hunting, and snowmobile trails.

Private residences and land leases.

Domestic water sources.

Range.

Terrain stability. Unstable soils and mountainous terrain are present on the western edge of the TSA.

Strategies and Tactics

Strategies

Control strategies for mountain pine beetle were assigned to each of the BMUs (work area) within the Peace Forest District. It should be noted that numerous work areas were intersected to allow for a smooth line of where extensive current attack has been located.

Tactics

Tactics are equivalent to treatments and are applied to specific areas or infestations within a BMU. The appropriate combination of tactics must be selected for each strategy to accomplish the stated objectives. Relevant tactics for bark beetles are listed in Appendix 7 with associated time frames. Rarely will a single treatment be sufficient to deal with a particular infestation. Normally, a combination of treatments will be necessary. Further, most treatments will have to be repeated each year that the strategy remains in place. Unless the nature of the forest is changed, the susceptibility, and often the risk of subsequent infestation, will be similar from year to year.

A wide range of tactics can be employed to manage both mountain pine beetle including the following. It should be noted that this tactic listing is not intended to be exhaustive. New treatments are constantly being developed and applications refined. The Regional Entomologist will be able to provide local variations in application and advice on new developments.

- ✓ Susceptibility and risk rating of all susceptible stands.
- ✓ Annual aerial overview.
- ✓ Annual detailed aerial sketch mapping of all stands with high and moderate hazard, capturing infestation data into a GIS tracking system.
- ✓ Large scale, colour, air photography of high treatment priority areas.
- ✓ Intensive ground probing/truthing (recce) of all infested polygons to delineate the extent of infestation and green attack, and to identify single tree and harvest options.
- ✓ Use of all methods of single tree treatments including fall and burn (conventional, helicopter assist and mechanical), single tree selection, small patch harvesting (snip and skid), etc. within infested polygons.
- ✓ Aggressive directed harvesting of all infested polygons, including the use of selection cutting regimes in appropriate stands. This will protect remaining site cover from attack, while minimizing opening size and maximum removal of beetles infested timber.
- ✓ Semiochemical programs for both single tree and harvest treatment areas.
- ✓ Small patch logging within infested polygons combined with other tactics.
- ✓ Salvage and rehabilitate old infested stands, where feasible.

Other bark beetle procedures that will be adhered to and used when implementing any tactic, that deviate from guidebooks for both bark beetles outlined in Appendix 8 which states the standards for over wintering mortality survey protocols.

Evaluate results of forest health management practices over the short and long-term and modify practices accordingly

Control strategies for mountain pine beetle have been assigned on a BMU basis in the Dawson Creek TSA over the last two years and have been expanded to include the Ft. St. John TSA in 2006-2007. These control strategies must re-evaluated yearly to reflect the current beetle status and other planning considerations including access, and other resource issues.

Suppression Bark Beetle Populations list, map, and description of bark beetle management units and strategies

Beetle management unit summary

The following table outlines all of the BMUs in the Peace Forest District, along with their control strategies for mountain pine beetle, hectares of attack (detailed aerial surveys 2006), and hectares of susceptible host (hazard rating greater than 0). There are 34 suppression BMUs in the Peace Forest District for mountain pine beetle.

Table 9. BMU Summary showing TSA, BMU 3 letter code, mountain pine beetle control strategies, susceptible hectares, and number of infests, red trees, and hectares of attack for the Peace Forest District (2006).

TSA	BMU*	Code	Control Strategy	Susceptible ha	No. Infests	No. Trees	Area (ha)
DDC	Bearhole H	BEA	Holding	17,427.68	407	806	102.75
DDC	Bearhole S	BEA	Suppression	77,632.19	1,014	1,695	254.61
DDC	Belcourt G	BEL	Salvage	35,671.57	277	14,367	116.92
DDC	Belcourt H	BEL	Holding	7,149.37	57	103	14.25
DDC	Belcourt S	BEL	Suppression	28,463.97	157	382	40.50
DJO	Blueberry	BLU	Suppression	730,965.91	195	263	49.00
DDC	Boucher	BOU	Suppression	39,334.88	323	495	81.00
DDC	Bullmoose	BUL	Salvage	62,509.19	2,236	1,675,993	5,890.52
DDC	Carbon G	CAR	Salvage	28,923.83	115	392	29.25
DDC	Carbon H	CAR	Holding	31,197.70	184	410	47.25
DDC	Carbon S	CAR	Suppression	35,567.79	421	810	105.25
DDC	Club Creek East	CLCE	Salvage	20,477.62	363	806	92.25
DDC	Club Creek West	CLCW	Salvage	17,493.65	45	390	14.75
DJO	Crying Girl	CRY	Suppression	68,032.55	235	298	58.75
DDC	Dawson Creek	DAW	Suppression	157,194.37	61	79	15.25
DDC	Dickebush	DIC	Salvage	25,807.41	412	808	104.00
DDC	Dunlevey	DUN	Suppression	49,880.89	67	84	16.75
DDC	East Pine	EAP	Suppression	24,631.36	119	113	29.75
DDC	Falling Creek	FAC	Salvage	13,086.56	344	2,161	98.83
DDC	Feller's Creek	FEL	Salvage	43,620.72	1,100	1,942	279.50
DDC	Gething	GET	Suppression	62,023.55	541	2,606	168.59
DJO	Graham	GRA	Suppression	334,945.12	5	8	1.25
DDC	Gulf	GUL	Salvage	10,569.43	134	881	39.25
DJO	Halfway	HAL	Suppression	206,273.62	142	195	35.50
DDC	Hart Highway	HAH	Salvage	2,966.79	69	1,038	26.59
DDC	Highhat	HIG	Salvage	13,815.42	285	658	73.25
DDC	Honeymoon Creek	HON	Suppression	30,854.00	794	1,236	199.00

DDC	Hudon's Hope	HUD	Suppression	92,768.82	759	7,978	261.19
DJO	Kahntah	KAH	Suppression	749,011.39	0	0	0.00
DDC	Kakwa G	KAK	Salvage	27,674.23	392	1,116	100.25
DDC	Kakwa H	KAK	Holding	9,458.81	37	78	9.25
DDC	Kakwa S	KAR	Suppression	12,859.85	0	0	0.00
DJO	Kiskatinaw	KIS	Suppression	239,971.95	117	116	29.25
DDC	Kobes	KOB	Suppression	165,293.93	269	371	67.25
DDC	Kowen Hills	KOW	Salvage	15,452.22	384	727	96.00
DDC	Lemoray	LMY	Salvage	13,960.52	79	4,316	67.40
DDC	Lone Prairie G	LON	Salvage	15,774.96	481	742	121.00
DDC	Lone Prairie H	LON	Holding	36,193.88	1,101	1,762	276.75
DJO	Lone Prairie S	LON	Suppression	25,243.73	825	1,192	206.75
DDC	Lower Beatton	LBE	Suppression	503,920.05	11	20	2.75
DDC	Lower Burnt	LBU	Salvage	27,691.42	632	12,013	272.09
DDC	Lower Moberly H	LMO	Holding	5,713.30	120	119	30.00
DDC	Lower Moberly S	LMO	Suppression	92,590.41	205	113	51.25
DDC	Lower Red Deer G	LRD	Salvage	3,946.68	76	263	20.75
DDC	Lower Red Deer H	LRD	Holding	7,371.33	142	275	36.00
DJO	Lower Red Deer S	LRD	Suppression	54,735.21	559	1,180	141.50
DDC	Milligan	MIL	Suppression	473,875.54	0	0	0.00
DDC	Murray-Monkman East	MUME	Salvage	30,839.06	622	2,476	163.07
DDC	Murray-Monkman Mid	MUMM	Salvage	30,215.10	732	2,123,831	7,783.66
DDC	Murray-Monkman West	MUMW	Salvage	97,497.29	324	3,005,125	6,360.79
DDC	Narraway G	NAR	Salvage	6,327.14	85	182	21.25
DDC	Narraway H	NAR	Holding	4,843.54	81	183	20.25
DDC	Narraway S	NAR	Suppression	17,943.61	164	255	41.25
DDC	North Hasler	NHA	Salvage	21,274.88	519	1,234	133.25
DDC	One Island H	ONE	Holding	1,987.41	40	57	10.00
DDC	One Island S	ONE	Suppression	189,042.67	1,609	2,285	403.50
DDC	Pine LeMoray	LEM	Salvage	29,867.93	60	358,721	661.65
DDC	Pine Pass North	UMPN	Salvage	52,640.92	323	387,851	1,418.50
DDC	Pine Pass South	UMPS	Salvage	44,621.25	198	1,275,112	2,471.36
DDC	Pine River G	PIR	Salvage	23,027.77	410	406	103.00
DDC	Pine River H	PIR	Holding	26,848.72	132	142	33.00
DDC	Pine River S	PIR	Suppression	41,253.11	188	5,486	75.73
DDC	Puggins H	PUG	Holding	28,972.25	460	706	115.50
DDC	Puggins S	PUG	Suppression	112,610.14	2,199	2,664	552.25
DDC	Redwillow	RED	Suppression	104,989.17	819	1,653	208.20
DDC	Rocky Creek	ROC	Salvage	20,352.36	469	133,712	648.97
DJO	Septimus	SEP	Suppression	67,324.94	277	103	69.25
DDC	Sikanni	SIK	Suppression	312,049.25	0	0	0.00
DDC	South Hasler	SHA	Salvage	27,364.72	327	12,054	229.35
DJO	Sukunka-Bluff	SUK	Salvage	21,110.95	551	3,097	166.62
DJO	Tommy Lakes	TOM	Suppression	705,233.56	0	0	0.00
DDC	Trutch	TRU	Suppression	436,391.55	0	0	0.00
DDC	Upper Burnt	UBU	Salvage	38,736.74	43	36,746	412.86
DDC	Upper Moberly	UMPU	Salvage	116,959.32	5,833	486,590	3,345.31
DDC	Upper Red Deer	URD	Salvage	39,648.21	154	715	42.25

DDC	Upper Sukunka/Gwillim East	USGE	Salvage	21,385.96	574	365,624	1,172.97
DDC	Upper Sukunka/Gwillim West	USGW	Salvage	65,252.44	95	260,805	767.59
DDC	Wapiti G	WAP	Salvage	35,155.65	558	1,072	141.50
DDC	Wapiti H	WAP	Holding	9,801.47	85	131	21.25
DDC	Wapiti S	WAP	Suppression	35,048.65	277	451	70.25
DDC	Westcoast-Caron	WEC	Salvage	26,361.85	441	819	111.25
DDC	Williston Lake	WIL	Suppression	18,027.32	0	0	0.00
DDC	Willow	WIW	Salvage	8,617.36	146	322	36.75
DDC	Wolverine	WOV	Salvage	56,191.38	856	4,700	243.42
Totals				*7,675,841*	*35,943*	*10,216,710*	*37,830*

*Some BMUs were split into multiple management objectives.

Performance Measures

As specified earlier in this report the Ministry of Forests has defined three main performance measures to evaluate the effectiveness of bark beetle management. These performance measures include the following to monitor the implementation of bark beetle management within an identified management unit.

SURVEY & DETECTION: Area (ha) and % of susceptible forested land base that has been surveyed and where existing infested areas have been identified, evaluated, and assigned a management strategy.

The following table outlines the amount of hectares total, susceptible to mountain pine beetle and flown by detailed aerial surveys in 2006 in the Peace Forest District. It should be noted that the hectares flown and mapped for the detailed aerial surveys exceeds the susceptible hectares even though the entire Fort St. John TSA was not mapped because the surveys also crossed over non-susceptible areas.

Table 10. Survey and Detection Performance Measure (Peace Forest District 2006).

Total Hectares	*Susceptible hectares*	*Detailed aerial survey hectares mapped*
7,675,844.46	2,200,255.25	3,099,396.99

TREATMENT: % of currently infested trees removed, treated, or otherwise abated, annually prior to the beetle flight period (does NOT include areas baited where no other action was carried out) and PLAN ACHIEVEMENT: % of each strategy that has been achieved.

The following table outlines the second and third performance measure of treatment and plan achievement reporting the amount of recorded “reds” from detailed aerial surveys, green:red ratios, number of trees treated by treatment type and plan achievement by BMU for 2004, 2005 and 2006 in the Peace Forest District.

Table 11. Treatment and Plan Achievement Performance Measures for the Peace Forest District for 2004-2005.

						Treated trees						Achievement
District	**Responsibility**	**BMU**	**Reds**	**G:R ratio**	**Greens**	**Harvesting (Reds)**	**Fall and Burn**	**Heli-assist**	**Mechanical**	**Other**	**Total**	
DDC	TFL48	Boucher	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TFL48	Carbon	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TFL48	Club Creek East	274	1.00	274	-	-	-	-	-	-	0.0%
DDC	TFL48	Club Creek West	1,668	1.00	1,668	3	55	-	-	-	58	3.5%
DDC	TFL48	Dickebush	270	1.00	270	-	-	-	-	-	-	0.0%
DDC	TFL48	Dunlevey	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TFL48	East Pine	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TFL48	Falling Creek	901	1.00	901	-	-	-	-	-	-	0.0%
DDC	TFL48	Gething	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TFL48	Gulf	279	1.00	279	-	-	-	-	-	-	0.0%
DDC	TFL48	Hart Highway	127	1.00	127	-	-	-	-	-	-	0.0%
DDC	TFL48	Highhat	733	1.00	733	-	-	-	-	-	-	0.0%
DDC	TFL48	Kowen Hills	432	1.00	432	-	-	-	-	-	-	0.0%
DDC	TFL48	Lemoray	373	1.00	373	-	-	-	-	-	-	0.0%
DDC	TFL48	Lower Burnt	9,298	1.00	9,298	6	-	-	-	-	6	0.1%
DDC	TFL48	North Hasler	992	1.00	992	-	-	-	-	-	-	0.0%
DDC	TFL48	Rocky Creek	5,351	1.00	5,351	35	1,289	-	-	-	1,324	24.7%
DDC	TFL48	South Hasler	1,029	1.00	1,029	208	-	-	-	-	208	20.2%
DDC	TFL48	Sukunka-Bluff	2,288	1.00	2,288	-	-	-	-	-	-	0.0%
DDC	TFL48	Upper Burnt	2,148	1.00	2,148	36	-	-	-	-	36	1.7%
DDC	TFL48	Westcoast-Caron	587	1.00	587	-	-	-	-	-	-	0.0%
DDC	TFL48	Willow	427	1.00	427	17	-	-	-	-	17	4.0%
DDC	TFL48	Wolverine	1,138	1.00	1,138	18	153	-	-	-	171	15.0%

		DDC TFL48 Total	*28,315*	*1.00*	*28,315*	*323*	*1,497*	*-*	*-*	*-*	*1,820*	*6.4%*
DDC	TSA	Bearhole	2	1.00	2	-	-	-	-	-	-	0.0%
DDC	TSA	Belcourt	462	1.00	462	-	704	-	-	-	704	152.4%
DDC	TSA	Bullmoose	781	1.00	781	47	328	-	-	-	375	48.0%
DDC	TSA	Dawson Creek	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	East Pine	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	Feller's Creek	-	1.00	-	-	35	-	-	-	35	0.0%
DDC	TSA	Honeymoon Creek	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	Hudon's Hope	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	Kakwa	24	1.00	24	-	-	-	-	-	-	0.0%
DDC	TSA	Kiskatinaw	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	Lone Prairie	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	Lower Moberly	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	Lower Red Deer	84	1.00	84	-	29	-	-	-	29	34.5%
DDC	TSA	Murray-Monkman East	222	1.00	222	28	6	-	-	-	34	15.3%
DDC	TSA	Murray-Monkman Mid	5,804	1.00	5,804	456	1,719	-	-	-	2,175	37.5%
DDC	TSA	Murray-Monkman West	8,687	1.00	8,687	16	5,154	-	-	-	5,170	59.5%
DDC	TSA	Narraway	16	1.00	16	-	-	-	-	-	-	0.0%
DDC	TSA	One Island	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	Pine LeMoray	10	1.00	10	-	-	-	-	-	-	0.0%
DDC	TSA	Pine Pass North	243	1.00	243	-	-	-	-	-	-	0.0%
DDC	TSA	Pine Pass South	482	1.00	482	-	-	-	-	-	-	0.0%
DDC	TSA	Pine River	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	Puggins	2	1.00	2	-	-	-	-	-	-	0.0%
DDC	TSA	Redwillow	-	1.00	-	-	-	-	-	-	-	0.0%

DDC	TSA	Septimus	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	Upper Moberly	410	1.00	410	37	-	-	-	-	37	9.0%
DDC	TSA	Upper Red Deer	1,108	1.00	1,108	-	1,022	-	-	-	1,022	92.2%
DDC	TSA	Upper Sukunka/Gwillim East	1,443	1.00	1,443	-	29	-	-	-	29	2.0%
DDC	TSA	Upper Sukunka/Gwillim West	577	1.00	577	-	-	-	-	-	-	0.0%
DDC	TSA	Wapiti	226	1.00	226	-	-	-	-	-	-	0.0%
		DDC TSA Total	*20,583*	*1.00*	*20,583*	*584*	*9,026*	-	-	-	*9,610*	*46.7%*
DJO	TSA	Blueberry	-	1.00	-	-	-	-	-	-	-	0.0%
DJO	TSA	Crying Girl	-	1.00	-	-	-	-	-	-	-	0.0%
DJO	TSA	Graham	-	1.00	-	-	-	-	-	-	-	0.0%
DJO	TSA	Halfway	-	1.00	-	-	-	-	-	-	-	0.0%
DJO	TSA	Kobes	-	1.00	-	-	-	-	-	-	-	0.0%
DJO	TSA	Lower Beatton	-	1.00	-	-	-	-	-	-	-	0.0%
		DJO TSA Total	-	*1.00*	-	-	-	-	-	-	-	0.0%
DPG	TSA	Bastille	-	1.00	-	-	-	-	-	-	-	0.0%
DPG	TSA	Buchanan East (Bastille)	-	1.00	-	-	-	-	-	-	-	0.0%
DPG	TSA	Buchanan West (Kitchi)	-	1.00	-	-	-	-	-	-	-	0.0%
DPG	TSA	Jarvis	-	1.00	-	-	-	-	-	-	-	0.0%
DPG	TSA	Kakwa River	-	1.00	-	-	-	-	-	-	-	0.0%
		DPG TSA Total	-	*1.00*	-	-	-	-	-	-	-	*0.0%*
		Grand Total	***48,898***	***1.00***	***48,898***	***907***	***10,523***	***-***	***-***	***-***	***11,430***	***23.4%***

Table 12. Treatment and Plan Achievement Performance Measures for the Peace Forest District for 2005-2006.

						Treated trees						Achievement
District	**Responsibility**	**BMU**	**Reds**	**G:R ratio**	**Greens**	**Harvesting**	**Fall and Burn**	**Heli-assist**	**Mechanical**	**Other**	**Total**	
DDC	TFL48	Boucher	53	1.00	53	-	-	-	-	-	-	0.0%
DDC	TFL48	Carbon	1,279	1.00	1,279	14	299	-	-	-	313	24.5%
DDC	TFL48	Club Creek East	712	1.00	712	-	917	-	-	-	917	128.8%
DDC	TFL48	Club Creek West	4,159	1.00	4,159	-	2,132	6	-	3	2,141	51.5%
DDC	TFL48	Dickebush	32,833	1.00	32,833	-	-	-	-	-	-	0.0%
DDC	TFL48	Dunlevey	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TFL48	East Pine	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TFL48	Falling Creek	3,014	1.00	3,014	-	-	-	-	-	-	0.0%
DDC	TFL48	Gething	98	1.00	98	-	-	-	-	-	-	0.0%
DDC	TFL48	Gulf	1,652	1.00	1,652	-	-	-	-	-	-	0.0%
DDC	TFL48	Hart Highway	441	1.00	441	-	-	-	-	-	-	0.0%
DDC	TFL48	Highhat	145	1.00	145	-	-	-	-	-	-	0.0%
DDC	TFL48	Kowen Hills	121	1.00	121	-	-	-	-	-	-	0.0%
DDC	TFL48	Lemoray	1,788	1.00	1,788	-	-	-	-	-	-	0.0%
DDC	TFL48	Lower Burnt	8,019	1.00	8,019	549	2,315	-	-	-	2,864	35.7%
DDC	TFL48	North Hasler	1,518	1.00	1,518	30	92	-	-	5	127	8.4%
DDC	TFL48	Rocky Creek	6,932	1.00	6,932	-	5,477	-	-	2	5,479	79.0%
DDC	TFL48	South Hasler	3,251	1.00	3,251	350	-	-	-	-	350	10.8%
DDC	TFL48	Sukunka-Bluff	898	1.00	898	-	843	-	-	-	843	93.9%
DDC	TFL48	Upper Burnt	3,339	1.00	3,339	265	-	-	-	-	265	7.9%
DDC	TFL48	Westcoast-Caron	240	1.00	240	-	-	-	-	-	-	0.0%
DDC	TFL48	Willow	474	1.00	474	-	-	-	-	-	-	0.0%

DDC	TFL48	Wolverine	8,577	1.00	8,577	-	7,609	-	-	-	7,609	88.7%
		DDC TFL48 Total	*79,543*	*1.00*	*79,543*	*1,208*	*19,684*	*6*	*-*	*10*	*20,908*	*26.3%*
DDC	TSA	Bearhole	87	1.05	91	-	-	-	-	-	-	0.0%
DDC	TSA	Belcourt	910	1.12	1,019	-	1,031	-	-	-	1,031	101.2%
DDC	TSA	Bullmoose	3,938	1.00	3,938	-	-	2,515	-	-	2,515	63.9%
DDC	TSA	Dawson Creek	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	East Pine	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	Feller's Creek	699	1.00	699	-	12	885	-	4	901	128.9%
DDC	TSA	Honeymoon Creek	747	1.00	747	15	160	-	-	-	175	23.4%
DDC	TSA	Hudon's Hope	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	Kakwa	1,275	1.00	1,275	-	2,874	-	-	2	2,876	225.6%
DDC	TSA	Kiskatinaw	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	Lone Prairie	92,261	1.00	92,261	-	-	-	-	-	-	0.0%
DDC	TSA	Lower Moberly	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	Lower Red Deer	1,014	1.00	1,014	-	-	889	-	2	891	87.9%
DDC	TSA	Murray-Monkman East	73	1.00	73	7	-	-	-	-	7	9.6%
DDC	TSA	Murray-Monkman Mid	6,418	1.00	6,418	152	1,928	961	-	-	3,041	47.4%
DDC	TSA	Murray-Monkman West	54,870	1.00	54,870	-	1,735	21,075	-	-	22,810	41.6%
DDC	TSA	Narraway	185	1.19	220	-	218	-	-	-	218	99.0%
DDC	TSA	One Island	291	1.00	291	-	-	-	-	-	-	0.0%
DDC	TSA	Pine LeMoray	986	1.00	986	-	-	-	-	-	-	0.0%
DDC	TSA	Pine Pass North	637	1.50	956	-	-	-	-	-	-	0.0%
DDC	TSA	Pine Pass South	2,602	1.50	3,903	-	-	-	-	-	-	0.0%
DDC	TSA	Pine River	10	1.00	10	-	-	-	-	-	-	0.0%

DDC	TSA	Puggins	11,211	0.80	8,969	-	5	-	-	-	5	0.1%
DDC	TSA	Redwillow	34	1.00	34	-	2	-	-	-	2	5.9%
DDC	TSA	Septimus	-	1.00	-	-	-	-	-	-	-	0.0%
DDC	TSA	Upper Moberly	1,384	1.50	2,076	-	-	-	-	-	-	0.0%
DDC	TSA	Upper Red Deer	2,632	1.00	2,632	-	-	4,586	-	3	4,589	174.4%
DDC	TSA	Upper Sukunka/Gwillim East	2,040	1.43	2,917	-	12	-	-	-	12	0.4%
DDC	TSA	Upper Sukunka/GwillimWest	2,268	1.43	3,243	-	-	-	-	-	-	0.0%
DDC	TSA	Wapiti	995	0.85	846	-	-	1,104	-	1	1,105	130.7%
		DDC TSA Total	*187,567*	*1.08*	*189,488*	*174*	*7,977*	*32,015*	*-*	*12*	*40,178*	*21.2%*
DJO	TSA	Blueberry	-	1.00	-	-	-	-	-	-	-	0.0%
DJO	TSA	Crying Girl	-	1.00	-	-	-	-	-	-	-	0.0%
DJO	TSA	Graham	-	1.00	-	-	-	-	-	-	-	0.0%
DJO	TSA	Halfway	-	1.00	-	-	-	-	-	-	-	0.0%
DJO	TSA	Kobes	-	1.00	-	-	-	-	-	-	-	0.0%
DJO	TSA	Lower Beatton	-	1.00	-	-	-	-	-	-	-	0.0%
		DJO TSA Total	-	*1.00*	-	-		-	-	-	-	*0.0%*
DPG	TSA	Bastille	198	1.00	198	-	-	-	-	-	-	0.0%
DPG	TSA	Buchanan East (Bastille)	292	1.00	292	-	-	-	-	-	-	0.0%
DPG	TSA	Buchanan West (Kitchi)	444	1.00	444	-	-	-	-	-	-	0.0%
DPG	TSA	Jarvis	628	1.00	628	-	678	-	-	-	678	108.0%
DPG	TSA	Kakwa River	621	1.00	621	-	975	-	-	-	975	157.0%
		DPG TSA Total	*2,183*	*1.00*	*2,183*	-	*1,653*	-	-	-	*1,653*	*75.7%*
		Grand Total	***269,293***	***1.04***	***271,214***	***1,382***	***29,314***	***32,021***	***-***	***22***	***62,739***	***23.1%***

Table 13. Treatment and Plan Achievement Performance Measures for the Peace Forest District for 2006-2007.

						Treated trees						Achievement
District	**Responsibility**	**BMU**	**Reds**	**G:R ratio**	**Greens**	**Harvesting**	**Fall and Burn**	**Heli-assist**	**Mechanical**	**Other**	**Total**	
2006/2007												
DDC	TFL48	Boucher	495	18.00	8,910	-	-	-	-	-	-	0.0%
DDC	TFL48	Carbon	1,612	1.00	1,612	-	-	-	-	-	-	0.0%
DDC	TFL48	Club Creek East	806	1.00	806	-	-	-	-	-	-	0.0%
DDC	TFL48	Club Creek West	390	1.00	390	2	-	-	-	-	2	0.5%
DDC	TFL48	Dickebush	808	1.00	808	-	-	-	-	-	-	0.0%
DDC	TFL48	Dunlevey	84	1.00	84	-	224	-	-	-	224	266.7%
DDC	TFL48	East Pine	105	1.00	105	-	233	-	-	-	233	221.9%
DDC	TFL48	Falling Creek	2,161	1.00	2,161	-	-	-	-	-	-	0.0%
DDC	TFL48	Gething	2,606	0.20	521	-	-	-	-	15	15	2.9%
DDC	TFL48	Gulf	881	1.00	881	-	-	-	-	-	-	0.0%
DDC	TFL48	Hart Highway	1,038	1.00	1,038	-	-	-	-	-	-	0.0%
DDC	TFL48	Highhat	658	1.00	658	-	-	-	-	-	-	0.0%
DDC	TFL48	Kowen Hills	727	1.00	727	-	-	-	-	-	-	0.0%
DDC	TFL48	Lemoray	4,316	1.00	4,316	-	-	-	-	-	-	0.0%
DDC	TFL48	Lower Burnt	12,013	1.00	12,013	-	-	-	-	-	-	0.0%
DDC	TFL48	North Hasler	1,234	1.00	1,234	-	-	-	-	-	-	0.0%
DDC	TFL48	Rocky Creek	133,712	1.00	133,712	-	-	-	-	-	-	0.0%
DDC	TFL48	South Hasler	12,054	1.00	12,054	-	-	-	-	-	-	0.0%

DDC	TFL48	Sukunka-Bluff	3,097	1.00	3,097	-	-	-	-	-	-	0.0%
DDC	TFL48	Upper Burnt	36,746	1.00	36,746	-	-	-	-	-	-	0.0%
DDC	TFL48	Westcoast-Caron	819	1.00	819	-	-	-	-	-	-	0.0%
DDC	TFL48	Willow	322	1.00	322	-	-	-	-	-	-	0.0%
DDC	TFL48	Wolverine	4,700	1.00	4,700	-	-	-	-	-	-	0.0%
		DDC TFL48 Total	*221,384*	*1.70*	*227,714*	*2*	*457*	-	-	*15*	*474*	*0.2%*
DDC	TSA	Bearhole	2,501	8.90	22,259	203	172	9,484	-	-	11,463	51.5%
DDC	TSA	Belcourt	14,852	1.00	14,852	-	-	-	-	-	-	0.0%
DDC	TSA	Bullmoose	1,664,243	1.00	1,664,243	-	-	-	-	-	-	0.0%
DDC	TSA	Dawson Creek	79	1.00	79	-	-	-	-	-	-	0.0%
DDC	TSA	East Pine	8	1.00	8	-	1,332	-	-	-	1,332	16,650.0%
DDC	TSA	Feller's Creek	1,942	1.00	1,942	-	-	155	-	-	155	8.0%
DDC	TSA	Honeymoon Creek	1,236	10.50	12,978	3	442	17,731	-	-	18,205	140.3%
DDC	TSA	Hudon's Hope	2,868	101.00	289,668	-	6,095	-	-	1	6,096	2.1%
DDC	TSA	Kakwa	1,194	31.00	37,014	-	-	-	-	-	-	0.0%
DDC	TSA	Kiskatinaw	116	1.00	116	-	-	-	-	-	-	0.0%
DDC	TSA	Lone Prairie	3,696	1.00	3,696	-	-	-	-	-	-	0.0%
DDC	TSA	Lower Moberly	232	1.00	232	-	18,762	-	-	-	18,762	8,087.1%
DDC	TSA	Lower Red Deer	1,718	12.60	21,647	4	-	5,188	-	-	5,238	24.2%
DDC	TSA	Murray-Monkman East	2,476	1.00	2,476	-	-	-	-	-	-	0.0%
DDC	TSA	Murray-Monkman Mid	2,123,831	1.00	2,123,831	8,768	-	-	-	-	8,768	0.4%

DDC	TSA	Murray-Monkman West	3,005,125	1.00	3,005,125	-	-	-	-	-	-	0.0%
DDC	TSA	Narraway	620	1.00	620	-	-	-	-	-	-	0.0%
DDC	TSA	One Island	2,342	1.00	2,342	-	-	-	-	-	-	0.0%
DDC	TSA	Pine LeMoray	298,360	1.00	298,360	-	-	-	-	-	-	0.0%
DDC	TSA	Pine Pass North	580,753	1.00	580,753	-	-	-	-	-	-	0.0%
DDC	TSA	Pine Pass South	1,079,964	1.00	1,079,964	-	-	-	-	-	-	0.0%
DDC	TSA	Pine River	6,034	144.00	868,896	-	10,583	-	-	-	10,583	1.2%
DDC	TSA	Puggins	3,370	2.90	9,773	-	-	-	-	-	-	0.0%
DDC	TSA	Redwillow	1,653	17.10	28,266	18	-	12,569	-	-	12,877	45.6%
DDC	TSA	Septimus	103	1.00	103	-	19,711	9,437	-	-	29,148	28,299.0%
DDC	TSA	Upper Moberly	555,843	1.00	555,843	-	-	-	-	-	-	0.0%
DDC	TSA	Upper Red Deer	715	1.00	715	-	-	-	-	-	-	0.0%
DDC	TSA	Upper Sukunka/Gwillim East	365,624	1.00	365,624	-	-	-	-	-	-	0.0%
DDC	TSA	Upper Sukunka/Gwillim West	260,805	1.00	260,805	-	-	-	-	-	-	0.0%
DDC	TSA	Wapiti	1,654	36.90	61,033	-	-	3,427	-	-	3,427	5.6%
		DDC TSA Total	*9,983,957*	*12.86*	*11,313,263*	*8,996*	*57,097*	*57,991*	-	*1*	*126,053*	*1.1%*
DJO	TSA	Blueberry	263	40.70	10,704	-	1,360	-	-	-	1,360	12.7%
DJO	TSA	Crying Girl	298	1.00	298	-	405	-	-	-	405	135.9%
DJO	TSA	Graham	8	1.00	8	-	-	-	-	-	-	0.0%
DJO	TSA	Halfway	195	1.00	195	-	135	-	-	-	135	69.2%

DJO	TSA	Kobes	371	5.30	1,966	-	1,688	-	-	-	1,688	85.8%
DJO	TSA	Lower Beatton	20	56.50	1,130	-	178	-	-	-	178	15.8%
		DJO TSA Total	*1,155*	*17.58*	*14,301*	-	*3,766*	-	-	-	*3,766*	*26.3%*
DPG	TSA	Bastille	24,628	1.00	24,628	-	-	-	-	-	-	0.0%
DPG	TSA	Buchanan East (Bastille)	785	1.00	785	-	-	-	-	-	-	0.0%
DPG	TSA	Buchanan West (Kitchi)	31,330	1.00	31,330	-	-	-	-	-	-	0.0%
DPG	TSA	Jarvis	73,958	1.00	73,958	-	-	-	-	-	-	0.0%
DPG	TSA	Kakwa River	1,203	1.00	1,203	-	134	2,847	-	53	3,034	252.2%
		DPG TSA Total	*131,904*	*1.00*	*131,904*	-	*134*	*2,847*	-	*53*	*3,034*	*2.3%*
		Grand Total	***10,338,400***	***8.37***	***11,687,182***	***8,998***	***61,454***	***60,838***	***-***	***69***	***133,327***	***1.1%***

List of maps
The following maps were produced as part of this forest health strategy.

Overall Planning Maps

- ✓ Aerial overview map outlining all forest health factors recorded from 2006 surveys. (ddc_overview_500k.pdf).

- ✓ Detailed aerial survey map outlining mountain pine beetle incidence for the Peace Forest District (2006). (ddc_overview.pdf)

- ✓ Color themed mountain pine control strategies by BMU, which is also represented in Figure 8 of this report (ibm_management_strategies.pdf)

Numerous additional ***operational maps*** are posted on BeetleTracks (www.BeetleTracks.ca) under the map page including 1:20,000 scale maps showing detailed aerial incidence from 2006, major roads and water, working areas, etc.

TACTICAL PLAN: BUDGET AND ACTIVITIES WITHIN THE SUPPRESSION BMUS
Budget
Four worksheets outline the budget predicted required in 2007-2008 which are located in DCTSA MoF Budget Submission_BMUs_2006.xls and in the following four tables.

Activities
There is a wide range of activities or tactics, which can be implemented in each BMU. All tactics listed in section 4 of this report should be considered in all suppression BMUs. Sanitation and/ or salvage harvesting would be most appropriate in Holding or Salvage BMUs.

Table 14. Tactical Plan. Summary Table.

Budget proposal summary for Peace Forest District bark beetle management, 2006-2007.

District	BMU Name[1]	Strategy IBM	Detailed air[2]	Infested ground survey $[3]	Single tree $[4]	Baits[5]	Parks$ and Other[6]	Total $
DDC	Bearhole	S	$19,408.05	$811,200.00	$2,281,681.88	$0.00	$0.00	$3,112,289.92
DDC	Belcourt	S	$7,115.99	$133,450.00	$59,878.50	$0.00	$0.00	$200,444.49
DJO	Blueberry	S	$58,353.51	$176,475.00	$2,140,820.00	$0.00	$0.00	$2,375,648.51
DDC	Boucher	S	$4,408.85	$0.00	$0.00	$0.00	$0.00	$4,408.85
DDC	Carbon	S	$8,891.95	$0.00	$0.00	$0.00	$0.00	$8,891.95
DJO	Crying Girl	S	$10,705.19	$179,046.50	$59,600.00	$0.00	$0.00	$249,351.69
DDC	Dawson Creek	S	$3,249.82	$51,850.00	$7,900.00	$0.00	$0.00	$62,999.82
DJO	Dunlevey	S	$5,392.60	$61,841.00	$24,181.92	$0.00	$0.00	$91,415.52
DDC	East Pine	S	$743.39	$0.00	$0.00	$0.00	$0.00	$743.39
DJO	Graham	S	$22,760.37	$4,186.85	$2,327.92	$0.00	$0.00	$29,275.14
DDC	Gething	S	$10,115.85	$0.00	$0.00	$0.00	$0.00	$10,115.85
DJO	Halfway	S	$25,043.46	$108,189.80	$62,010.00	$0.00	$0.00	$195,243.26
DDC	Honeymoon Creek	S	$4,869.55	$635,200.00	$1,627,441.20	$0.00	$0.00	$2,267,510.75
DDC	Hudson's Hope	S	$4,252.55	$0.00	$0.00	$0.00	$0.00	$4,252.55
DJO	Kahntah	S	$11,857.00	$0.00	$0.00	$0.00	$0.00	$11,857.00
DDC	Kakwa	S	$2,168.44	$0.00	$0.00	$0.00	$0.00	$2,168.44
DDC	Kiskatinaw	S	$4,212.18	$93,600.00	$13,920.00	$0.00	$0.00	$111,732.18
DJO	Kobes	S	$10,947.97	$225,252.53	$625,381.72	$0.00	$0.00	$861,582.21
DDC	Lone Prairie	S	$6,310.93	$701,250.00	$154,960.00	$0.00	$0.00	$862,520.93
DJO	Lower Beatton	S	$7,543.79	$9,955.00	$129,385.00	$0.00	$0.00	$146,883.79
DDC	Lower Moberly	S	$23,147.60	$181,488.55	$11,300.00	$0.00	$0.00	$215,936.15
DDC	Lower Red Deer	S	$13,683.80	$503,100.00	$2,207,898.00	$0.00	$0.00	$2,724,681.80
DJO	Milligan	S	$24,241.72	$0.00	$0.00	$0.00	$0.00	$24,241.72
DDC	Narraway	S	$4,485.90	$139,400.00	$40,392.00	$0.00	$0.00	$184,277.90
DDC	One Island	S	$47,260.67	$1,367,650.00	$297,050.00	$0.00	$0.00	$1,711,960.67
DDC	Pine River	S	$10,313.28	$0.00	$0.00	$0.00	$0.00	$10,313.28
DDC	Puggins	S	$28,152.54	$1,759,200.00	$1,004,328.00	$0.00	$0.00	$2,791,680.54
DDC	Redwillow	S	$16,752.92	$655,200.00	$4,974,868.80	$0.00	$0.00	$5,646,821.72
DDC	Septimus	S	$1,144.35	$197,224.00	$10,300.00	$0.00	$0.00	$208,668.35
DJO	Sikanni	S	$11,405.23	$0.00	$0.00	$0.00	$0.00	$11,405.23
DJO	Tommy Lakes	S	$66,988.47	$0.00	$0.00	$0.00	$0.00	$66,988.47
DJO	Trutch	S	$45,119.61	$0.00	$0.00	$0.00	$0.00	$45,119.61
DDC	Wapiti	S	$8,762.16	$235,450.00	$2,324,873.43	$0.00	$0.00	$2,569,085.59
	Totals		**$ 529,810**	**$ 8,230,209**	**$ 18,060,498**	**$ -**	**$ -**	**$ 26,820,517**

NOTES
1. BMUs correspond to work areas.
2. Detailed air survey estimated at $0.25 per ha.
3. Ground surveys used number of sites instead of hectares of survey.
4. Fall and burn costs estimate: see estimate cost/ tree on MOF Activity&Funding worksheet.
5. Other: Lump sum for district given for other costs including overwintering mortality assessment and risk rating etc.

Budget proposal sumry table

Table 15. Tactical Plan. Spreadsheet 1. BMU Activity and Funding.

Spreadsheet 1. 2006/07 Submission - BMU Activity and Funding --- FINAL

								Surveys					Treatments									
								Detailed Air[7]		Ground			Fall & Burn		MSMA		Other		Baits[10]			
Region[1]	District	BMU Name	Priority[2]	Ranking[3]	Bark Btl Sp.[4]	Park?[5]	Strategy[6]	ha	$	sites[8]	$/site	$	trees	$/tree[9]	$	trees	$	ha	$	#	$	Total BMU Cost ($)
RNI	DDC	Bearhole	2	17	IBM	1	Suppression	77,632.19	$19,408.05	1,014	$800.00	$811,200.00	15,086	$151.25	$2,281,681.88							$3,112,290
RNI	DDC	Belcourt	2	14	IBM	0	Suppression	28,463.97	$7,115.99	157	$850.00	$133,450.00	382	$156.75	$59,878.50							$200,444
RNI	DJO	Blueberry	1	5	IBM	0	Suppression	233,414.04	$58,353.51	195	$905.00	$176,475.00	10,704	$200.00	$2,140,820.00							$2,375,649
RNI	DDC	Boucher	2	29	IBM	0	Suppression	17,635.41	$4,408.85	323	$0.00	$0.00	8,910	*$0.00*	$0.00							$4,409
RNI	DDC	Carbon	2	32	IBM	0	Suppression	35,567.79	$8,891.95	412	$0.00	$0.00	810	*$0.00*	$0.00							$8,892
RNI	DJO	Crying Girl	1	7	IBM	0	Suppression	42,820.74	$10,705.19	235	$761.90	$179,046.50	298	$200.00	$59,600.00							$249,352
RNI	DDC	Dawson Creek	2	23	IBM	1	Suppression	12,999.28	$3,249.82	61	$850.00	$51,850.00	79	*$100.00*	$7,900.00							$63,000
RNI	DJO	Dunlevey	1	6	IBM	1	Suppression	21,570.39	$5,392.60	67	$923.00	$61,841.00	84	$287.86	$24,181.92							$91,416
RNI	DDC	East Pine	2	25	IBM	0	Suppression	2,973.56	$743.39	119	$0.00	$0.00	113	$0.00	$0.00							$743
RNI	DJO	Graham	1	11	IBM	1	Suppression	91,041.48	$22,760.37	5	$837.37	$4,186.85	8	$290.99	$2,327.92							$29,275
RNI	DDC	Gething	2	31	IBM	0	Suppression	40,463.40	$10,115.85	541	$0.00	$0.00	521	$0.00	$0.00							$10,116
RNI	DJO	Halfway	1	8	IBM	1	Suppression	100,173.65	$25,043.46	142	$761.90	$108,189.80	195	*$318.00*	$62,010.00							$195,243
RNI	DDC	Honeymoon Creek	2	19	IBM	0	Suppression	19,478.21	$4,869.55	794	$800.00	$635,200.00	12,978	$125.40	$1,627,441.20							$2,267,511
RNI	DDC	Hudson's Hope	2	30	IBM	0	Suppression	17,010.20	$4,252.55	759	$0.00	$0.00	805,778	$0.00	$0.00							$4,253
RNI	DJO	Kahntah	1	1	IBM	1	Suppression	47,428.00	$11,857.00	0	$900.00	$0.00	0	*$250.00*	$0.00							$11,857
RNI	DDC	Kakwa	2	12	IBM	1	Suppression	8,673.77	$2,168.44	0	$900.00	$0.00	0	$158.40	$0.00							$2,168
RNI	DDC	Kiskatinaw	2	24	IBM	1	Suppression	16,848.71	$4,212.18	117	$800.00	$93,600.00	116	*$120.00*	$13,920.00							$111,732
RNI	DJO	Kobes	1	6	IBM	0	Suppression	43,791.87	$10,947.97	269	$837.37	$225,252.53	1,966	$318.05	$625,361.72							$861,582
RNI	DDC	Lone Prairie	2	22	IBM	1	Suppression	25,243.73	$6,310.93	825	$850.00	$701,250.00	1,192	*$130.00*	$154,960.00							$862,521
RNI	DJO	Lower Beatton	1	3	IBM	1	Suppression	30,175.15	$7,543.79	11	$905.00	$9,955.00	1,130	$114.50	$129,385.00							$146,884
RNI	DDC	Lower Moberly	2	28	IBM	0	Suppression	92,590.41	$23,147.60	205	$885.31	$181,488.55	113	$100.00	$11,300.00							$215,936
RNI	DDC	Lower Red Deer	2	15	IBM	0	Suppression	54,735.21	$13,683.80	559	$900.00	$503,100.00	14,868	$148.50	$2,207,898.00							$2,724,682
RNI	DJO	Milligan	1	2	IBM	0	Suppression	96,966.86	$24,241.72	0	$761.90	$0.00	0	$200.00	$0.00							$24,242
RNI	DDC	Narraway	2	13	IBM	0	Suppression	17,943.61	$4,485.90	164	$850.00	$139,400.00	255	$158.40	$40,392.00							$184,278
RNI	DDC	One Island	2	20	IBM	1	Suppression	189,042.67	$47,260.67	1,609	$850.00	$1,367,650.00	2,285	*$130.00*	$297,050.00							$1,711,961
RNI	DDC	Pine River	2	26	IBM	0	Suppression	41,253.11	$10,313.28	188	$0.00	$0.00	789,984	$0.00	$0.00							$10,313
RNI	DDC	Puggins	2	21	IBM	0	Suppression	112,610.14	$28,152.54	2,199	$800.00	$1,759,200.00	7,726	*$130.00*	$1,004,328.00							$2,791,681
RNI	DDC	Redwillow	2	16	IBM	0	Suppression	67,011.68	$16,752.92	819	$800.00	$655,200.00	28,266	$176.00	$4,974,868.80							$5,646,822
RNI	DDC	Septimus	2	27	IBM	0	Suppression	4,577.40	$1,144.35	277	$712.00	$197,224.00	103	$100.00	$10,300.00							$208,668
RNI	DJO	Sikanni	1	10	IBM	1	Suppression	45,620.92	$11,405.23	0	$837.37	$0.00	0	*$250.00*	$0.00							$11,405
RNI	DJO	Tommy Lakes	1	4	IBM	1	Suppression	267,953.87	$66,988.47	0	$761.90	$0.00	0	$750.00	$0.00							$66,988
RNI	DJO	Trutch	1	9	IBM	1	Suppression	180,478.44	$45,119.61	0	$761.90	$0.00	0	$750.00	$0.00							$45,120
RNI	DDC	Wapiti	2	18	IBM	1	Suppression	35,048.65	$8,762.16	277	$850.00	$235,450.00	16,642	$139.70	$2,324,873.43							$2,569,086
Total							-	2,119,238.7	$529,809.68	12,343	$680.36	$8,230,209.23	1,720,592	$ 180.42	$18,060,498.36		-		-		-	$26,820,517.27

Notes:

1. Region - Each region should consider submitting regional-level projects that encompass resources for admin (some beetle-related travel) and support for data base development and maintenance. Costs for these should be relatively minor. Aerial overview costs will be reserved by FPB for later disbursement or expenditure.
2. Priority - derived from discussions with Peace DFAM group March 2007.
3. Ranking - derived from discussions with DFAM group March 2007.
4. Bark Btl Species - there should be a separate BMU for each bark beetle species. Ie, if a BMU has both mountain pine beetle and fir beetle, there will be two BMU's entered with the same name - each dealing with the specific bark beetle. Enter "IBM" if mountain pine beetle; "IBD" if Douglas-fir beetle; "IBS" if spruce beetle.
5. Park? - Enter a "1" if Park-related activities are included in the BMU plan. Activities and costs for the BMU should reflect BOTH Park and MoF needs for the BMU (see further notes, etc., on Spreadsheet 3). Enter "0" if there is no Park within the BMU.
6. Strategy - Please only include BMU's within Aggressive Management Zones that have an assigned strategy of SUPPRESSION
7. Detailed Air - as noted above, this refers to detailed, operational-level surveys only in SUPPRESSION BMU's. Aerial Overview costs will be included in FPB submission.
8. Number of sites derived from detailed aerial surveys.
9. $/tree taken from 2006/07 actual rates.
10. Baits - costs for baits should include any special costs associated with placement (ie, if baits are not placed in conjunction with other activities).
11. Other lump sum to include overwintering mortality assessments, risk rating, etc.

These BMUs were included as suppression for detailed aerial surveys only.

Table 16. Tactical Plan. Spreadsheet 2. Infestation Status Description.

Spreadsheet 2. 2006/07 Submission - Infestation Status Description - FINAL

						Data Elements					
Region	District	Work Area	Bark Btl Sp.[1]	Park?[2]	Strategy[3]	G:R Ratio[4]	# Red Trees[5]	# Green Trees[6]	# Spots[7]	Sus. Area (ha)[8]	Total BMU Cost ($)
RNI	DDC	Bearhole	IBM	1	Suppression	8.90	1,695	15,086	1,014	77,632.2	$3,112,290
RNI	DDC	Belcourt	IBM	0	Suppression	1.00	382	382	157	28,464.0	$200,444
RNI	DJO	Blueberry	IBM	0	Suppression	40.70	263	10,704	195	233,414.0	$2,375,649
RNI	DDC	Boucher	IBM	0	Suppression	18.00	495	8,910	323	17,635.4	$4,409
RNI	DDC	Carbon	IBM	0	Suppression	1.00	810	810	421	35,567.8	$8,892
RNI	DJO	Crying Girl	IBM	0	Suppression	1.00	298	298	235	42,820.7	$249,352
RNI	DDC	Dawson Creek	IBM	1	Suppression	1.00	79	79	61	12,999.3	$63,000
RNI	DJO	Dunlevey	IBM	1	Suppression	1.00	84	84	67	21,570.4	$91,416
RNI	DDC	East Pine	IBM	0	Suppression	1.00	113	113	119	2,973.6	$743
RNI	DJO	Graham	IBM	1	Suppression	1.00	8	8	5	91,041.5	$29,275
RNI	DDC	Gething	IBM	0	Suppression	0.20	2,606	521	541	40,463.4	$10,116
RNI	DJO	Halfway	IBM	1	Suppression	1.00	195	195	142	100,173.9	$195,243
RNI	DDC	Honeymoon Creek	IBM	0	Suppression	10.50	1,236	12,978	794	19,478.2	$2,267,511
RNI	DDC	Hudson's Hope	IBM	0	Suppression	101.00	7,978	805,778	759	17,010.2	$4,253
RNI	DJO	Kahntah	IBM	1	Suppression	0.00	-	-	0	47,428.0	$11,857
RNI	DDC	Kakwa	IBM	1	Suppression	31.00	-	-	0	8,673.8	$2,168
RNI	DDC	Kiskatinaw	IBM	1	Suppression	1.00	116	116	117	16,848.7	$111,732
RNI	DJO	Kobes	IBM	0	Suppression	5.30	371	1,966	269	43,791.9	$861,582
RNI	DDC	Lone Prairie	IBM	1	Suppression	1.00	1,192	1,192	825	25,243.7	$862,521
RNI	DJO	Lower Beatton	IBM	1	Suppression	56.50	20	1,130	11	30,175.2	$146,884
RNI	DDC	Lower Moberly	IBM	0	Suppression	1.00	113	113	205	92,590.4	$215,936
RNI	DDC	Lower Red Deer	IBM	0	Suppression	12.60	1,180	14,868	559	54,735.2	$2,724,682
RNI	DJO	Milligan	IBM	0	Suppression	0.00	-	-	0	96,966.9	$24,242
RNI	DDC	Narraway	IBM	0	Suppression	1.00	255	255	164	17,943.6	$184,278
RNI	DDC	One Island	IBM	1	Suppression	1.00	2,285	2,285	1,609	189,042.7	$1,711,961
RNI	DDC	Pine River	IBM	0	Suppression	144.00	5,486	789,984	188	41,253.1	$10,313
RNI	DDC	Puggins	IBM	0	Suppression	2.90	2,664	7,726	2,199	112,610.1	$2,791,681
RNI	DDC	Redwillow	IBM	0	Suppression	17.10	1,653	28,266	819	67,011.7	$5,646,822
RNI	DDC	Septimus	IBM	0	Suppression	1.00	103	103	277	4,577.4	$208,668
RNI	DJO	Sikanni	IBM	1	Suppression	0.00	-	-	0	45,620.9	$11,405
RNI	DJO	Tommy Lakes	IBM	1	Suppression	0.00	-	-	0	267,953.9	$66,988
RNI	DJO	Trutch	IBM	1	Suppression	0.00	-	-	0	180,478.4	$45,120
RNI	DDC	Wapiti	IBM	1	Suppression	36.90	451	16,642	277	35,048.6	$2,569,086
Total						-	32,131	1,720,592	12,352	2,119,239	$26,820,517

Notes:
dealing with the specific bark beetle. Enter "IBM" if mountain pine beetle; "IBD" if Douglas-fir beetle; "IBS" if spruce beetle
if there is no Park within the BMU.
3. Strategy - Please only include BMU's within Aggressive Management Zones that have an assigned strategy of SUPPRESSION

4. An unbiased estimate from closest area where both red and green trees are present. Note italized numbers are estimates. Areas where IBM has not been surveyed to date were given a G:R ratio of 1:
5. Actual reds - derived from detailed aerial surveys.
6. Number of grfeens- total of recorded reds from detailed aerial surveys mulitpled by G:R ratio.
7. Total number of attack polygons, regardless of size, taken from 2006 detailed aerial surveys.
8. Susceptible area in BMU (>0). The total of all areas identified as >0 using Shore/Safranyik or equivalent for IBM.

MOF Infestation status

Table 17. Tactical Plan. Spreadsheet 3. Parks Activities and Related Costs.

Spreadsheet 3. Parks-related Activities and Costs[1]

				Surveys						Treatments										
				Detailed Air			Ground			Fall & Burn			MSMA		Other		Baits		
Region[2]	TSA	Work Area	Bark Btl Sp	ha	$	sites[3]	$/site	$	trees[4]	Rate	$	trees	$	trees	$	#	$	Total Park Cost ($)
RNI	DDC	Bearhole Lake	IBM	12,704.79	$ 3,176	242	$800	193,600.00	3,142	$ 151.25	$ 475,182		$ -					$ 671,958
RNI	DDC	Bearhole Lake PA	IBM	5,053.73	$ 1,263	77	$800	61,600.00	1,139	$ 151.25	$ 172,304		$ -					$ 235,167
RNI	DJO	Beatton	IBM	329.21	$ 82	0	$905	-	-	$ 114.50	$ -		$ -					$ 82
RNI	DJO	Beatton River	IBM	265.61	$ 66	0	$905	-	-	$ 114.50	$ -		$ -					$ 66
RNI	DJO	Buckinghorse River Way	IBM	35.89	$ 9	0	$762	-	-	$ 750.00	$ -		$ -					$ 9
RNI	DJO	Butler Ridge	IBM	6,840.07	$ 1,710	18	$923	16,614.00	22	$ 287.88	$ 6,333		$ -					$ 24,657
RNI	DJO	Cecil Lake ER	IBM	129.50	$ 32	0	$905	-	-	$ 114.50	$ -		$ -					$ 32
RNI	DJO	Charlie Lake	IBM	97.62	$ 24	0	$905	-	-	$ 114.50	$ -		$ -					$ 24
RNI	DJO	Clayhurst ER	IBM	501.14	$ 125	0	$905	-	-	$ 114.50	$ -		$ -					$ 125
RNI	DJO	Ekwan Lake PA	IBM	1,741.98	$ 435	0	$900	-	-	$ 250.00	$ -		$ -					$ 435
RNI	DJO	Graham-Laurier	IBM	99,422.76	$ 24,856	0	$837	-	-	$ 290.99	$ -		$ -					$ 24,856
RNI	DDC	Gwillim Suppression area	IBM	5,563.67	$ 1,391	983	$850	835,550.00	1,394	$ 130.00	$ 181,220		$ -					$ 1,018,161
RNI	DDC	Kakwa	IBM	12,859.85	$ 3,215	1,159	$900	1,043,100.00	5,563,074	$ 158.40	$ 881,190,922		$ -					$ 882,237,237
RNI	DDC	Kiskatinaw	IBM	54.48	$ 14	0	$800	-	-	$ 120.00	$ -		$ -					$ 14
RNI	DDC	Kiskatinaw River PA	IBM	237.64	$ 59	0	$800	-	-	$ 120.00	$ -		$ -					$ 59
RNI	DJO	Milligan Hills	IBM	7,827.95	$ 1,957	0	$762	-	-	$ 200.00	$ -		$ -					$ 1,957
RNI	DDC	One Island Lake	IBM	58.92	$ 15	1	$850	850.00	1	$ 130.00	$ 130		$ -					$ 995
RNI	DJO	Peace River Corridor	IBM	2,517.52	$ 629	0	$905	-	-	$ 114.50	$ -		$ -					$ 629
RNI	DJO	Pink Mountain	IBM	97.63	$ 24	0	$762	-	-	$ 318.00	$ -		$ -					$ 24
RNI	DJO	Redfern-Keily	IBM	80,619.83	$ 20,155	0	$837	-	-	$ 250.00	$ -		$ -					$ 20,155
RNI	DDC	Rolla Canyon ER	IBM	42.99	$ 11	0	$850	-	-	$ 100.00	$ -		$ -					$ 11
RNI	DJO	Sikanni Chief Canyon PA	IBM	4,706.70	$ 1,177	0	$837	-	-	$ 250.00	$ -		$ -					$ 1,177
RNI	DJO	Sikanni Chief Falls PA	IBM	798.55	$ 200	0	$837	-	-	$ 250.00	$ -		$ -					$ 200
RNI	DJO	Sikanni Chief River ER	IBM	2,172.65	$ 543	0	$837	-	-	$ 250.00	$ -		$ -					$ 543
RNI	DJO	Sikanni Old Growth	IBM	1,439.45	$ 360	0	$837	-	-	$ 250.00	$ -		$ -					$ 360
RNI	DJO	Sudeten	IBM	4.64	$ 1	0	$762	-	-	$ 200.00	$ -		$ -					$ 1
RNI	DDC	Swan Lake	IBM	81.92	$ 20	0	$850	-	-	$ 100.00	$ -		$ -					$ 20
RNI	DJO	Taylor Landing	IBM	0.99	$ 0	0	$905	-	-	$ 114.50	$ -		$ -					$ 0
Total Parks				218,508.14	$ 61,552	2,480	$847	$ 2,151,314	5,568,772	$ 196.76	$ 882,026,091	0	$ -	0	0	0	$0.00	$ 884,238,957

Notes:

1. Those BMU's identified on Spreadsheet 1 as containing activities related to parks should be listed on this sheet with park-specific activities and funding needs identified.
2. Region - Each region should consider submitting regional-level projects that encompass resources for admin (some beetle-related travel) and support for data base development and maintenance. Costs for these should be relatively minor. Aerial overview costs will be reserved by FPB for later disburs
3. Number of sites derived from 2006 detailed aerial surveys.

Knowledge Gaps
The greatest knowledge gap in the Peace Forest District in 2006 is the magnitude of the long range dispersal event and the success of the dispersed beetles in areas never previously infested.

Another unknown is the dispersal of mountain pine beetle into Alberta and how their treatment efforts will affect the Peace either directly or indirectly through infestation and funding pressures.

In addition to this population expansion rates and over wintering mortality assessments are scheduled for late March – early April 2007 to determine possible beetle pressures for the 2007 flight year.

Previous to the 2006 flight, mountain pine beetle behaved very differently in the Peace than elsewhere in BC. Unique differences included;

- ✓ high percent of two-year cycle populations,
- ✓ high margin attacks including strip attacks, pitch outs, mutli-attacks over consecutive years,
- ✓ high over wintering mortality,
- ✓ color change time frame delayed, and
- ✓ association with other insects including lodgepole pine beetle, *Ips*, and red turpentine beetle.

However, in 2006 with the magnitude of the attack in the south Peace Mountain pine beetle has been quite successful and is expected to establish in these areas spreading easterly and northerly. Population dynamics are quite variable in the north Peace with areas with sparse infestations of single fading trees ranging to areas of large polygons of attack. The diversity of attack appears to be mainly wind driven from the long range dispersal event in 2006.

Training
Two main formal types of training have been implemented in the Peace Forest District and could continue on a yearly basis targeting mountain pine beetle management. Training parameters should be redefined as beetle dynamics change over time.

<u>1. Ground crews mountain pine beetle pre-work/ training sessions.</u>
All ground crews including ground surveyors and treatment personnel went through a mandatory pre-work session were mountain pine beetle biology, identification, and overall management principals for mountain pine beetle as it relates to the Peace was covered.
Training included a ½ day office session followed by a ½ day field session
It is recommended that similar pre-work/ training sessions continue.

<u>2. Managers and planners</u>
a 2 day training course was offered by West Fraser Mills Ltd. by October 2005

Marnie Duthie-Holt was the instructor and this course focused on biology, identification, and management scenarios with real examples from the Dawson Creek Forest District. The workshop outline is included for reference.

Additional courses could be planned for various planners.

The Ministry of Forests and Range personnel including Tracy Coombes and Rob Kopecky have also conducted various informal training sessions with private land owners throughout the Peace Forest District to aid in their detection of mountain pine beetle on private land and provide options for treatments. In addition to these personal site visits the Ministry of Forests and Range spearheaded by Tracy Coombes have put together an information brochure which was mailed out to land owners.

MEDI-FOR
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Mountain Pine Beetle Biology, Survey, and Management Workshop
October 2005

Time: 8:30 – 4:30 pm each day (October 17 and 18th, 2005)
Place: Classroom: West Fraser Mills Ltd., Chetwynd Division Boardroom
Field session: within 45 minute drive of Chetwynd
Instructor: Marnie Duthie-Holt

Workshop Outline Day 1: October 17, 2005

Approximate time	Description of activity	Equipment needs
8:30 - 8:45	Introductions and expectations Seminar material overview	Handouts
8:45 - 10:15	Bark beetle biology and identification presentation	Power point presentation
10:15 - 10:30	Morning break	
10:30 - 11:15	Insect collection and damage sample quiz	Insect specimens and damage specimens (6 stations and quiz)
11:15 - 12:00	Bark beetle biology and identification handout completion in groups	Handouts
12:00 - 1:00	Lunch	
1:00 - 1:30	Review of handout	
1:30 - 2:30	Ground survey techniques and interpretation of reports presentation	Power point presentation
2:30 - 3:15	Ground Survey exercise	Handouts
3:15 - 3:30	Afternoon break	
3:30 - 4:30	Bark Beetle Management Techniques Presentation	Power point presentation

Day 2: October 18, 2005

Approximate time	Description of activity	Equipment needs
8:30 -10:00	Management scenario exercise	Maps, handouts
10:00 - 10:15	Morning break	
10:15-10:45	Review Ground Survey and Management exercises	Power point presentation
10:45 - 11:30	Drive to field site	Field Gear (hatchet, cruisers vest, pencils, markers, walkbox, notebook, raingear, sturdy boots)
11:30 – 2:00	Field site – examination of coding system and conduct survey Eat lunch in the field	
2:00 – 2:45	Drive to classroom	
2:45 - 4:00	Video "Stalking a Forest Killer"* Course review	TV/ VCR
4:00 - 4:30	Questions and wrap up Workshop Evaluations	Handouts

BeetleTracks
A web based "real time", user restricted, comprehensive data tracking system was developed in 2005-2006 by Medi-For Forest Health Consulting and Larix Forestry Inc. called, "BeetleTracks" (**www.beetletracks.ca**). Development work continued on this program in 2006-2007 by IPAC.

Currently all of the areas in the Spread Control area along the Alberta border within BC are using BeetleTracks to track detailed aerial, ground survey, and treatment data. These areas include;

- ✓ Peace Forest District
  - o including West Fraser program for the Dawson Creek TSA and parks and
- ✓ Canfor program - TFL48 and the Ft. St. John TSA,
- ✓ Mackenzie Forest District,
- ✓ Rocky Mountain Forest District (Cranbrook and Invermere TSAs),
- ✓ Columbia Forest District, and
- ✓ Headwater Forest District including the MOF and parks programs.

BeetleTracks incorporates all detailed aerial survey data which is then intersected by district, BMU, working area, mapsheet, aerial survey source, proposed harvesting, parks, responsibility, access type including distance to roads, and aspect. Susceptibility rating is also linked to each infestation if available.

The database is then populated with;

- ✓ ground survey data,
- ✓ quality control and quality assurance data,
- ✓ helicopter pads including detailed descriptions of any limitations of their use (i.e. if they are weather sensitive),
- ✓ helicopter and surveyors hours, and
- ✓ treatment data including number of trees felled (and flown for helicopter assisted burning) and burnt and any discrepancies with the survey data on a daily basis, and
- ✓ cycle time information is also recorded for helicopter assisted burning.

This allows access to the data in real time allowing planners with the ability to stay on top of the program and make necessary changes in a timely manner.

One of the largest benefits of BeetleTracks is the preservation of data integrity. Restrictions to data entry have been built into the data entry forms to minimize erroneous errors.

This data tracking system also allows for cross referencing of budgets which is especially important as the program progresses and funds become limited. As well, since BeetleTracks is linked to ArcView updated maps including but not limited to sites surveyed, number of treatment trees identified and treated can be generated easily. Samples of the maps created to date are included on the map link button on BeetleTracks.

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Appendices

Appendix 1. Description of mountain Pine Beetle outbreak stages.
Taken from Stock 2005.

Recent synthesis on mountain pine beetle population dynamics considers that beetle populations have identifiable developmental stages that have a significant impact on appropriate strategy selection. This synthesis is not yet published in refereed journals. What follows is adapted from presentations and by, and discussions with Les Safranyik and Al Carroll (Research Scientists, Canadian Forest Service, Pacific Forestry Centre). More information can be found at
http://www.pfc.cfs.nrcan.gc.ca/entomology/mpb/outbreak/index_e.html

IBM populations cycle through 3 "phases" which have markedly different characteristics. Outbreaks of IBM occur when climatic and host-tree factors combine to produce suitable conditions, usually at the landscape level.

Characteristics of Endemic populations

- ✓ Low level state between outbreaks. Endemic IBM populations are sometimes defined numerically, for example, as one infested tree per 40.5 ha. However, numeric thresholds are not strictly adequate to describe the character of endemic populations.
- ✓ IBM infest weakened and decadent trees. Endemic populations exist primarily in susceptible "predisposed trees" such as very old "veteran" mature trees, stressed trees in the understory or suppressed part of the canopy, lightning-struck trees, wind damaged trees, trees weakened by agents such as other scolytids, porcupines or stem diseases, or perhaps trees stressed by root disease or dwarf mistletoes.
- ✓ IBM in these trees is often associated with secondary bark beetles such as *Ips* or *Hylurgops* spp, which act as both facilitators and competition for IBM.
- ✓ Currently attacked trees are seldom located near original brood trees
- ✓ No obvious relationship between tree dbh and IBM attack.
- ✓ Yearly mortality is normally less than volume growth.
- ✓ Attacked trees are scattered singly or in small groups.
- ✓ IBM attack pitch tubes are often not apparent.

All of the above characteristics mean that endemic populations exist as widely scattered single tree infestations, occurring essentially at random. Consequently, currently infested trees are hard to find because of the difficulty in predicting their occurrence, and because they are often not located near parent brood trees. Pitch tubes, a characteristic "signature" of IBM attack, are not usually evident on IBM attacked trees in the endemic population phase. Factors such as host resistance, natural enemies, weather, and competition for food and space interact during endemic periods to keep reproduction and brood mortality in balance and restrain populations from increasing. A change that reduces the controlling effects of any one or a combination of these factors could theoretically result in the development of incipient populations.

Characteristics of Incipient infestations

- ✓ Incipient populations are those with beetle numbers that exceed a minimum level necessary to overcome the resistance of the average large diameter apparently healthy tree in a stand. Incipient infestations can develop either because tree resistance is reduced or because brood survival has increased as a result of favourable weather conditions.
- ✓ Populations grow, but slowly. Incipient infestations grow relatively slowly and, on average, population and infestation levels may not even double in successive years.
- ✓ Populations tend to escape detection and concern.
- ✓ Most of the trees are in larger diameter classes. Brood survival in large dbh trees is higher than in smaller trees for a number of nutritional and physical reasons such as thicker bark and phloem, and reduced mortality from drying of the bark or cold temperatures.
- ✓ Infestations are scattered and confined to individual stands,
- ✓ The number of infested trees *usually* increases annually, but unsuccessful attack ("pitchouts") may occur in significant numbers within stands.

Clumps of infested trees grow in size and number over time

Incipient populations move to landscape and outbreak level in ~ 5(?) yrs or faster (2-3 generations?)

Aggressive control may save trees over the long term, even if "suppression" is not 100 % effective.

The incipient phase of mountain pine beetle population development is the most accessible and vulnerable to aggressive management action.

Characteristics of outbreak populations
Require sustained favourable climate for beetle survival, such as a series of mild winters and good weather during the dispersal and attack periods.

Require pine of susceptible age and size. Susceptible landscapes contain an abundance of lodgepole pine greater than 20 cm in diameter and 80 years of age.

Widespread with large annual increases in infested areas. Incipient infestations develop into landscape level outbreaks as groups of infested trees coalesce into larger patches and new infestations develop annually through within-stand and long range dispersal. Populations are resilient to normal mortality losses due to high numbers. Outbreak populations are very resilient to normal mortality and can easily rebound following large-scale mortality. Brood mortality is in the range of 80 to 95%, equivalent to a range of 5 to 20% survival, resulting in a 2 to 8 fold potential increase in population and damage levels (with a 2 to 4 fold increase being the norm).

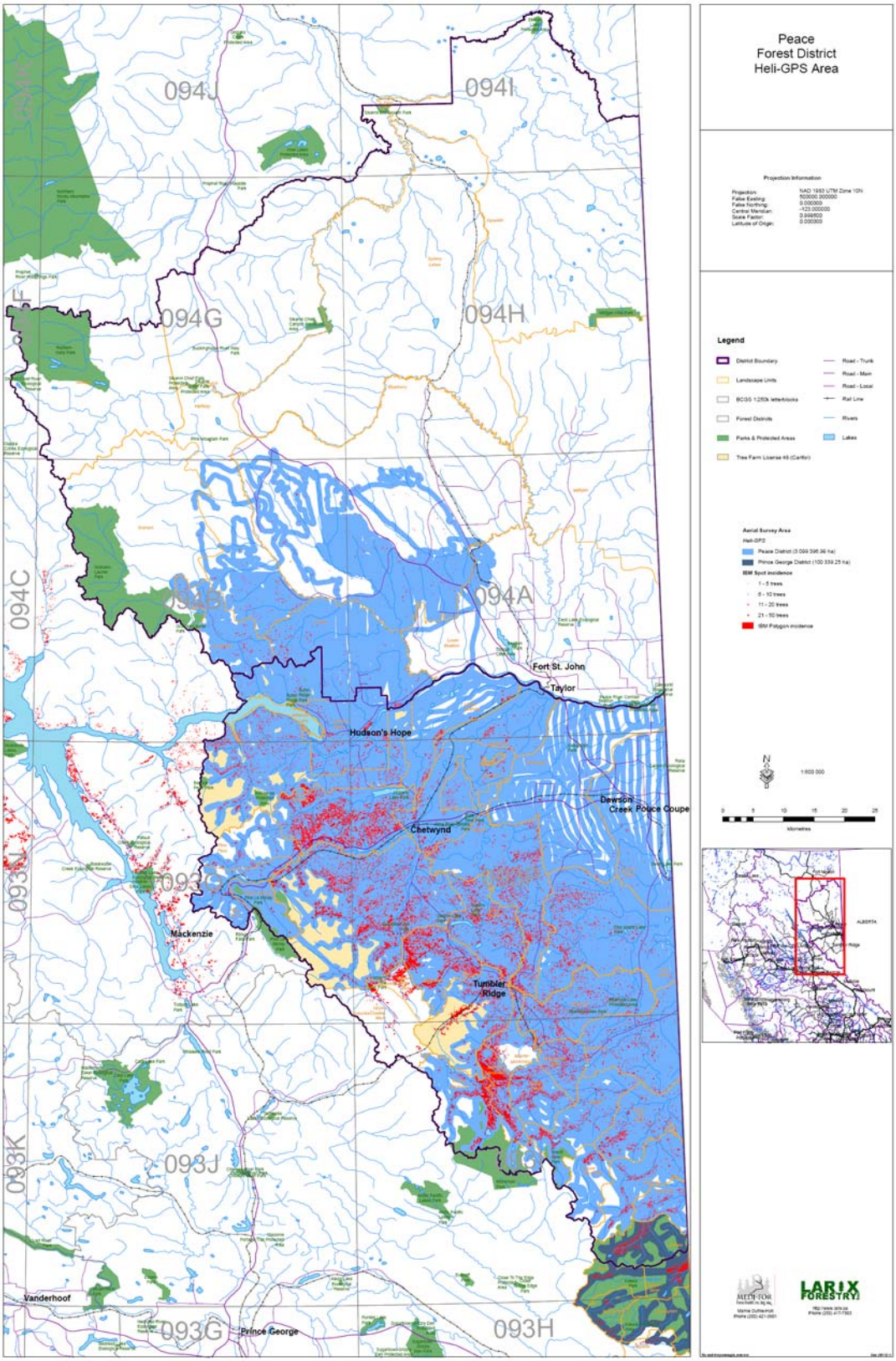
A strong relationship between dbh and tree mortality. Epidemic IBM populations select and kill large diameter apparently healthy trees, although new infestation spots may

initially focus on predisposed trees. Consequently, trees in the dominant and co-dominant size classes will suffer the heaviest mortality.

More than 80% of pines over 10 cm dbh may be killed over large areas, with perhaps 60% of volume and 40% of stems killed being the average.
Outbreak populations within particular stands may last up to 6 years. At the landscape level outbreaks tend to last 10-15 years, and collapse when available food supply runs out, or a change in weather suitability (e.g. a cold weather event) occurs.

Twenty to forty years may elapse between outbreaks. This pertains when an outbreak is allowed to run its full course. Clearly this depends on the two essential factors, climate and food supply. The central interior of British Columbia experienced a large outbreak in the mid-1980's, which was stopped by a severe unseasonable cold weather event. The "next" outbreak in the central interior started in the mid-1990's, an interval of only 10 years. In fact, these two outbreaks could be considered 2 chapters of the same outbreak.

Appendix 2. Map of area flown for detailed aerial surveys mapping in 2006, Peace Forest District.



Appendix 3. Mountain pine beetle detailed aerial surveys hectares surveyed by work area in the Peace Forest District and Kakwa Provincial Park, 2006.

Work Area	Heli-GPS Area (ha)
Prince George Forest District	
Bastille	4,221.28
Buchanan East (Bastille)	23,130.57
Buchanan West (Kitchi)	12,828.57
Jarvis	11,734.95
Kakwa	31,524.27
Kakwa River	16,899.62
Total	*100,339.25*
Peace Forest District	
Bearhole	95,040.97
Belcourt	59,736.37
Blueberry	260,446.07
Boucher	37,736.35
Bullmoose	60,702.30
Carbon	58,816.51
Club Creek East	18,566.02
Club Creek West	12,285.18
Crying Girl	61,133.27
Dawson Creek	119,558.00
Dickebush	25,523.07
Dunlevey	47,813.19
East Pine	24,235.02
Falling Creek	10,218.38
Feller's Creek	41,877.97
Gething	58,279.24
Graham	10,296.84
Gulf	8,339.17
Halfway	90,480.95
Hart Highway	2,702.37
Highhat	13,802.99
Honeymoon Creek	30,843.72
Hudon's Hope	92,371.11
Kiskatinaw	189,454.97
Kobes	155,339.74
Kowen Hills	15,330.11
Lemoray	6,945.51
Lone Prairie	77,176.60
Lower Beatton	32,940.32
Lower Burnt	21,458.32

Lower Moberly	83,742.00
Lower Red Deer	65,626.27
Murray-Monkman East	19,827.92
Murray-Monkman Mid	29,195.10
Murray-Monkman West	58,609.74
Narraway	27,431.04
North Hasler	20,590.56
One Island	190,160.21
Pine LeMoray	26,110.32
Pine Pass North	32,788.28
Pine Pass South	37,939.76
Pine River	90,798.41
Puggins	140,759.87
Redwillow	104,974.75
Rocky Creek	17,895.71
Septimus	66,915.77
South Hasler	18,237.99
Sukunka-Bluff	21,078.54
Upper Burnt	14,696.56
Upper Moberly	115,241.83
Upper Red Deer	27,541.53
Upper Sukunka/Gwillim East	3,593.56
Upper Sukunka/Gwillim West	1,098.30
Wapiti	73,546.80
Westcoast-Caron	26,344.56
Williston Lake	11,996.38
Willow	8,583.83
Wolverine	24,620.77
Total	*3,099,396.99*
Grand total	*3,199,736.25*

Appendix 4. Breakdown of susceptible hectares by Beetle Management Unit and Susceptibility Class for the entire Peace Forest District.
Classes are as follows;

Hazard Category	Hazard Class	
0	Nil	0
1	Low	>0-20
2	Mod.	>20-40
3	High	>40-60
4	Extreme	>60-80
5	Very extreme	>80-100

TSA	BMU	0	1	2	3	4	5	Totals
DDC	Bearhole	30,230.76	17,186.52	10,675.22	12,893.43	17,320.03	6,753.92	*95,059.87*
DDC	Belcourt	41,642.39	7,369.93	2,609.17	6,020.83	11,971.67	1,670.92	*71,284.90*
DDC	Boucher	21,699.47	12,260.25	2,835.98	1,220.69	978.29	340.22	*39,334.88*
DDC	Bullmoose	34,536.88	9,374.05	5,759.46	5,561.44	5,437.36	1,840.02	*62,509.19*
DDC	Carbon	57,685.48	19,123.37	7,988.70	6,920.28	3,705.61	265.88	*95,689.32*
DDC	Club Creek East	6,579.67	6,701.40	2,246.56	2,367.77	1,884.25	697.97	*20,477.62*
DDC	Club Creek West	13,140.45	1,703.60	664.53	762.09	699.60	523.40	*17,493.65*
DDC	Dawson Creek	144,195.09	10,227.23	1,785.53	698.35	145.62	142.55	*157,194.37*
DDC	Dickebush	8,737.87	7,368.31	3,804.60	2,927.19	2,446.61	522.83	*25,807.41*
DDC	Dunlevey	28,310.51	12,599.20	3,598.70	3,298.30	1,890.64	183.55	*49,880.89*
DDC	East Pine	21,657.80	2,167.00	527.63	196.20	67.30	15.44	*24,631.36*
DDC	Falling Creek	4,862.11	3,246.00	1,255.21	1,435.40	1,652.48	635.37	*13,086.56*
DDC	Feller's Creek	26,938.77	7,486.26	2,876.09	3,325.49	2,141.05	853.06	*43,620.72*
DDC	Gething	21,560.15	21,482.34	8,012.95	6,904.19	3,879.08	184.83	*62,023.55*
DDC	Gulf	7,165.50	2,251.28	547.43	386.52	174.57	44.12	*10,569.43*
DDC	Hart Highway	1,206.70	630.40	338.71	449.27	299.24	42.47	*2,966.79*
DDC	Highhat	4,115.93	4,642.26	1,562.14	1,523.76	1,752.93	218.39	*13,815.42*
DDC	Honeymoon Creek	11,375.79	6,076.12	2,982.34	3,213.22	4,180.71	3,025.81	*30,854.00*
DDC	Hudon's Hope	75,758.62	11,327.59	3,573.64	1,483.47	478.73	146.78	*92,768.82*

DDC	Kakwa	41,319.11	4,718.34	1,914.90	1,086.14	668.66	285.73	*49,992.88*
DDC	Kiskatinaw	223,123.24	13,134.44	1,596.84	954.20	806.86	356.36	*239,971.95*
DDC	Kowen Hills	1,732.64	4,666.08	2,440.75	2,948.30	3,002.62	661.83	*15,452.22*
DDC	Lemoray	12,113.53	968.70	356.40	270.45	134.35	117.08	*13,960.52*
DDC	Lone Prairie	24,000.89	18,088.61	7,728.24	11,621.64	12,467.71	3,305.49	*77,212.58*
DDC	Lower Burnt	11,939.23	8,196.60	1,960.81	2,173.06	2,471.99	949.74	*27,691.42*
DDC	Lower Moberly	91,605.71	3,759.23	1,861.25	598.69	196.48	282.39	*98,303.76*
DDC	Lower Red Deer	23,884.54	9,765.63	3,570.61	3,839.03	15,086.01	9,907.39	*66,053.22*
DDC	Murray-Monkman East	17,970.39	4,225.16	1,930.58	2,378.12	2,065.14	2,269.67	*30,839.06*
DDC	Murray-Monkman Mid	13,559.75	4,703.97	1,881.72	2,549.55	4,064.47	3,455.64	*30,215.10*
DDC	Murray-Monkman West	90,523.41	2,607.39	1,353.40	868.72	445.94	1,698.43	*97,497.29*
DDC	Narraway	12,322.74	6,078.37	2,193.81	3,075.16	3,847.70	1,596.49	*29,114.28*
DDC	North Hasler	6,421.99	6,276.18	2,494.22	2,751.52	2,739.77	591.20	*21,274.88*
DDC	One Island	101,950.67	40,640.09	14,851.70	12,926.15	13,175.83	7,485.65	*191,030.08*
DDC	Pine LeMoray	28,787.27	719.42	160.92	104.66	44.68	50.98	*29,867.93*
DDC	Pine Pass North	47,825.64	2,444.66	1,469.55	482.63	128.55	289.88	*52,640.92*
DDC	Pine Pass South	41,076.68	2,512.55	762.08	160.54	46.52	62.87	*44,621.25*
DDC	Pine River	78,632.53	8,541.32	1,955.53	1,250.15	333.03	420.47	*91,133.02*
DDC	Puggins	83,533.99	27,356.29	8,164.15	8,443.49	10,185.37	3,899.10	*141,582.40*
DDC	Redwillow	37,977.49	18,420.97	7,301.41	12,463.19	18,751.71	10,074.41	*104,989.17*
DDC	Rocky Creek	7,041.21	7,130.68	2,376.77	2,482.79	1,210.37	110.54	*20,352.36*
DDC	Septimus	62,747.54	4,043.51	221.80	210.38	77.25	24.46	*67,324.94*
DDC	South Hasler	22,860.33	3,418.99	410.08	399.38	223.25	52.68	*27,364.72*
DDC	Sukunka-Bluff	6,432.91	8,311.84	1,941.19	1,878.41	1,925.52	621.07	*21,110.95*
DDC	Upper Burnt	36,912.29	1,373.35	112.80	187.13	107.24	43.94	*38,736.74*
DDC	Upper Moberly	58,796.78	27,761.71	12,828.38	7,416.17	7,111.37	3,044.90	*116,959.32*
DDC	Upper Red Deer	35,963.33	2,007.40	497.69	422.88	324.65	432.27	*39,648.21*

DDC	Upper Sukunka/Gwillim East	17,541.78	2,046.41	1,452.50	328.29	12.90	4.07	*21,385.96*
DDC	Upper Sukunka/Gwillim West	64,766.98	251.65	94.64	118.49	20.68	-	*65,252.44*
DDC	Wapiti	43,435.14	13,223.39	5,057.48	8,096.60	8,065.92	2,127.23	*80,005.77*
DDC	Westcoast-Caron	6,316.64	6,413.31	3,240.90	3,558.98	5,065.33	1,766.69	*26,361.85*
DDC	Williston Lake	17,996.06	13.25	10.24	3.27	4.51	-	*18,027.32*
DDC	Willow	1,743.96	2,394.44	1,391.99	1,453.21	1,459.47	174.29	*8,617.36*
DDC	Wolverine	35,707.47	8,481.74	4,736.57	4,365.87	2,300.22	599.51	*56,191.38*
	DDC Totals	*1,969,963.82*	*437,918.75*	*163,966.46*	*163,455.14*	*179,677.84*	*74,869.98*	*2,989,851.99*
DJO	Blueberry	497,551.87	148,765.08	40,424.23	25,913.09	15,518.51	2,793.14	*730,965.91*
DJO	Crying Girl	24,709.94	21,773.14	10,449.80	8,206.04	2,748.46	145.18	*68,032.55*
DJO	Graham	243,903.64	62,809.09	16,511.27	9,033.41	2,675.85	11.85	*334,945.12*
DJO	Halfway	106,099.77	62,701.80	19,025.74	12,760.74	5,314.27	371.28	*206,273.62*
DJO	Kahntah	701,583.39	24,773.06	15,398.66	4,838.61	1,913.71	503.95	*749,011.39*
DJO	Kobes	121,502.06	22,485.64	9,049.76	6,762.15	4,137.27	1,357.06	*165,293.93*
DJO	Lower Beatton	473,744.90	18,636.45	6,218.10	3,671.81	925.96	722.84	*503,920.05*
DJO	Milligan	376,908.69	78,885.66	13,231.20	3,203.98	1,617.82	28.20	*473,875.54*
DJO	Sikanni	266,428.33	26,520.76	12,785.45	6,307.63	7.07	-	*312,049.25*
DJO	Tommy Lakes	437,279.69	165,095.92	49,074.72	39,436.69	13,403.66	942.89	*705,233.56*
DJO	Trutch	255,913.11	133,151.00	30,409.53	14,411.93	2,470.74	35.25	*436,391.55*
	DJO Totals	*3,505,625.39*	*765,597.61*	*222,578.44*	*134,546.07*	*50,733.32*	*6,911.64*	*4,685,992.47*
	Grand Totals	*5,475,589.21*	*1,203,516.36*	*386,544.91*	*298,001.21*	*230,411.16*	*81,781.62*	*7,675,844.46*

Appendix 5. Memorandum of understanding between Parks (WALP) and the MOF. Taken from Stock 2005.

Preface: This document appears to be on the web in only one place, as Appendix I of the Provincial Bark Beetle Technical Implementation Guidelines.
http://www.for.gov.bc.ca/hfp/forsite/fhdata/ProvBBStrategy.pdf

MOU is in effect as of March 2004.

Memorandum of Understanding Between Ministry of Forests and B. C. Parks.

Memorandum of Understanding Between

Ministry of Forests

And

Ministry of Water, Land and Air Protection Environmental Stewardship Division

Regarding

Bark Beetle Management in Parks and Protected Areas

I. Introduction:

Forested areas in British Columbia are subject to various insect disturbances and insects move freely through forested landscapes. While insect infestations are considered part of a natural forest renewal process in protected areas, they may require management in crown forests allocated for timber production. Since insects do not recognize jurisdictional boundaries, they will move from protected area forests into crown forests or conversely, from crown forests into protected area forests. Prevention of insect spread across boundaries may necessitate management actions within crown forests to maintain protected area values or within protected areas to protect timber values in adjacent crown forests. The current mountain pine beetle epidemic presents a situation where the management of beetle infestations to prevent spread of beetles across boundaries is a high priority. The effective management of the mountain pine beetle epidemic requires a coordinated program between the Ministry of Water Land and Air Protection, Environmental Stewardship Division (MWLAP, ESD) and the Ministry of Forests (MoF). This MOU establishes the foundation for a coordinated beetle management program between ESD and MoF.

II. Purpose:

As a result of the mountain pine beetle epidemic in British Columbia, government has initiated a multi-year program directed at reducing losses to both crown forests managed for timber production, and other resources, caused by mountain pine beetles. Priority treatment of spruce and Douglas-fir beetle may also be required in some areas. MoF and

ESD are co-operating in management of bark beetle issues in areas of common interest. This MOU has been jointly developed by MoF and the Parks and Protected Areas Branch of ESD. The purpose of this Memorandum of Understanding is to facilitate the management of bark beetles in priority areas to reduce current or projected impacts on the forest land base, regardless of administrative authority. This MOU is intended to define the structure and process of a co-operative program for bark beetle management

III. Other Agreements
This MOU is not meant to replace or affect other agreements currently in place with BC Parks (now ESD, MWLAP) or other agencies.

IV. Term:
The term of this MOU shall begin on the date of signing and may be terminated upon mutual consent of the two parties.

V. Annual Review:
This MOU will be reviewed annually or updated as required to incorporate new government direction or changes to forest or protected areas management policy.

VI. General Principles:
The objective of insect management in forests outside of parks and protected areas is to minimize losses to resource values.

The objective of insect management inside parks and protected areas is to allow natural process to prevail; however, to maintain protected area values or prevent of cross boundary spread of insects to adjacent crown forests, insect management in parks and protected areas may be required.

ESD and MoF, subject to current legislation and their management policies and with respect to the goals and objectives of each Ministries mandate, will cooperatively manage insect infestations to prevent cross boundary spread of insects. In some cases infestation management actions may be limited by social, economic or ecological considerations. To coordinate management of beetle in areas of mutual interest, ESD and MoF will share information, knowledge, expertise and resources required to maintain both agencies insect management objectives.

MoF and ESD will cooperate on funding submissions for beetle management activities as well as on planning, research and communication initiatives.

VII. Funding of Management Programs
Provincial Program Funding. When appropriate, MoF Headquarters and ESD Parks and Protected Areas Branch will cooperatively apply to government for Provincial beetle management programs. Beetle management program funding will be allocated to appropriate MoF or ESD regions for high priority treatment programs in protected areas and crown forests based upon mutually agreed criteria as required to meet cooperatively defined provincial beetle management objectives. Beetle program funding associated

with protected areas management may be applied to high priority planning, mapping, research or long–term management activities as agreed upon by MoF and ESD Parks and Protected Areas Branch.

Regional Beetle Management Programs · Funding will be allocated to MoF or ESD Regions by MoF HQ based on prioritized treatment units and strategic management goals for both protected areas and adjacent forests. MoF and ESD regional staff will cooperatively determine regional protected area beetle management goals and treatment activities; however, treatments in parks and protected areas will follow BC Parks Conservation Program Policies and will not be conducted without ESD regional staff approval. Protected area treatment funding submissions will be included in all regional MoF treatment funding submissions. Beetle management activities in protected areas may require a higher level of planning and management to maintain protected area values. Research activities related to mountain pine beetle management may be undertaken in protected areas where appropriate under an approved park use permit.

VII. Beetle Management Activities

The objective of beetle management in both forest lands and protected areas is to reduce the impact of bark beetles and to prevent cross boundary spread of insects. Successful beetle management will require both short-term control activities and long-term management activities. Short-term control activities include all management actions undertaken to reduce current beetle populations in protected areas and adjacent forests (i.e.: beetle control/management actions). Long-term management actions in protected areas include all activities undertaken to vary forest types by age and species composition (i.e.; beetle habitat reduction).

Short-term management activities:
The BC Parks Conservation Program Policies define acceptable beetle management options for protected areas as:

i. Allow natural process to prevail (i.e. do not treat)
ii. Pheromone baits and insect trap trees
iii. Individual tree fall and burn on site
iv. Large-scale prescribed burn
v. Skid, pile and burn on site with low impact machinery (over snow is the preferable method, no access roads will be constructed, where remedial work is necessary the policy for restoration management will be followed.)

Note: Other treatment or management options such as the use of MSMA will be considered by the ESD Parks Regions and Parks and Protected Areas Branch on a case by case basis.

In general the annual treatment program will be implemented as follows: · MoF HQ will undertake provincial overview mapping and identification of all areas affected by bark beetles on an annual basis. This program is funded from the provincial forest health budget. The information from the overview mapping will be made available to both Regional and Provincial ESD staff.· Regional ESD and Regional and District MoF staff will be responsible for cooperatively identifying regional management priorities and

planning and coordinating short-term regional beetle management programs for both protected areas and adjacent forests. · To utilize economies of scale and operational efficiencies, most beetle control activities undertaken in protected areas including: detailed aerial mapping, ground probing, and treatment activities will be managed as a part of the MoF District/Regional beetle management program in which the protected area is located. Funding for protected area beetle management will be taken from provincial beetle management funding. · ESD regional staff will conduct appropriate impact assessments, and administer and monitor permit requirements.· Prior to the initiation of each yearly program, MoF HQ and ESD Parks and Protected Areas Branch, and, MoF and ESD regional staff respectively, will meet to review previous programs, set provincial treatment goals and plan funding allocations.

Long-term management activities

Long-term forest health activities in protected areas will be based on ecosystem management principles to vary the forest matrix in protected areas by both age and species composition where necessary to emulate the long-term range of natural variability of the area. Planning for these programs will be the responsibility of ESD, however, MoF may be consulted regarding forest health or other natural resource considerations. In some cases, forest ecosystem management activities such as undertaking prescribed burns; completing protected area beetle assessments; developing ecosystem management plans; or, mapping and inventory to support long-term management activities may be cooperatively undertaken by ESD and MoF.

VIII. Communications

To ensure consistency, communication with or information requests from media or other interest groups regarding park or protected area management of beetle infestations will be directed by MoF staff to either ESD Parks and Protected Areas Branch or ESD Regional Staff. Accordingly, all communications or requests for information to ESD staff regarding forest management in areas outside of parks or protected areas will be directed to appropriate MoF HQ or regional staff.

IX. Research

ESD and MoF will coordinate research activities regarding beetle management or forest health in general on both a provincial level through Parks and Protected Areas Branch and MoF HQ and at a regional level through MoF and ESD regional staff.

X. Conflict Resolution

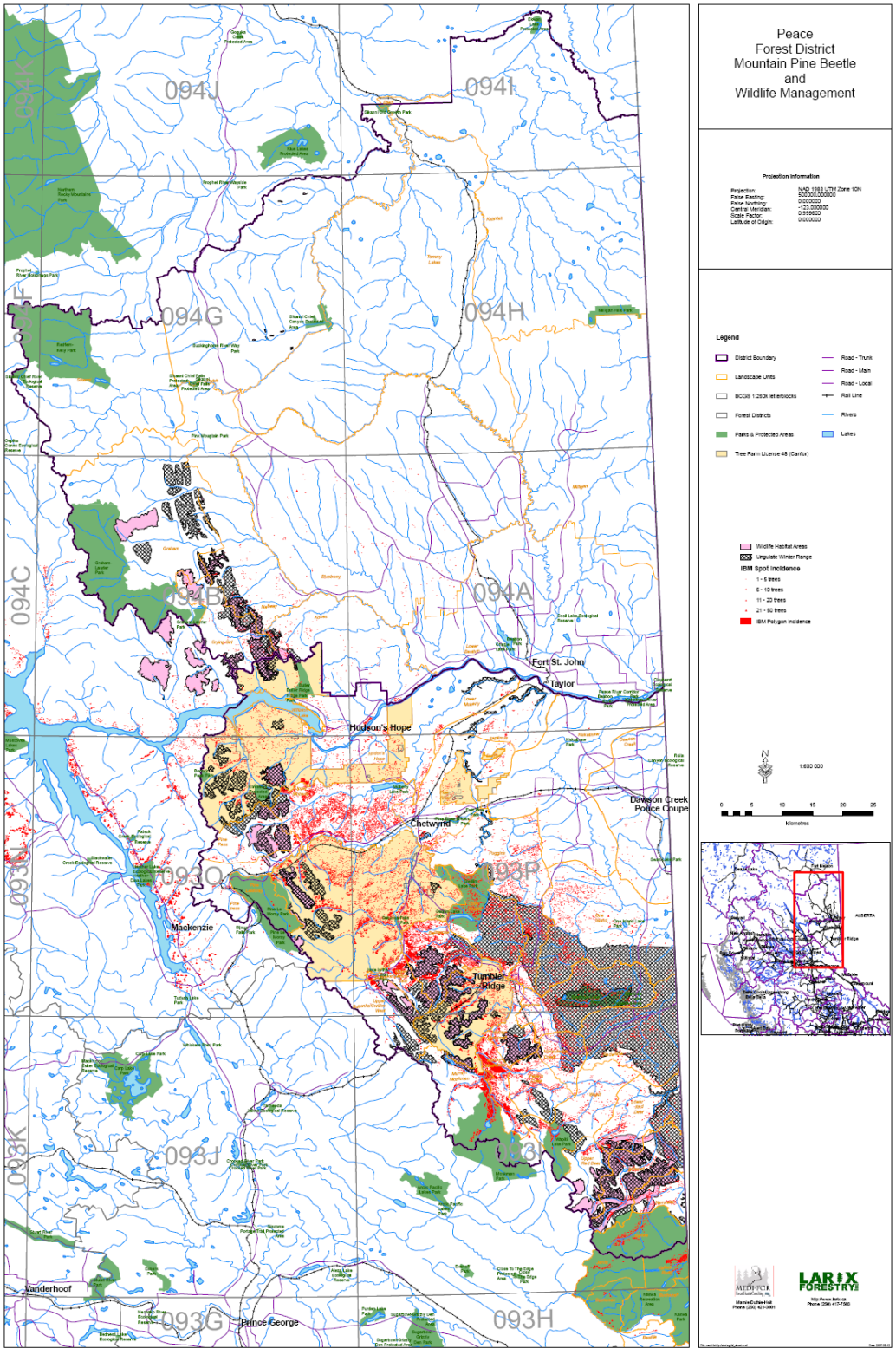
As a matter of principle both ESD and Forests desire to resolve any disputes that arise related to the management of the issues covered in this MOU at the lowest possible management level. This being the case, every effort will be made by senior field staff of both agencies to jointly explore and find mutually acceptable solutions to operational problems that may occur from time to time. When all attempts to resolve a dispute at the field level fail, the issue will be forwarded to ESD Parks and Protected Areas Branch and MoF Headquarters for consideration and resolution by respective Ministry executives.

The complete parks conservation program policies are available at:

http://wlapwww.gov.bc.ca/bcparks/conserve/consprog.htm

Parks and mountain pine beetle FAQ is available at:
http://wlapwww.gov.bc.ca/bcparks/conserve/pine_beetle/pine_beetle.htm

Appendix 6. Wildlife Habitat Areas (WHAs) and Ungulate Winter Range (UWRs) for the Peace Forest District (2006) as well as the 2006 Mountain pine beetle incidence.



Source: Joelle Scheck, Ecosystem Biologist, Ministry of Environment; email Joelle.Scheck@gov.bc.ca; January 2007.

Appendix 7. Annual Work Plan including sequence of events for Mountain Pine Beetle by Strategy with Critical Dates.

Tactics	Strategy	Critical Dates
Survey/Assessment		
Timing of adult flight		
Infestation intensity rating	All	June 15 – September 15
Hazard rating	All	Any time
Risk rating	All	Any time
Overview flights	1,2,3	Any time
Detailed Aerial GPS Surveys	1	July 15 – September 15
Overwintering mortality	1,2	August 1 – September 15
assessments	All	May 1 – June 15
Preliminary G:R ratio assessments	All	September
Ground surveys (grid probe, walkthrough, or star probe)	1	Post-flight to pre-flight
Harvesting		
Sanitation		
Salvage	1,2	Any time
High hazard host removal	3	Any time
Highest priority rating system	1,2	Any time
	1,2,3	Any time
Single Tree Treatments (STT)		
Fall & burn		
MSMA	1,2	October 15 – May 15
Debarking	1,2	July 25 – August 20
Small patch/single tree selection	1,2	Up to flight time
	1,2	Any time
Bait use (with B and C above)		
Containment		
Monitoring	1,2	May 1 – July 15
Prior and follow up to STT	1,2	July 1 – August 15
	1,2	Treatment to July 15
E. Hauling Restrictions		
	1,2	June 15 – September 15
F. Access Development		
	All	Any time
Silviculture Treatments		
Long term:		
Species manipulation		
Age class mosaic manipulation	All	As per harvest
	All	As per harvest

The strategies are as follows:

1. Prevention/Suppression
2. Holding
3. Salvage
4. Monitor

Appendix 8. Mountain Pine Beetle Overwintering Mortality Survey Protocols for the Dawson Creek TSA.

Assessment of Bark Beetle Winter Mortality and R-value Determination in Bark Samples
Sampling should be conducted in May yearly.

Site and sample selection:
- visit and collect samples from 1-3 sites in the Dawson Creek Forest District.

It is up to the collector to determine access routes and specific sites once general areas have been identified.

Sites must have an active MPB population that is defined as having a minimum of 12 mass attacked trees per site. Sites with a range of elevation should be selected where possible.

At each site the following information shall provide be collected:
- ✓ GPS coordinates of site
- ✓ Geographic location (drainage, etc)
- ✓ Date sampled
- ✓ Number of trees sampled and data for each tree.

Sampling Methods
Sample ±10 trees per site. Sample slabs should be cut at 1.3 m on north and south aspects after verification of current attack status. Try to avoid trees that have old attack from previous years, but woodpecker activity on trees selected is okay. Slabs should be removed with a chainsaw allowing enough bark surface to yield a 15 cm x 15 cm sample after trimming. If trees are relatively small, the entire round can be cut out. For each tree sampled, please provide the following information:
- ✓ dbh
- ✓ aspect (north or south)
- ✓ date sampled
- ✓ site number, tree number and location

Samples from trees should be clearly labeled with a felt marker as to site, tree # and aspect (N or S). Samples should then be paired, tied together with flagging tape and placed in bags (preferably burlap) or boxes for transportation.

1. Sample trees should not be directly adjacent to openings or road edges
2. Sample trees should have well established current bark beetle attack (2004 mass attack) around the whole bole at the 1.3 metre height.
3. Where possible, sample trees should be greater than 20 cm at dbh.
4. Partial attacks or trees with old strip attacks should be avoided.
5. Select trees randomly along existing probe lines or establish transects through infestations/attack centres.

6. Trees with woodpecker activity are acceptable for inclusion in the random sampling of 2004 mass attacked trees.

Cutting, Marking and Handling of Samples

- ✓ Two samples per tree are cut from the north and south aspects of mass attacked pine at a height of 1.3 metres.
- ✓ Samples must be slightly larger than 15 x 15 square centimeters to permit trimming to a consistent size.
- ✓ Avoid branches, scars or bark irregularities on the sample area.
- ✓ A vertical plunge cut with a chainsaw followed by two shallow horizontal crosscuts at the top and bottom allows easy sample removal. The larger the tree diameter the shallower the plunge cut needs to be.
- ✓ Samples should be labeled with stapled-on labels as well as with felt pen in case the paper label tears off. A felt pen mark on the freshly cut wood surface with at least the site, tree number and aspect is recommended.

- ✓ Samples should be paired up after marking with the cut surfaces facing each other and tied together with one or two wraps of flagging to hold then together.
- ✓ Paired samples are than placed in cone sacks (usually two sacks/site) or boxes and labeled by district and site.
- ✓ Samples should be stored in a cool shaded area until shipping to the West Fraser in Chetwynd. Water or fuel exposure should be avoided.

Appendix 8. Dawson Creek timber supply area: analysis in support of an AAC uplift, partitioned to salvage mountain pine beetle attacked lodgepole pine stands

Dawson Creek Timber Supply Area

Analysis in support of an AAC Uplift, Partitioned to Salvage Mountain Pine Beetle attacked Lodgepole Pine Stands

August 2005

Draft
Version 1c

Completed for:
Ministry of Forests – Peace Forest District
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Executive summary

Following are the key points of a timber supply analysis to measure the impact of a mountain pine beetle epidemic in the Dawson Creek TSA.

1. Primary assumption is that the Dawson Creek TSA is currently in the initial stages of a MPB epidemic. Estimates on the level of mortality, the intensity of the epidemic, shelflife period, regeneration delay period are unknown and highly subjective.
2. A MPB epidemic model was used to estimate the amount of mortality in the short term (i.e., 10-20 year). Total attacked volume in the conventional and the small pine land bases, and the year of attack was then applied to the FSSIM forest estate model. FSSIM was used to predict the level of the mid-term fall down in harvest and the amount of non-recoverable losses (NRLs) in mature merchantable pine.
3. The results of the initial harvest simulations were unexpected.
4. The 1996 and 2002 allowable annual cut (AAC) for the TSA is significantly below the long-term sustainable yield (LRSY). This has a significant impact on perceived expectations of what should/may occur as a result a MPB epidemic.
5. The 2002 TSR2 analysis was re-run. The revised analysis utilized a modified inventory (updated to May, 2005), and a timber harvesting land base (THLB) coverage that was provided by the MOF and is slightly larger (3.6%) than the 2002 THLB. Though not part of this analysis, a revised inventory is believed to be the primary reason.
6. The current analysis utilized the same analysis unit definitions and the same yield tables as were developed and used by the MoF in the 2002 timber supply review (TSR2). This posed some problems, as the yield tables did not truly correspond to the analysis unit areas they were to represent, (they underestimated the current volume in conifer stands and overestimated volume in deciduous stands – the small pine stands were accurately represented). Operational adjustment factors were applied to the analysis units to ensure the model calculated the same growing stock as is currently on the inventory file.
7. The 2002 TSR2 did an elaborate cycling of mortality in the non-contributing forest land base. This was not done in the current analysis, as mortality from the MPB greatly exceeded the cycling previously determined.
8. The TSA landbase is divided into 3 components: deciduous leading, traditional conifer leading, and small pine stands. The current long-run sustained yield (LRSY) for the conifer and small pine stands was determined to be 12.1% and 30.0% higher than the current corresponding coniferous apportionments. The deciduous harvest forecast was accelerated by setting it to the current deciduous apportionment, and then falling the harvest to the deciduous LRSY.
9. Within the Dawson Creek TSA, there is 34.5 million cubic metres of merchantable pine within the THLB that is at risk to the MPB. Utilizing the MPB epidemic and control model, and estimating the 70% of the larger diameter stems (≥17.5cm dbh) and 25% of the smaller stems (≥12.5 and <175.cm dbh) would be attacked, resulted in mature merchantable pine mortality of 19.6 million cubic metres or 57% of the pine at risk. Mortality was apportioned, 13.85 million m3 in

the conifer THLB and 5.75 million m3 in the small pine THLB. Pine mortality was also determined for the non-contributing land base. Mortality was not modeled for the deciduous land base.

10. The forest estate model prioritized harvesting in pine stands attacked by MPB.
11. The results of the harvest simulations revealed that the current AAC could be sustained indefinitely – even though the MPB epidemic will result in an almost 13,000,000 cubic metre pine NRLs over the next 13 years. The reason is that the current AAC is below the LRSY for the TSA. Which basically means that the forest resource in underutilized and capable of withstanding considerable mortality.
12. Pine mortality had an impact on the deciduous harvest flow. The duration of the short-term AAC was reduced from 30 years to 20 years. The harvest then stepped down to the LRSY of 617,000m3.
13. Accelerated harvest levels were tested to identify the extent of the mid-term fall and the amount of NRL.
14. Although information was accumulated separately for the traditional conifer, small pine and deciduous land bases, the table following describes the results for the TSA as-a-whole.

Scenario # and Description	Short Term Harvest Level	Short-term % change from Base Case	Mid Term Harvest level	Mid term Percent change from Base Case	Long term Harvest level	Volume at risk	Dead Pine Volume harvested	Total pine volume lost (NRL)	Percent Salvaged
LRSY (80 periods)	1,731,222	-6.9%	1,731,222	8.5%	1,732,000	0	0	0	
Base Case (40 periods)	1,782,322	-4.2%	1,782,322	11.7%	1,782,322	0	0	0	
Current AAC - no beetle	1,860,000	0.0%	1,595,000	0.0%	1,595,000	0	0	0	
MPB Base Case - current AAC	1,860,000	0.0%	1,595,000	0.0%	1,620,322	19,605,361	6,511,885	13,093,476	33%
20% uplift Conif. and Small Pine	2,055,600	10.5%	1,641,000	2.9%	1,732,000	19,605,361	7,736,564	11,868,797	39%
50% uplift Conif. and Small Pine	2,349,000	26.3%	1,645,000	3.1%	1,732,000	19,605,361	9,553,861	10,051,500	49%
70% uplift Conif. and Small Pine	2,544,600	36.8%	1,641,000	2.9%	1,732,000	19,605,361	10,402,950	9,202,411	53%
100% uplift Conif. and Small Pine	2,838,000	52.6%	1,634,000	2.4%	1,732,000	19,605,361	11,465,682	8,139,679	58%
200% uplift C 300sp	3,916,000	110.5%	1,572,000	-1.4%	1,732,000	19,605,361	14,199,911	5,405,450	72%

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I Tabular analysis results
II Analysis Modelling Assumptions
III IFSBeetle Background Information

Dawson Creek Timber Supply Area

Analysis in support of an AAC Uplift,
Partitioned to Salvage Mountain Pine Beetle attacked
Lodgepole Pine Stands

Introduction

From 1999 to present 2005, a mountain pine beetle epidemic has rapidly grown and spread across the north-central interior of B.C. Analysis and review of the effects of the epidemic have to-date been focused on the hardest hit timber supply areas (TSA) – basically those TSAs west of the Rocky Mountains.

In 2003 the MPB epidemic began its spread to areas within and slightly east of the Rocky Mountains. Evidence of this occurrence became apparent when aerial overview flights revealed the appearance of red-attacked lodgepole pine trees within the south-western borders of the Dawson Creek TSA. The previous notion was that heights-of-land and scarcity of host material consistent with the Rocky Mountains would present a physical barrier to the infestation. This optimism has unfortunately been abandoned.

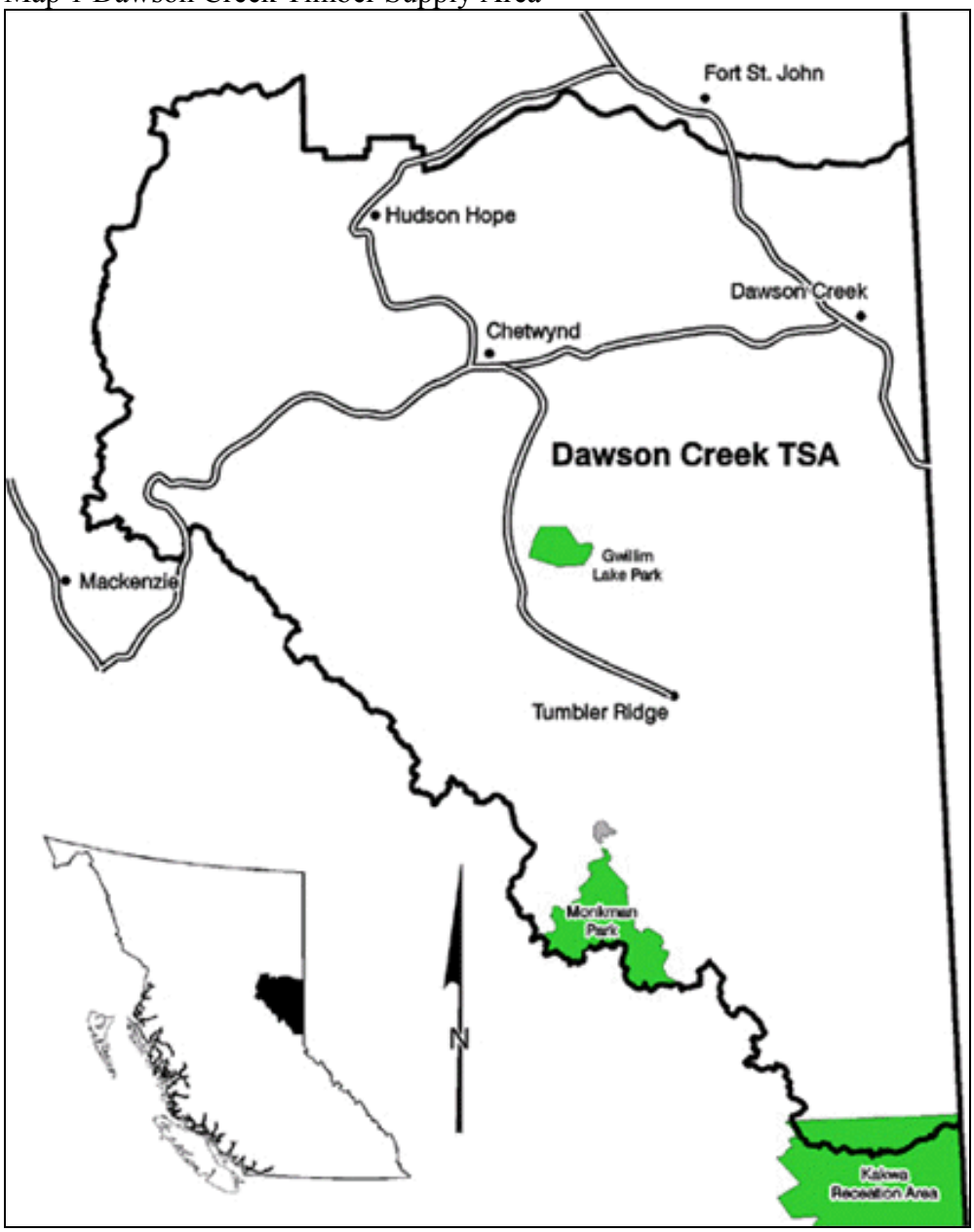
Concern regarding control of the epidemic and our ability cut it short before it can spread uncontested across into the boreal plains of Alberta and Saskatchewan is high. Collaboration between the BC and Alberta governments regarding control measures has begun. One hope is that coordinated control measures, primarily in the form of harvesting MPB infested trees, will result in our ability to limit the infestations spread over the Rocky Mountains long enough for the epidemic to implode within the BC interior. Another long-shot is that a cold-weather event will kill the beetle populations.

The licensees and BCTS within the Dawson Creek Forest District have in 2004 responded to the surge in MPB mortality within the TSA. To-date, pile and burn measures and small selective harvests have addressed almost all identified red-attack sites. The investment in these control measures has been substantial. Its success however is not encouraging. While operational control may have helped to minimize expansion mortality rates, the influx of beetle populations for the west continues, evidence of which even today presents itself with the occurrence of red tree crowns at ever increasing northern latitudes.

To help address active operational control measures, Dawson Creek licenses feel that an uplift to the allowable annual cut (AAC) is warranted. The intention of this report is to examine the impact of various uplifts on the growing stock for the TSA.

The premier difficult in conducting such an analysis is determining a reasonable estimation of the amount of mortality that may occur. The number of potential scenarios is innumerable. And certainty around the most probable scenarios is weak. This analysis will utilize two models to estimate the amount of pine mortality that may result from several different management and mortality possibilities.

Map 1 Dawson Creek Timber Supply Area



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Methodology

This analysis report presents the results of a series of possible management and mortality scenarios that depict the potential impact of the MPB on the merchantable growing stock in the Dawson Creek TSA. The forest estate modeling information and assumptions utilized in this analysis are taken from several sources. The land base inventory is current for disturbance to May 2005, and has been updated since the Timber Supply Review with new inventories for some parts of the TSA. The timber harvesting land base is defined using the Timber Supply Review logic identified in the October 2002 Timber Supply Review for the Dawson Creek TSA. Analysis unit definitions and managed and unmanaged stand yield tables were also taken from the TSR for the Dawson Creek TSA[5]. Management considerations largely follow those of the TSR with the exception that the grizzly bear habitat forest cover constraints were removed. These sources of information provided the base data for replicating a Dawson Creek TSA timber supply analysis – prior to a MPB epidemic.

Modeling a mountain pine beetle epidemic was carried out by IFS utilizing a beetle epidemic and control simulation model to carry out short-term mortality predictions[6]. The output from this model was then applied to the MOF's forest estate model (FSSIM) to measure mid term impacts. The methodology involved making assumptions regarding:

- Current (2004) infestation intensity
- Pine volume-at-risk
- Shelf life of attacked stems.
- Regeneration delay of non recoverable losses
- Current and short-term harvest flow
- Forest cover constraints
- Timber harvesting land base determination
- Yield Tables
- Mortality in the non-contributing forested land base

Detailed information regarding each of these items is appended to this report. Generally, modeling was carried out as follows:

i. The TSR2 Base Case analysis was re-created using and updated inventory file.
ii. The TSR2 analysis units remained unchanged as were the yield tables associated with each of these analysis units.
iii. A base case harvest flow for the conifer, deciduous and small pine land bases was re-established to ensure modelling logic confirmed with the TSR2.
iv. Pine mortality was then determined using a beetle epidemic model to predict the amount and rate of pine volume killed over the next decade. The model was

[5] The initial analysis unit definitions and yield tables are identical to TSR2.
[6] The epidemic model is the Reed-Frost model developed by Cole et al, in 1985 and modified into a MPB epidemic and control simulation model by IFS in 1986, and re-visited in 2003. Details regarding the model are appended to this report.

developed by IFS in 1986 using a formula developed by Cole et al, and adjusted for beetle epidemics in the USA, in the Chilcotin and for the current epidemic in Vanderhoof.

v. The output from the beetle epidemic model was used to identify the amount of pine mortality (volume) in the traditional conifer land base and the small pine land base. The timing of this mortality was also predicted using this model.

vi. The TSA's analysis units were reassigned numbers to indicate the predicted year in which they are assumed to be attacked.

vii. Attacked AUs were prioritized for harvesting.

viii. If an attacked AU is not harvested before the end of the shelf-life period (4 years), the pine component of the stand (for non-pine leading AUs) is lost. For pine-leading AUs, the entire stand volume (pine and non-pine) is lost and assumed to regenerate after 10 years to an unmanaged pine stand.

ix. Pine volume within the non-contributing forested land base was modeled under the same assumptions as the THLB.

x. Harvest levels for the simulation were applied using the following rules.
    1 Current apportioned AAC split by deciduous, small pine and conifer
    2 Increase apportioned AAC by 10 percent (small pine and conifer only)
    3 Increase apportioned AAC by 30 percent (small pine and conifer only)
    4 Increase apportioned AAC by 60 percent (small pine and conifer only)
    5 Increase apportioned AAC by 100 % (small pine and conifer only)

xi. Harvest rules were applied as follows:
    1 Dead pine stands first
    2 Pine stands at risk second
    3 Conifer stands with a significant pine component
    4 Relative oldest first

Additional details regarding the modeling assumptions used are provided in Appendix II.

Current Land Base Status

The area and volume data cited in Table 1 are based upon the Dawson Creek TSA inventory files that have been updated to June 2005.

Table 1 Dawson Creek TSA Statistics

Landbase		Areas (ha)	Volumes [4]	vol/ha
TSA	Gross Land base	2,342,553		
	Gross Productive Forest Land Base [1] (includes parks and eco reserves)	1,500,473	215,231,751	143
	Timber Harvesting Land Base (THLB) [2]	756,342	140,592,849	186
	Merchantable THLB Area [3]	509,323	130,297,599	256
Deciduous	Merchantable THLB Area	181,259	42,607,712	235
	Merchantable Pine Volume [5]		1,580,182	
Total Conifer	Merchantable conifer THLB	328,064	87,689,887	267
	Merchantable Pine Volume		32,986,362	
Traditional Conifer	Merchantable THLB Area	279424	73,510,146	263
	Pine Volume in the Conifer land base		22,565,538	
	Merchantable THLB Area - pine leading	75,706	21.517.202	284
	Pine Volume in pine leading		17,460,546	
Small Pine land base	Merchantable THLB Area	48,640	14,179,742	291
	Pine Volume in the Small Pine land base		10,420,824	

1 Gross Forest Land Base includes parks and eco-reserves which contribute to biodiversity. The equivalent TSR2 value is 1,509,142 ha

2 The THLB equivalent area in the MOFs TSR2 was 730,220 ha

3 Merchantable THLB area and volumes was defined as all stands having >120m3/ha

4 All Volumes are net of decay waste and breakage and adjusted for VRI. Volumes are 17.5+cm dbh utilization for all species except pine which is 12.5. (the 9.0cm+dbh and 7.5cm dib top utilization limits for small pine are not reported)

5 Where pine component is > 10percent and stand volume/ha is >120m3/ha

The values provided in Table 1 are reflective of the Dawson Creek timber supply area Crown forest inventory which has been updated for logging depletions to 2005. Volumes relate to inventory volumes adjusted for phase 1 sampling. Table 1 identifies that there is approximately 33 million cubic metres of merchantable pine volume in the coniferous timber harvesting land base that is at risk to attack by the mountain pine beetle.

Current Status of the Allowable Annual Cut

The AAC for the Dawson Creek TSA (effective July 2005) is 1,860,000 cubic metres per year. This is apportioned in the Dawson Creek Rationale for AAC Determination May 2003, as shown in Table 2. Also shown are the annual non-recoverable losses applicable to blowdown, fire, insects and disease. All figures shown in this report are net of these NRLs.

Table 2 Current Partitioned AAC

Partition	AAC (m^3/year)	Assumed Non Recoverable Losses (NRLs) in m^3/year
Traditional Conifer	878,000 or less	48,778
Small Pine	100,000 or more	1,360
Leading Deciduous stands	882,000	8,754
Total	1,860,000	58,892

The analysis conducted herein does not address the impact of pine mortality within the leading deciduous stands that contributes to the current deciduous partition. Of the approximately 42 million cubic metres of mature merchantable conifer and deciduous volume existing within the deciduous land base, only 1.6 million cubic metres of this is pine. Hence the impact of the MPB and potential pine mortality in deciduous-leading stands should be relatively small (e.g., 4 percent).

The impact of the MPB on the coniferous land base was modeled using both a short-term beetle epidemic and control simulation model, and a mid to long term forest estate model. Simulations were conducted separately for the small pine component of the TSA and the remaining and significantly larger coniferous component of the TSA.

Short term Mortality Predictions

At present, there is no truly accurate way to predict the intensity of the spread of a MPB epidemic across the Dawson Creek TSA. Barriers imposed by the Rocky Mountains and typically colder temperature associated with these latitudes, place geographic and climate variables on mortality predictions that are completely different from what has been experienced in the BC central interior. Nevertheless, some form of mortality prediction is required to estimate and model the potential impact of pine mortality on harvest flows in the Dawson Creek TSA.

The Reed-Frost epidemic model developed in the U.S.A. (Cole et al 1985)[7], and modified by Industrial Forestry Service Ltd. in 1986 (for used in the Chilcotin MPB epidemic) was used to bring some degree of science to this question. Specify details regarding the

Cole, Walter E., Gene D. Amman and Chester E. Jensen 1985 Mountain Pine Beetle Dynamics in Lodgepole Pine Foresters. Part II: Modeling of Mountain Pine Beetle Populations. USDA For. Serv., Gen. Tech. Report INT-188

model are provided in Appendix III. Many of the variables in the equations related to this epidemic model have been refined and localized using known mortality values from the current epidemic in the Vanderhoof Forest District, as well as data from the Cariboo-Chilcotin epidemic of the mid-1980s.

Very generally, inputs to the epidemic model include Dawson Creek TSA forest stand attributes such as: area, stand composition, the proportion of each stand's volume that exists in large diameter stems versus small diameter stems, and estimates on the amount of volume at risk that occurs in large diameter stems versus small diameter stems. This however is not a spatial epidemic model. The proximity of stands to existing mortality, elevation, wind, etc is not modeled. The model assumes all stands are equally at risk, and that based upon previous epidemics, mortality will occur such that 70% of larger diameter stems (eg >17.5cm dbh) will be attacked, and 25% of the smaller diameter stems (12.5cm to 17.5 cm dbh). Mortality was calculated separately for the traditional conifer land base and the small pine land base, and separately again for the THLB versus non-contributing land base (NCLB). Figure 1 illustrates the predicted pine mortality in the traditional conifer land base, as well as showing the current allowable annual cut of 868,000 cubic metres per year, and non-recoverable losses as a result of directing 787,000 m^3 annually to clearcuts, 100,000m^3/year to selection harvests and 2000 m^3/year to a pile and burn program.

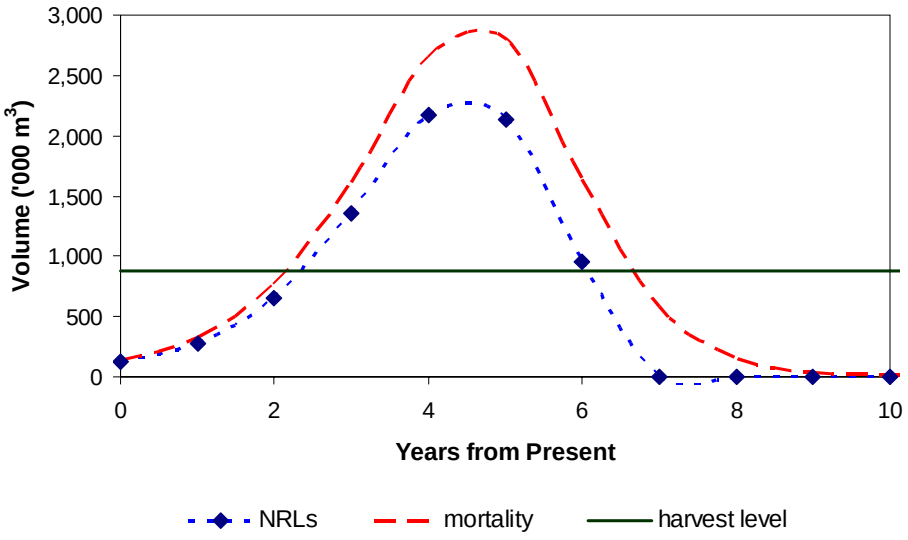


Figure 1 Short Term Predicted Mortality in the Conventional Conifer land base

The epidemic model was used to both predict the level and the rate of spread of pine mortality aspatially over time. Figure 2 and Table 3 provide the post-analysis mortality results calcualted by the MPB epidemic model, as well as the levels of mortality imposed in the forest estate model (FSSIM) for both the traditional coniferous and the small pine land bases. For the purposes of this analysis, the epidemic was assumed to completely run its course in 9 years, as represented by the blue mortality line and the red columns in Figure 2. The small change in future mortality (i.e., after 2013) as predicted by the green

hatched line is largely academic, and would produce only a small change in the mid-term timber supply.

The epidemic model estimated that 19.6 million cubic metres of merchantable pine volume within the timber harvesting land base will be killed by the mountain pine beetle over the next 8 years. This represents approximately 57 percent of the mature, merchantable pine volume within the TSA. A proportionally similar amount of mortality was also calculated for the pine component of stands in the non-contributing land base (e.g., comprised of poor sites, environmentally sensitive areas, parks, inoperable sites, riparian reserves). Mortality occurred in both pure pine and mixedwood stands.

Table 3 Mortality and Rate of Attack in the THLB

	Traditional Conifer THLB		**Small Pine THLB**		**Total Conifer THLB**	
Year	**Percent mortality**	**Mortality (m^3)**	**Percent mortality**	**Mortality (m^3)**	**Weighted Percent Mortality**	**Mortality [1] (m^3)**
2005	8%	1,108,080	2%	115,087	6.2%	1,223,167
2006	9%	1,246,590	4%	230,174	7.5%	1,476,765
2007	11%	1,523,610	7%	402,805	9.8%	1,926,415
2008	14%	1,939,140	15%	863,154	14.3%	2,802,294
2009	18%	2,493,180	24%	1,381,046	19.8%	3,874,227
2010	18%	2,493,180	26%	1,496,133	20.3%	3,989,314
2011	13%	1,800,630	16%	920,697	13.9%	2,721,328
2012	9%	1,246,590	6%	345,262	8.1%	1,591,852
Totals	100	13,851,002		5,754,359	100.0%	19,605,361

1 Note that these mortality numbers are estimated based upon 2005 volumes. The actual volume that will die could also be presented by growing these stand the requisite number of years until mortality occurs. If done, this estimate of 19.6 million cubic metres would increase to approximately 21.3 million cubic metres.

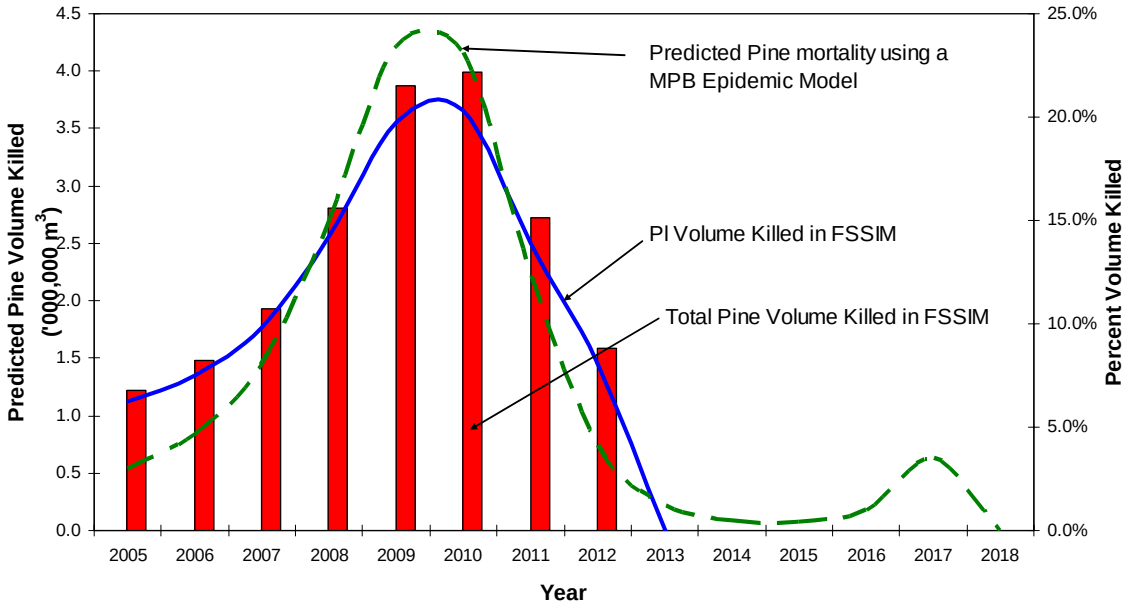


Figure 2 Estimated Mortality and Rate of Attack

Modelling Assumptions

Other epidemic modelling assumptions that were factored into the forest estate model include shelf-life, traditional non recoverable losses (e.g., NRLs described in Table 2), regeneration delay, control methods, economic limits on harvesting, and limits on the amount of harvestable small pine volume. General information regarding these assumptions follow:

Shelf-life is a measure of the average number of years between when a pine tree is killed by MPB and when the trees is no longer considered of commercial value – typically due to the development of rot within the stem and checking around the perimeter. The shelf-life period of a stand can be influenced by many factors, including climate, moisture, soil and the commercial end-product of the trees. In the Prince George TSA, shelf-life terms of three to five years have been generally assumed for the production of lumber. Some OSB manufactures contend that a shelf-life of 10-12 years may be reasonable for the production of OSB chips. Licensees within the Dawson Creek TSA were queried on what they believed might be the shelf-life of pine in their operating areas. Though uncertainty exists, 3-5 years was estimated to be the shelf-life for primary manufacturers. In this analysis an average 4-year shelf-life period was applied to the models.

NRL regeneration delay is a forest variable that, while not influencing short-term harvest forecasts, will affect the mid-term through the depth of the fall-down and the timing of harvest recovery. Once again, data does not support any one estimate. A period of 10 years was used in this analysis. Stands having less than 120 cubic metres of merchantable timber after the pine was killed were assumed to regenerated to unmanaged stands after a 10-year delay. Stands retaining or acquiring more than 120 m^3/ha within 40 years after the epidemic were considered merchantable and remained eligible for harvesting.

Control methods are management actions that are used to control the MPB epidemic. These methods might include pheromone traps, single tree pile and burn, selective logging and clearcut logging. The beetle epidemic model may be used to conduct analysis on the effect of single tree pile and burn, selective logging and clearcut logging. The forest estate model (FSSIM) analysis assumed cleacut logging only.

Economic limits on the amount of harvesting are a measure of the amount that the allowable annual cut could relatively be increased, in light of current market demands and the capacity of existing processing facilities. In this analysis the AAC was increased incrementally to a maximum 200% increase in the traditional coniferous apportionment, and 300% in the small pine apportionment.

Limits on the amount of dead volume harvested might relate to market demands or problems with manufacturing of significant quantities of dead fibre. It is well known that the inclusion of dead pine in the manufacturing of OSB is problematic at best. Given that this analysis has not extended the shelf-life to meet potential OSB capabilities, there has been no limit placed on the amount of dead volume harvested. However, licensees have indicated that piece size is a prime concern within their manufacturing facilities. This provided additional incentive to keep the small pine partition separate from the traditional conifer land base.

Analysis Results

The prime assumption of this analysis is that a MPB epidemic will occur in the Dawson Creek TSA. The FSSIM forest estate model is not designed to simulate the onset of an epidemic and the impact of alternative beetle management control regimes. It can however, estimate the impact of the current and accelerated harvest levels on the predicted (pre-determined) level of mortality.

Assessment of the TSA without the MPB

Prior to determining the effect of the MPB on the Dawson Creek TSA, the re-built forest estate model was tested to assess the harvest flow results relative to the timber supply review that was completed in 2002. To support this analysis, three scenarios were completed.

Scenario 1. This first scenario mimicked the MOFs' Base Case, which was to derive a sustainable harvest level over a 400-year period. This was carried out to ensure the results were reasonable, relative to changes in the THLB and TSA inventory.

Scenario 2. Scenario 2 was run for 800 years (80 decades) to determine a long-run sustained yield. The purpose of this scenario is to derive that target in the long term that future harvest levels, after the epidemic, must be able to re-attain.

Scenario 3. Scenario 3 modeled the current harvest apportionment. This scenario established the base case against which the impacts of alternative, accelerated harvest levels were measured.

The results of these 3 scenarios, relative to the MOFs' TSR2 are shown in Figure 3 and summarized in Table 4.

Figure 3 Conifer, Deciduous and Small Pine Harvest flows Without a Beetle Epidemic

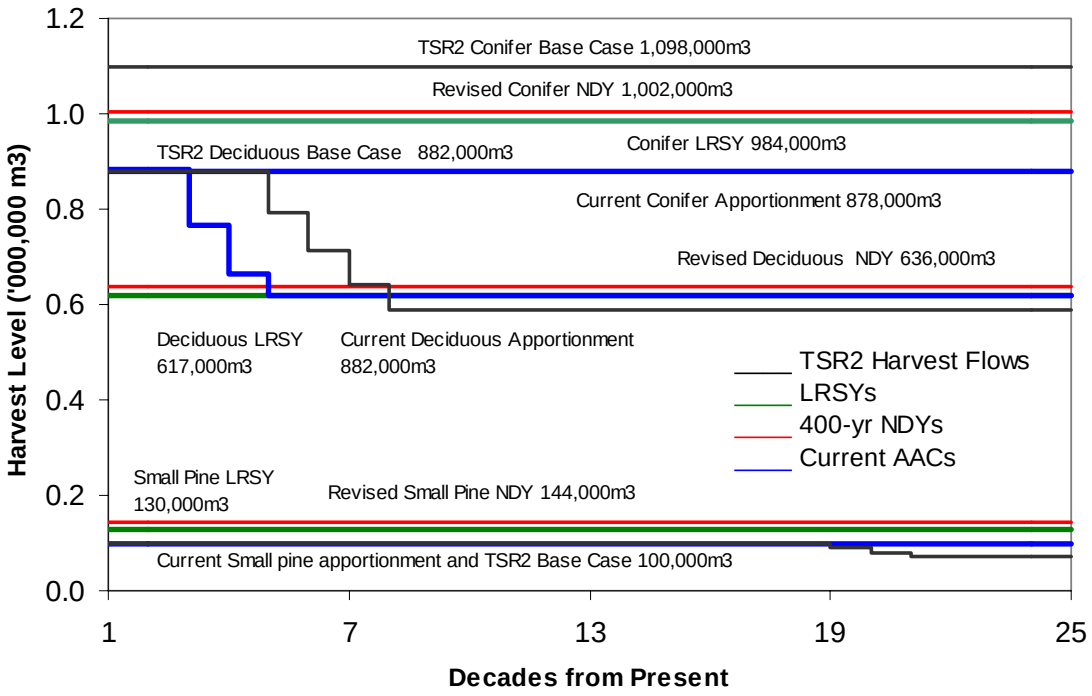


Table 4 Base Case Harvest Levels

Scenario	Term	Traditional Conifer	Small Pine	Deciduous
MOF's TSR2	short term	1,098,222	100,000	879,922
	long term	1,098,222	72,140	588,246
S.1. 400-year NDY	short term	1,002,322	144,000	636,000
	long term	1,002,322	144,000	636,000
S.2. LRSY	short term	984,222	130,000	617,000
	long term	984,222	130,000	617,000
S.3. Current AAC	short term	878,010	100,000	882000
	long term	878,010	100,000	617000

There are several important points to make in regard to these results:

1. The 400-year NDY (i.e., non-declining yield) best mimics what was determined to be the base case in the TSR2 report. Differences can be attributed to a revised inventory that appears to have shifted the average site index of many stands downwards. Since the yield tables have not been localized to the analysis unit areas representing this new inventory, some uncertainty exists in the revised scenario.

2. An 800-year long run sustained yield (LRSY) was determined to establish a future harvest flow target to be attained after the effects of the epidemic have passed. It was also established to verify that the current coniferous harvest levels are below their respective LRSY.
3. The current AAC is shown in table 4 to reveal that the current coniferous and small pine harvest levels for the Dawson Creek TSA are well below what the coniferous land base can sustain. This is especially important to understand when reviewing the impacts of the MPB on the harvest flows for the TSA. To understand the impacts of these flows, it is easiest if one considers the mountain pine as another licensee (albeit operating without tenure or consideration for geographic or geopolitical boundaries). If the established licensee's apportionments are below what the land base can sustain, then the impact of the MPB is mitigated by the difference between the current AAC and the short-term potential AAC of an accelerated harvest.

Assessment of the TSA with the MPB

As indicated previously, the forest estate model was adjusted to reflect the occurrence of a mountain pine beetle epidemic attacking and killing mature pine stands within the timber harvesting land base and the non-contribution land base. Approximately 60 percent of the pine at risk is assumed to be killed over the next 8 years. A total of six alternative harvesting scenarios were run. Of primary interest in each scenario was the amount of beetle wood harvested relative to the amount killed. Figures 4 through to Figure 9 illustrate the impact of the conifer harvest uplift and the MPB epidemic in the short, mid and long-term.

Figure 4 Harvest flow resulting from pine mortality while maintaining current apportionments

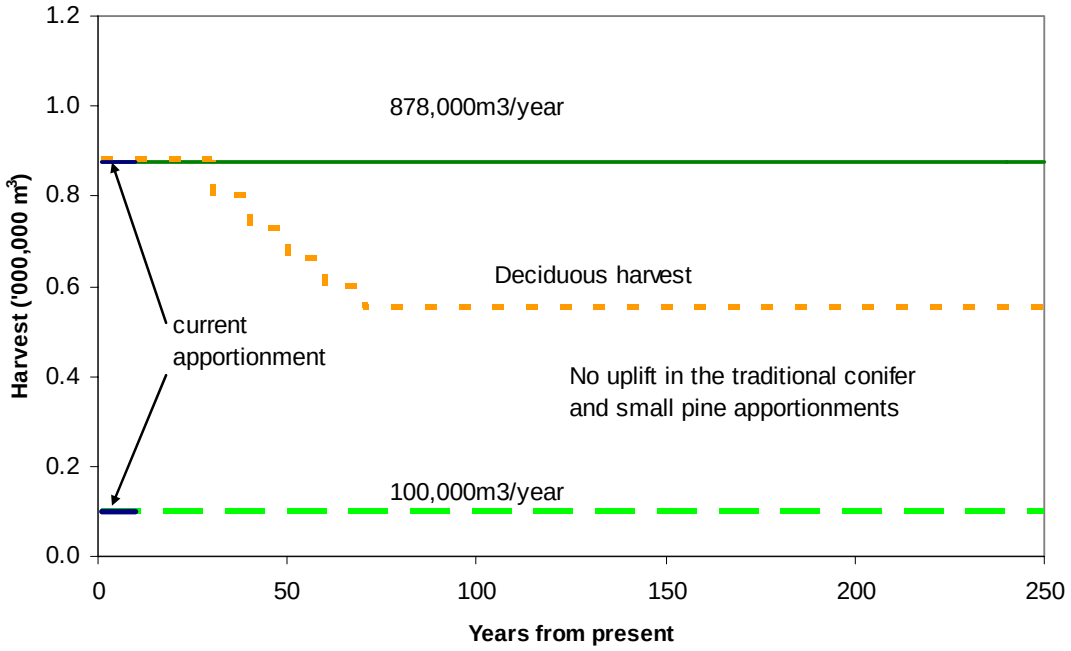


Figure 5 Harvest flow resulting from pine mortality and a 20% conifer AAC uplift

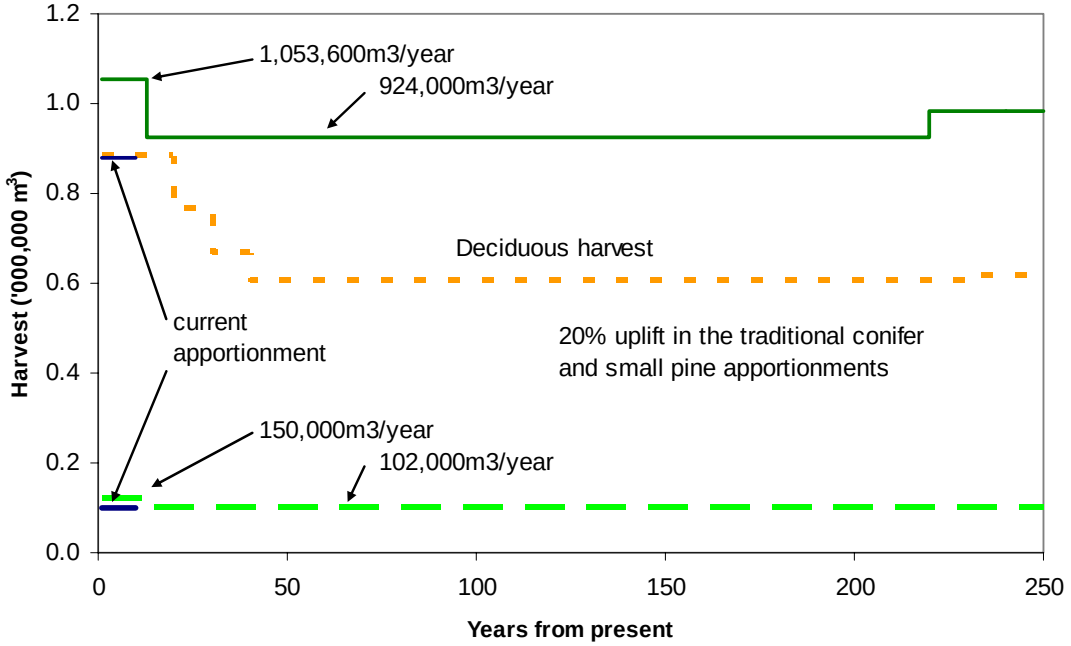


Figure 6 Harvest flow resulting from pine mortality and a 50% conifer AAC uplift

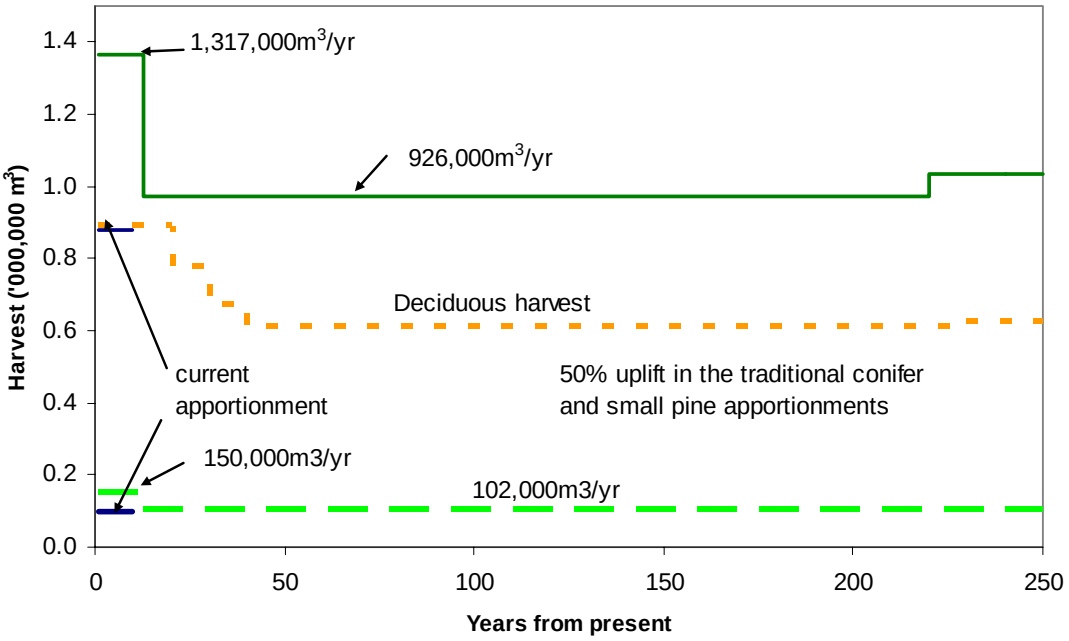


Figure 7 Harvest flow resulting from pine mortality and a 70% conifer AAC uplift

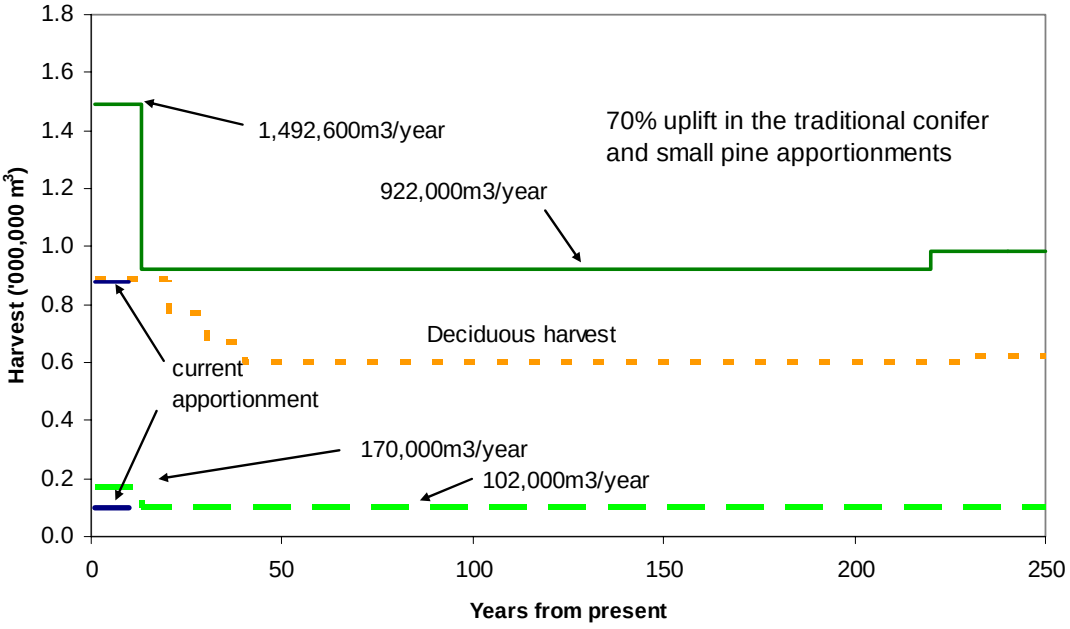


Figure 8. Harvest flow resulting from pine mortality and a 100% Conifer AAC uplift

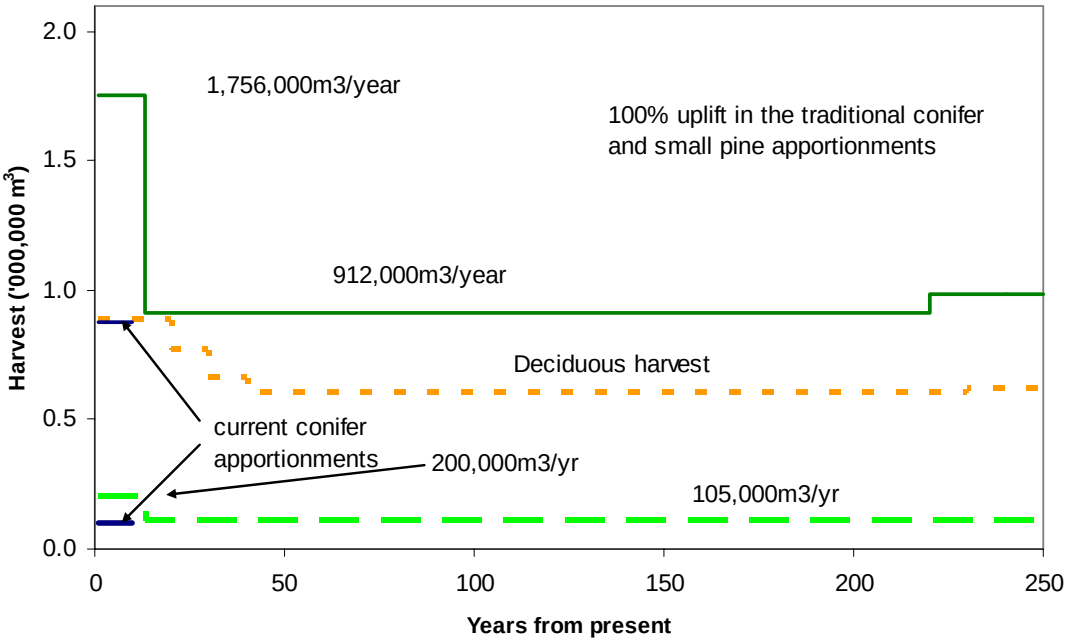
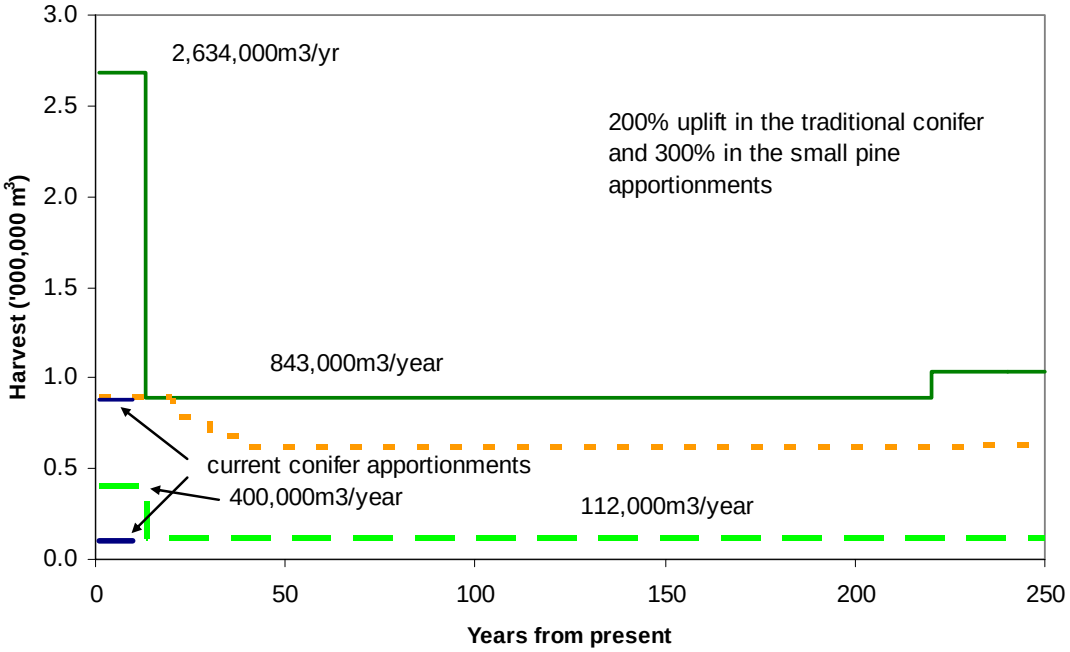


Figure 9 Harvest flow with a 200% conifer and 300% small pine AAC uplift



The results of these harvest simulations are no doubt somewhat surprising. The explanation is fortunately relatively simple. An accelerated harvest level and beetle mortality can be sustained on the Dawson Creek TSA land base because there is a surplus of old timber, and because the current and long-term harvest levels are below the sustainable harvest levels for the TSA. As modeled, if there were no beetle, the TSA could still support an accelerated harvest of double the current coniferous AAC for 20 years and then drop and sustain the current AAC for the next 250 year.

Note that the MPB epidemic does have an impact on the deciduous harvest flow relative to the harvest flow depicted in Figure 3 that showed the current deciduous apportionment. Without the beetle, the current deciduous AAC could be sustained for the next 30 years. Pine mortality reduces this to 20 years in the deciduous land base. The reduction is primarily a function of forest cover constraints within certain deciduous areas that are taxed as a result of increased coniferous harvesting.

As a comparative measure, Figure 10 and Table 4 illustrate the relative amount of pine that is salvaged as a result of the various accelerated harvest levels.

Figure 10 Percent pine salvaged by scenario

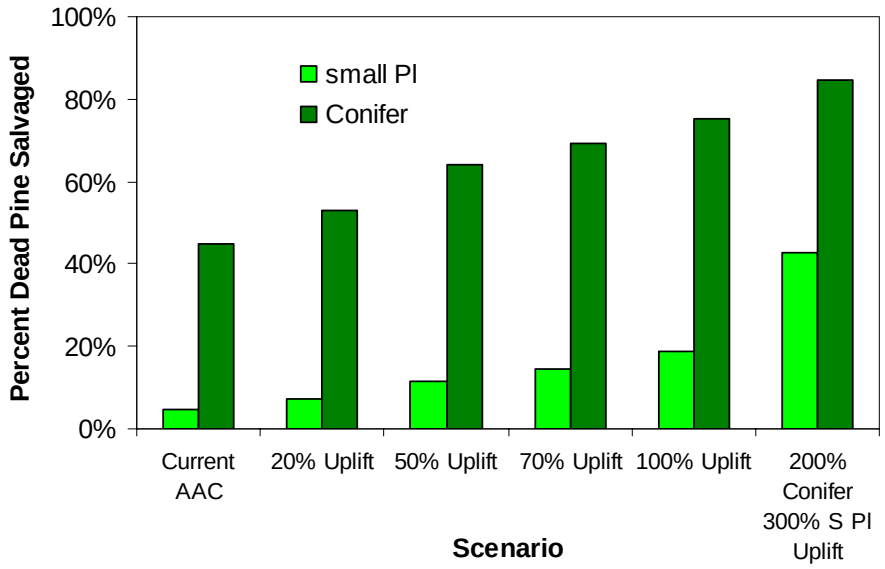


Table 5. Percent Pine Salvaged by Scenario

Scenario	small Pl	Conifer
Current AAC	4.6%	45.1%
20% Uplift	7.3%	52.8%
50% Uplift	11.7%	64.1%
70% Uplift	14.4%	69.1%
100% Uplift	18.6%	75.0%
200% Conifer 300% S Pl Uplift	42.9%	84.7%

Conclusion

This analysis reveals the based upon the best data available at this time; an accelerated harvest level can be directed towards mountain pine beetle killed lodgepole pine stands with negligible impact in the mid-term. The reason this is possible is because the current AAC is below the long run sustained yield for the TSA. All of the scenarios tested, with the exception of the 200 percent conifer increase, provide a mid-term harvest level that is above the current apportionment of 878,000 m^3/year for the traditional coniferous land base. An immediate 400% increase in the small pine apportionment provides a mid-term harvest level of 112,000m^3/year, 12 percent above the current small pine apportionment.

Discussion

There exists considerable uncertainty around modelling assumptions specific to the Dawson Creek TSA. The 2003 AAC Rationale for the Dawson Creek TSA identified and discussed many of these uncertainties and the weight they placed upon the decision to set the AAC below the calculated long-term sustainable harvest level. While some uncertainties, such as operability estimates, losses to oil, gas and mining exploitation, and mixedwood and balsam utilization, provided downward pressure on AAC calculations, other uncertainties such as site quality estimates provide significant upward pressure. Resolution of these uncertainties is typically costly and often require years of data collection and effort to rationalize. The mountain pine beetle epidemic further complicates forest modelling assumptions and places additional uncertainty around predicting future timber supplies.

What is certain is that the sooner dead pine stands are harvested and converted back to productive land, the less are the problems contending with a potentially massive rehabilitation program. Furthermore, though not modeled in this analysis, the effect of actively harvesting green-attacked pine is a reduction in MPB populations and some direct control over the spread of beetle populations.

Appendix I

Tabular Summary of Results

Traditional Conifer											
Scenario # and Description	Salvage length (years)	Short Term Harvest Level (m3/year)	Harvest duration (years)	Short-term % change from current AAC	Mid-term harvest level (m3/year)	Mid-term % change from current AAC	Long-term harvest level	Volume at risk (m3)	Dead Pine Volume harvested (m3)	Total pine volume lost (NRL) (m3)	Percent Salvaged
LRSY (80 periods)		984,222	800	12.1%	984,222	12.1%	985,000	0	0	0	n/a
Base Case (40 periods)	4	1,002,322	13	14.2%	1,002,322	14.2%	1,002,322	0	0	0	n/a
Current AAC - no beetle		878,000	400	0.0%	878,000	0.0%	878,000	0	0	0	n/a
MPB Base Case - current AAC	4	878,000	13	0.0%	878,000	0.0%	903,322	13,851,002	6,244,776	7,606,226	45.1%
20% uplift Conif. and Small Pine	4	1,053,600	13	20.0%	924,000	5.2%	985,000	13,851,002	7,317,200	6,533,802	52.8%
50% uplift Conif. and Small Pine	4	1,317,000	13	50.0%	926,000	5.5%	985,000	13,851,002	8,882,352	4,968,650	64.1%
70% uplift Conif. and Small Pine	4	1,492,600	13	70.0%	922,000	5.0%	985,000	13,851,002	9,571,762	4,279,240	69.1%
100% uplift Conif. and Small Pine	4	1,756,000	13	100.0%	912,000	3.9%	985,000	13,851,002	10,394,589	3,456,413	75.0%
200% uplift Conifer 300% small pine	4	2,634,000	13	200.0%	843,000	-4.0%	985,000	13,851,002	11,728,883	2,122,119	84.7%

Small Pine											
Scenario # and Description	Salvage length (years)	Short Term Harvest Level (m3/year)	Harvest duration (years)	Short-term % change from current AAC	Mid-term harvest level (m3/year)	Mid-term % change from current AAC	Long-term harvest level	Volume at risk (m3)	Dead Pine Volume harvested (m3)	Total pine volume lost (NRL) (m3)	Percent Salvaged
LRSY (80 periods)	n/a	130,000	800	30.0%	130,000	30.0%	130,000	0	0	0	n/a
Base Case (40 periods)	n/a	144,000	400	44.0%	144,000	44.0%	144,000	0	0	0	n/a
Current AAC - no beetle	n/a	100,000	400	0.0%	100,000	0.0%	100,000	0	0	0	n/a
MPB Base Case - current AAC	4	100,000	400	0.0%	100,000	0.0%	100,000	5,754,359	267,109	5,487,250	4.6%
20% uplift Conif. and Small Pine	4	120,000	13	20.0%	100,000	0.0%	130,000	5,754,359	419,364	5,334,995	7.3%
50% uplift Conif. and Small Pine	4	150,000	13	50.0%	102,000	2.0%	130,000	5,754,359	671,509	5,082,850	11.7%
70% uplift Conif. and Small Pine	4	170,000	13	70.0%	102,000	2.0%	130,000	5,754,359	831,188	4,923,171	14.4%
100% uplift Conif. and Small Pine	4	200,000	13	100.0%	105,000	5.0%	130,000	5,754,359	1,071,093	4,683,266	18.6%
200% uplift Conifer 300% small pine	4	400,000	13	300.0%	112,000	12.0%	130,000	5,754,359	2,471,028	3,283,331	42.9%

Deciduous											
Scenario # and Description	Salvage length (years)	Short Term Harvest Level (m3/year)	Harvest duration (years)	Short-term % change from current AAC	Mid-term harvest level (m3/year)	Mid-term % change from current AAC	Long-term harvest level	Volume at risk (m3)	Dead Pine Volume harvested (m3)	Total pine volume lost (NRL) (m3)	Percent Salvaged
LRSY (80 periods)	n/a	617,000	800	0	617,000	0.0%	617,000	0	0	0	n/a
Base Case (40 periods)	n/a	636,000	400	0	636,000	3.1%	636,000	0	0	0	n/a
Current AAC - no beetle	n/a	882,000	30	0	617,000	0.0%	617,000	0	0	0	n/a
MPB Base Case - current AAC	n/a	882,000	20	0	617,000	0.0%	617,000	0	0	0	n/a
20% uplift Conif. and Small Pine	n/a	882,000	20	0	617,000	0.0%	617,000	0	0	0	n/a
50% uplift Conif. and Small Pine	n/a	882,000	20	0	617,000	0.0%	617,000	0	0	0	n/a
70% uplift Conif. and Small Pine	n/a	882,000	20	0	617,000	0.0%	617,000	0	0	0	n/a
100% uplift Conif. and Small Pine	n/a	882,000	20	0	617,000	0.0%	617,000	0	0	0	n/a
200% uplift Conifer 300% small pine	n/a	882,000	20	0	617,000	0.0%	617,000	0	0	0	n/a

TSA Total											
Scenario # and Description	Salvage length (years)	Short Term Harvest Level (m3/year)	Harvest duration (years)	Short-term % change from current AAC	Mid-term harvest level (m3/year)	Mid-term % change from current AAC	Long-term harvest level	Volume at risk (m3)	Dead Pine Volume harvested (m3)	Total pine volume lost (NRL) (m3)	Percent Salvaged
LRSY (80 periods)	n/a	1,731,222	800	-6.9%	1,731,222	8.5%	1,732,000	0	0	0	n/a
Base Case (40 periods)	n/a	1,782,322	400	-4.2%	1,782,322	11.7%	1,782,322	0	0	0	n/a
Current AAC - no beetle	n/a	1,860,000	400	0.0%	1,595,000	0.0%	1,595,000	0	0	0	n/a
MPB Base Case - current AAC	4	1,860,000	13	0.0%	1,595,000	0.0%	1,620,322	19,605,361	6,511,885	13,093,476	33.2%
20% uplift Conif. and Small Pine	4	2,055,600	13	10.5%	1,641,000	2.9%	1,732,000	19,605,361	7,736,564	11,868,797	39.5%
50% uplift Conif. and Small Pine	4	2,349,000	13	26.3%	1,645,000	3.1%	1,732,000	19,605,361	9,553,861	10,051,500	48.7%
70% uplift Conif. and Small Pine	4	2,544,600	13	36.8%	1,641,000	2.9%	1,732,000	19,605,361	10,402,950	9,202,411	53.1%
100% uplift Conif. and Small Pine	4	2,838,000	13	52.6%	1,634,000	2.4%	1,732,000	19,605,361	11,465,682	8,139,679	58.5%
200% uplift Conifer 300% small pine	4	3,916,000	13	110.5%	1,572,000	-1.4%	1,732,000	19,605,361	14,199,911	5,405,450	72.4%

Appendix II

Detailed Modeling Assumptions

Detailed Modelling Assumptions

Current (2004) infestation intensity

Current 2004 infestation intensity was applied as per the IFSBeetle model. This may have overstated or understated the current level of infestation. Following are details regarding the current known level of infestation accumulated by Marnie Dothie-Holt from consultation with Dawson Creek TSA licensees:

For the TSA (so summary information from each licensee and BCTS) provide for the past 3-4 years

Amount of surveyed green and red attack pine volume;
From ground surveys – Winter 2004/Spring 2005

Source	Trees attacked	Volume killed (m3)
Canfor	14276 green attacked	4711
	10207 red attacked	3368
West Fraser (CFI)	16923 green attacked	5584
	11072 red attacked	3654
From detailed aerial surveys	50085 red attacked	16528
	78025 green attacked	25748

The amount of red and green attack volume harvested:

It should be noted that only the files provided by West Fraser for their harvesting intersected current IBM attack.

West Fraser harvested 2183 reds and 3045 greens, with volumes of 469 m and 762 m respectively.

Assumptions

- ✓ Pl volume of pl/ha is 250 m3/ha.
- ✓ Only detailed aerial survey information was used.
- ✓ G:R ratio factor will be applied to determine greens with the following factors applied in the
  - Belcourt 2.6
  - Red Deer 1.8
  - Monkman (Murray) 1.4
  - Sukunka 1.4
  - All other areas within TSA 1.6
  - TFL average 1.1

Ground survey results Note: only ground survey results for 2004. (i.e. red volume, green volume, number reds, number of greens)

2004 Survey Results			
Greens	Reds	Green Volume (m3)	Red Volume (m3)
16,923	11,072	5,84	3,653

Pine volume-at-risk

For the purposes of this analysis, the pine volume at risk was assumed to be any stand having greater than a 10 percent pine component and greater than 60 years of age. This may be slightly optimistic, as input from Medi-For Forest Health Consulting who has supervised much of the survey information of the Peace makes the following comment:

"**Medi-For Forest Health Consulting:** Around 30-40 years. The smallest diameter attacked was around 7.5 cm DBH but this occurred on very stressed trees therefore the age of these trees is assumed to be quite a bit older than would be expected. No actual cores were taken during ground surveys so this is just a "best guess"."

Comments from some Terry Shore in Dawson Creek in May suggested that while mortality may occur in very young and very small diameter stems, this was unlikely to be the norm and beetle population over-wintering in these stems were unlikely to survive.

Shelf life of attacked stems.

Shelflife of attacked stems were assumed to be 4 years. Following are the inputs and comments from Dawson Creek Licensees:

West Fraser: I am guessing 2 years – max of three. We couldn't stand a steady diet of this stuff maybe 100,000 m^3 per year and that is pushing it. Fraser lake is putting in new equipment to deal with the deep checks but we don't have that yet.
Canfor: 5 years
BCTS**:** No response.

Regeneration delay of non-recoverable losses

In this analysis, non-recoverable losses were regenerated after 10 years. Once again, better information does not exist. The 10-year estimate is consistent with the values used in the Prince George TSA analysis.

Regeneration delay was not applied to mixed-wood stands wherein there existed significant volume in other species. In these stands, the pine component was removed from the total stand volume. The minimum harvest age was then adjusted to match the point in time when the residual stand achieved 120m3/ha.

Current and short-term harvest flow

The current harvest flow was set to the AAC for the Dawson Creek TSA. A 13-year term was applied to the harvest flow based on the assumption that the epidemic will run its

course over the next 9 years, and there remains a 4 year shelf-life on the stands killed in this final year.

Forest cover constraints

Forest cover constraints were applied as per the TSR2 analysis. The exception being constraints on grizzly bear habitat. There appears in the TSR some confusion on what the Grizzly requirements should be. The TSR2 report quotes that "Grizzly bear habitat is managed to retain early seral forest", suggesting that early forest conditional are good habitat. Conversely, the TSR2 applied a maximum constraint of 33% < 3 metres. This analyst is not sure whether the constraint should be a minimum of 33% < 3 metres (as modeled in the TSR) or a maximum (as written in Section A.4.11 of the TSR).

Timber harvesting land base determination

The THLB for the Dawson Creek TSA was defined using a cover acquired by IFS in a previous government project. This analysis did not verify the accuracy of this coverage.

Yield Tables

The yield tables used in this analysis are identical to the MOF TSR2 yield tables. However, in comparison of the total mature merchantable growing stock on the inventory files to the growing stock predicted by the FSSIM model whereby THLB area is multiplied by the yield table volume at the appropriate age, discrepancy existed. Since estimating the short-term time supply is critical in this analysis, (and because time and funds precluded re-producing the yield tables), and operational adjustment factor was applied to the yield tables in the OAF.DAT FSSIM file. An existing traditional conifer yield tables were increased by 7%. All existing small pine yield tables were left unchanged. All deciduous leading yield tables were reduced by 11.9%. The yield tables for future managed stands were unchanged.

Mortality in the non-contributing forested land base

Mortality in the non-contributing land base was modeled for both the traditional conifer and small pine land bases at the same rate as for the THLB portion for both. Total mortality was calculated using the IFSBeetle model.

Table A 1 Mortality in the NCLB

Year	Traditional Conifer THLB		Small Pine THLB		Total Conifer THLB	
	Percent mortality	Mortality (m3)	Percent mortality	Mortality (m3)	Weighted Percent Mortality	Mortality [1] (m3)
2005	8%	755,570	2%	57,998	6.59%	813,568
2006	9%	850,017	4%	115,996	7.83%	966,013
2007	11%	1,038,909	7%	202,993	10.06%	1,241,902
2008	14%	1,322,248	15%	434,985	14.23%	1,757,234
2009	18%	1,700,033	24%	695,976	19.41%	2,396,010
2010	18%	1,700,033	26%	753,975	19.88%	2,454,008
2011	13%	1,227,802	16%	463,984	13.70%	1,691,786
2012	9%	850,017	6%	173,994	8.30%	1,024,011
Totals	100	9,444,630		2,899,902	100.00%	12,344,532

1 This is the mortality estimate of all volumes at present. The future growth of stands over the next 8 years is not factored into this estimate

Harvest Rules

The analysis utilized a relative oldest first harvest rule. Superseding this rule was the harvesting of stands during the period when they were attacked. Stands attacked in 2005 were prioritized for harvesting from 2005 to 2009. Stands attacked in 2007 were prioritized from 2007 to 2011.

A final priority was placed on harvesting/salvaging old spruce stands (>140 years old) over the next 60 years.

Appendix III

Information on IFSBeetle

"IFSBEETLE (version 2.0)"

RATIONALE AND LOGIC FOR A BEETLE EPIDEMIC AND CONTROL SIMULATION MODEL

INTRODUCTION/BACKGROUNDER

The initial motivation for developing a beetle epidemic and control simulation model was the clear need to better forecast medium to long-term non-recoverable losses (NRLs) in support of T.S.A. – level timber supply analyses.

Version 1.0 of this model was first produced and utilized in 1986-87 to address the mountain pine beetle epidemic in the Cariboo-Chilcotin. During this time, the model was used to predict long-term NRLs for the 100-Mile House, Williams Lake and Quesnel TSAs. The 'expert' opinion at the time was that the western portion of the Quesnel T.S.A. and the southwestern portion of the Prince George T.S.A. were resistant due to elevation and latitude. Mountain (Mt.) Pine Beetle has had 15 generations to evolve and prove this belief to be short-sighted.

As a consultant, Industrial Forestry Service Ltd. (IFS) has and continues to get requests for timber supply analyses assessing the potential impact of "worst case" beetle epidemics. Analysis past and present raise such questions as: How much pine is at risk to attack? Is the current approved A.A.C. adequate to address a "worst case" scenario? Could individual licensees in the pine dominated supply blocks cope, or would massive shifts in operating areas be necessary? Is increasing the A.A.C. or "clearcut overkill" the only viable solution?

These questions were raised in the 1980's epidemic and unfortunately are frequently echoed today. One was and continues to be confronted with the paucity of data on beetle epidemics in British Columbia. The C.F.S. Forest Insect and Disease Surveys and Regional Ministry of Forest (MoF) probe data do not constitute a database of sufficient detail to begin forecasting epidemics for the next rotation. Pressing for answers regarding best professional estimates for potential losses result in blatant speculation (e.g. "assume 80% of all pine is dead within 5 years") or a candid and understandable admission that no one knows and only fools would guess. In attempting to answer the above questions, the initial step was to try and forecast beetle NRLs for the 100 years.

IFS proceeded with the development of a beetle epidemic and control stimulation model and completed the model early in 1986. The rationale at the time was that the primary benefit of such a model would be to forecast epidemics over a long planning horizon and with this forecast avoid epidemics through an arsenal of control measures early in their onset.

As in the past, the development of this model has included neither the participation nor direct advice of an entomologist. Lack of data and lack of adherence to the "scientific method of research and development" all but precluded that involvement. The initial intent was to get a rough model operational and then invite the specialists to participate and recommend direction for minor (or possibly major) changes and enhancement.

GENERAL OVERVIEW OF MODEL IFSBEETLE

IFSBeetle was developed with the following objectives:

1. The model must forecast for at least one full rotation (± 85 years), necessitating a methodology for growing and predicting the future susceptibility of current immature stands as well as current low risk mature stands.

2. As the model will not be experience (i.e. data) driven, it must be sufficiently flexible to allow the end-user to mould it, to fit the problem at hand.

3. The model must use existing readily available forest inventory data. This data must be compatible with the supply analyses in which the results will be used.

4. The model must be able to simulate variable harvest and control methods (e.g. clearcut, selection, single tree pile and burn), variable harvest levels, and be able to vary both methods and harvest level over time.

5. The model must be able to simulate constraints with respect to the economics and age of salvage harvesting and vary the former economic constraint by supply block and type group.

With varying degrees of success, the objectives have been met. Three entire T.S.A.s were analyzed in 1987 using various management strategies and options within the model to predict NRLs for a "worst case" Mt. Pine Beetle scenario.

The model has allowed IFS to calculate NRLs and the rate of beetle attack (subject to varied control measures and harvest levels) across portions of the Prince George, Vanderhoof and Lakes Forest Districts in the past 2 years.

In general terms, IFSBeetle is an epidemic and harvesting/control simulation model. If the user can provide a definition of stands at risk and limited input on the epidemic characteristics for the beetle, the model will simulate epidemics and predict NRLs for an almost infinite number of harvesting and control combinations. Its current principal use is to:

1) Assess the suitability of a combination of management decisions in the face of a "worst case" epidemic.
2) Derive the amount (proportion) of area the transfers from "pine at risk" to

"green attack" analysis units annually in an FSSIM forest estate model.

The model at present cannot forecast the "most probable" epidemic scenario.

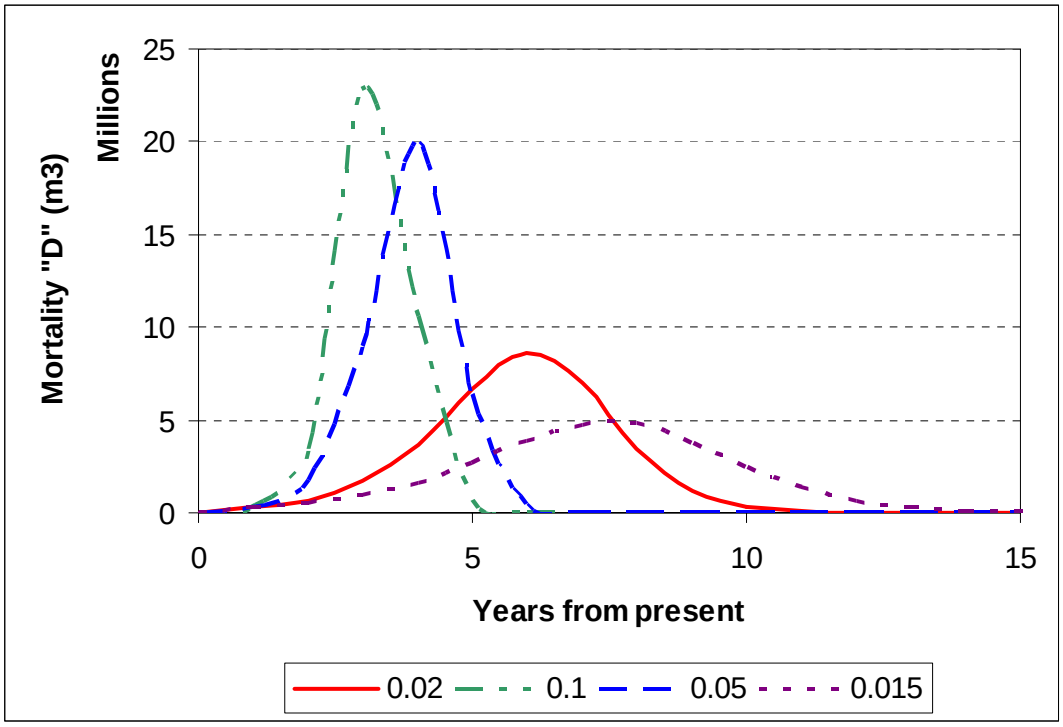
THE EPIDEMIC MODEL

The epidemic or mortality model adopted for use in IFSBeetle is the Reed-Frost model (Cole et al., 1985) [8]. The model takes the form of:

$$D_{t+1} = V_{t+1} * (1.0 - p)^{D_t})$$

Where "p" is the probability of one unit of volume (V) being killed at time "t+1". "D" is the predicted "dead" volume. If "p" is set to 1.0, the entire population would die immediately. The smaller the value of "p" the lower the probability of an attack and hence an epidemic would be slow and protracted. Figure 1 shows the form of the Reed-Frost model for four values of "p".

Figure A 1 General form of "p" in the Epidemic model



[8] **Cole**, Walter E., Gene D. Amman and Chester E. Jensen

1985 Mountain Pine Beetle Dynamics in Lodgepole Pine Foresters. Part II: Modeling of Mountain Pine Beetle Populations. USDA For. Serv., Gen. Tech. Report INT-188.

As applied by Cole et al. (1985), values for "p" were calculated for each diameter class in a stand. As used in IFSBeetle, the model only recognizes two diameter classes, i.e., largewood (stocking ≥ 17.5 cm+) and smallwood (stocking ≥ 12.5 <17.5 cm). Additionally, the Reed-Frost model was modified to reflect a lag in attack from largewood to smallwood of one year as follows:

$$D_{t+1} = SP@R * (1.0 - (1.0 - p)^{D_t}$$

$$d_{t+1} = sp@r * (1.0 - (1.0 - p)^{D_{t-1} + d_t})$$

where

D = mortality in pine ≥ 17.5 cm+ (m3/ha)
d = mortality in pine ≥ 12.5 and <17.5 cm (m3/ha)
SP@R = pine volume at risk ≥ 17.5 cm + m3/ha)
sp@r = pine volume at risk ≥ 12.5 and <17.5 cm (m3/ha)

Recognizing that harvest in the stand will be to 12.5 cm+, the model is modified accordingly to:

$$TD_{t+1} = T@R_{t+1} * (1.0 - (1.0 - p)^{Q_{t+1}})$$

$$Q_{t+1} = [\log(1.0-\{(D+d) / (Sp@r + sp@r)\}_{t+1}]/[\log(1.0-p)]$$

Extensive efforts were made to determine experienced "p" values in the Cariboo-Chilcotin epidemic, and more recently the Vanderhoof epidemic. In the final analysis, efforts were moderately successful after tracking every pine type through up to six values of "p", coming within 10% of the Regional M.O.F. estimates of mortality.

In the chilcotin analyses a single "p" value of 0.02 was used for two reasons: it produces an uncontrolled epidemic of approximately 10 years duration and a mortality ratio of 2.3 to 1.0 for years zero to two, (i.e. $(D+d)_{t=2}/ (D+d)_{t=1}$). This is consistent with IFS contract probe data indicating a ratio of 2.3 to 2.8/1.0 for these same years. The Vanderhoof epidemic however was slightly more intense and appears to have a shorter duration (ie 8-9 years). Data applied to the model resulted in a p value of 0.0255. This value was used in the current Dawson Creek analysis. As more data is collected by IFS for the emergency beetle task force, we will continue to calibrate the model for the current Mt. Pine Beetle epidemic.

In determining the volumes at risk to attack (i.e., SP@R and sp@r) it was necessary to develop a set of equations that predict the maximum volume per hectare at risk of attack for both the

largewood and smallwood components of a stand. The total per hectare susceptibility must, of course, vary with the level of largewood (most susceptible) stocking levels.

In reviewing American epidemic data, it is apparent that maximum mortality in the upper diameter classes approaches 85% over periods of eight (8) plus years with much lower mortality in the smaller diameter classes.

The equations currently being used are as follows for "high risk" stands:

$$Y = [M^2 - \{(M^2 * (1.0-ST1)^2) / ((1.0-ST1_{min})^2)\}]^{0.5}$$

$$X = (0.3 * ST2) + 0.225$$

And for "medium risk" stands:

$$Y2 = (0.33*ST1)\ 0.0825$$

where

Y = Predicted maximum mortality as a decimal fraction of stems/ha ≥17.5 cm d.b.h.

X = Predicated maximum mortality as a decimal fraction of stems/ha ≥12.5 <17.5 cm d.b.h.

M = Maximum mortality as a decimal fraction of stems/ha ≥17.5 cm d.b.h. when ST1 = 1.0

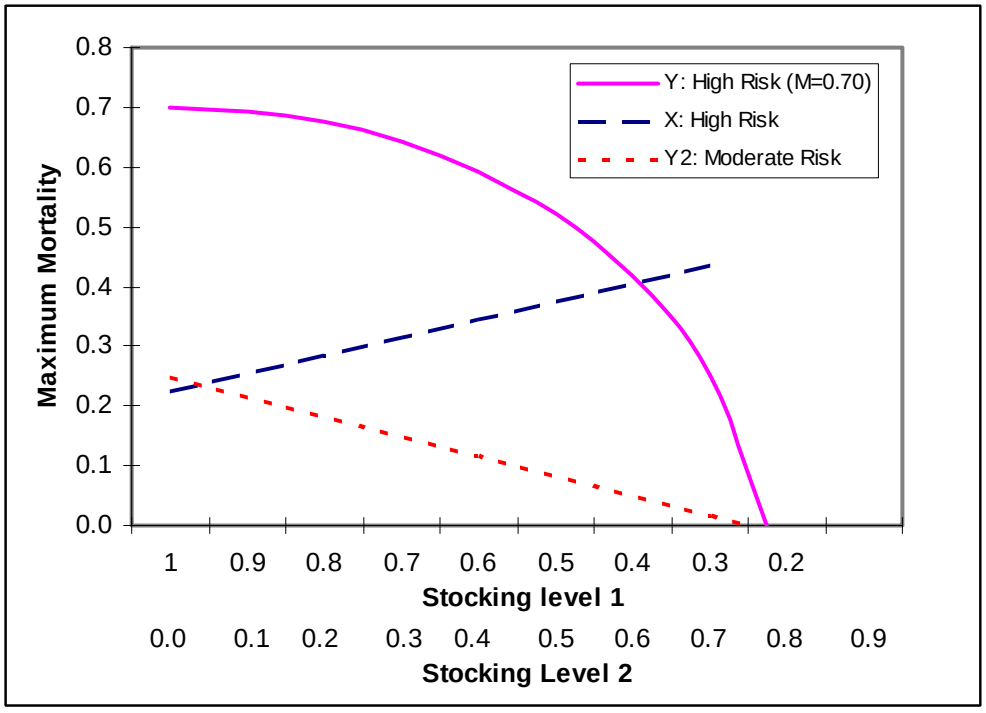
ST1 = Proportion of pine stocking as a decimal fraction for stems/ha ≥17.5 cm/≥12.5 cm d.b.h. (ST1≥ST1min)

$ST1_{min}$ = Minimum ST1 to qualify as high risk (e.g. 0.25) ST2 = 1.0 – ST1

ST2 = 1.0 – ST1

The three equations are shown in graphical form in Figure 2. Three points should be noted. First, as mortality in high-risk largewood rises, the maximum mortality in the smallwood component of the same stand falls. This reflects the scattered nature of the small diameter ST2 as ST1 increases. This relationship would not hold at "p" values higher than 0.02, i.e., a faster rate of mortality in ST1 would result in higher ST2 mortality. Second, in moderate risk stands, only the ST1 component is at risk of attack. Finally, it must be stressed that the equations themselves are variables. Each application of the model requires review of the Y, X and M values.

Figure A 2 Maximum Mortality as a function of Risk and Stocking Level



IFSBeetle has used two versions of the equations with "M" ranging from 0.70 to 0.90. The final equations to complete the linkage are as follows:

$$SP@R_{t=0} = Y * Vol1 * \%Sp$$

$$sp@r_{t=0} = X * (Vol2 - Vol1) * \%sp$$

Where

SP@R = species at risk in m3/ha

Vol1 = total m3/ha, all species (17.5 cm+)

Vol2 = total m3/ha all species (12.5cm+)

%sp = total proportion of species at risk

HARVESTING AND CONTROL MEASURES

The harvest, control and constraint options modeled within IFSBeetle include clearcutting, selective logging, single tree pile and burn, limits on annual dead volume salvaged, limits on age of dead volume salvaged, and "economic" constraints.

To illustrate the functioning of IFSBeetle, the discussion from here forward is based on a hypothetical stand of pine across a 10,000 ha area. Four scenarios test the impact of various control measures on epidemic dynamics. The results for each of the scenarios are described in graphical form. For each of the scenarios, stand dynamics are those as shown in Table A2.

Table A 2 Example Hypothetical Stand Characteristics

Stand Description	Attributes
Total Area	10,000 ha
Maximum mortality as a decimal fraction of stems/ha >= 17.5 cm dbh when ST1 = 1.0	0.75
Proportion of Pine stocking as a decimal fraction for stems/ha >= 17.5 / >=12.5 cm dbh (Note ST1 >= ST1 (min))	0.9
Minimum ST1 as a decimal fraction to qualify as high risk	0.25
Volume of stand >= 17.5 cm dbh	250 m3/ha
Volume of stand >= 12.5 cm dbh	275 m3/ha
Pine component of stand	85%

Table 3 provides the hypothetical values for four (4) different control strategies that are used to address a Mt. Pine Beetle epidemic that will develop within the stand described in Table 1.

The formulas described in Section 2 of this paper are an illustration of the concepts behind IFSBeetle. The actual modeling from here forward is an accounting problem, in which one must keep track of the three concurrent harvesting and control measures, tabulating dead, live-risk and non-risk volumes harvested, and making appropriate adjustments to the standing inventory before allowing the epidemic to act on the residual stand.

Table A 3 Harvest and Control Strategy for Four Hypothetical Scenarios

Scenario #	Year (t)	AC (m3)	DVL (m3)	Shelf – life (yrs)	Con 1 (m3)	Con 2 (m3)	Econ. (%)
1	0-15	0	0	0	0	0	100
2	0	0	0	0	0	0	100
	1-3	25,000	10,000	2	8,000	1,000	100
	4-15	35,000	15,000	2	8,000	0	100
3	0	0	0	0	0	0	100
	1	25,000	25,000	4	10,000	1,000	100
	2-15	60,000	60,000	4	25,000	0	100
4	0	20,000	20,000	5	0	0	100
	1-6	75,000	75,000	5	25,000	2,000	100
	7-15	20,000	20,000	5	0	0	100

Graphical depictions of the results of the different control scenarios are provided in Figures 3 to 5. The extensive tabular reports are not provided in this review.

Figure A 3 Comparison of Total Predicted Mortality for Four Example Scenarios

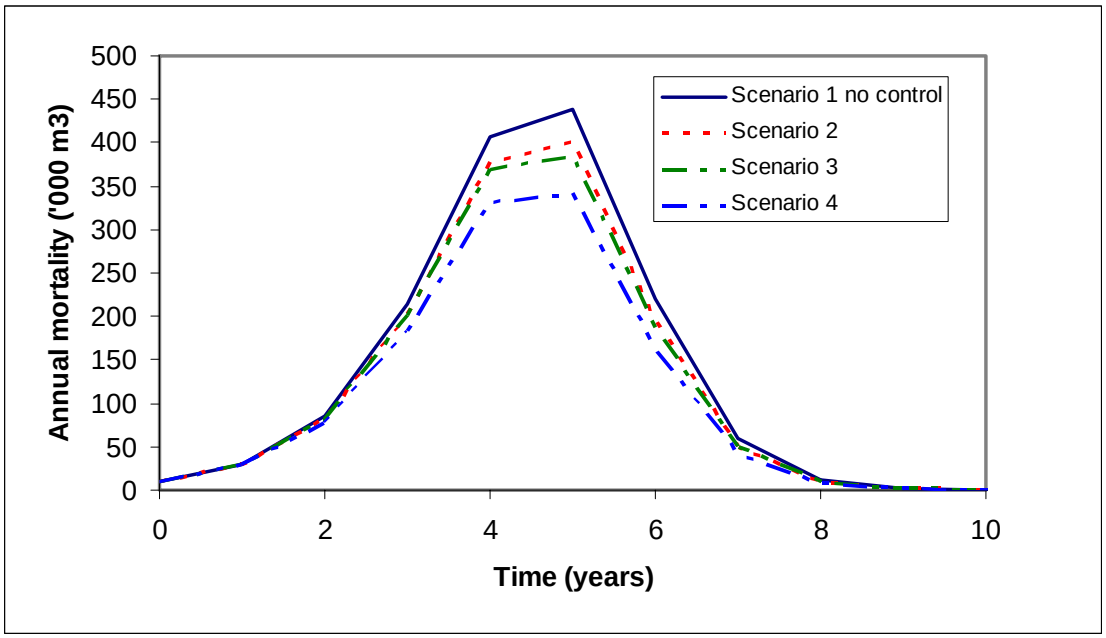


Figure A 4 Comparison of Total Predicted NRLs for Four Example Scenarios

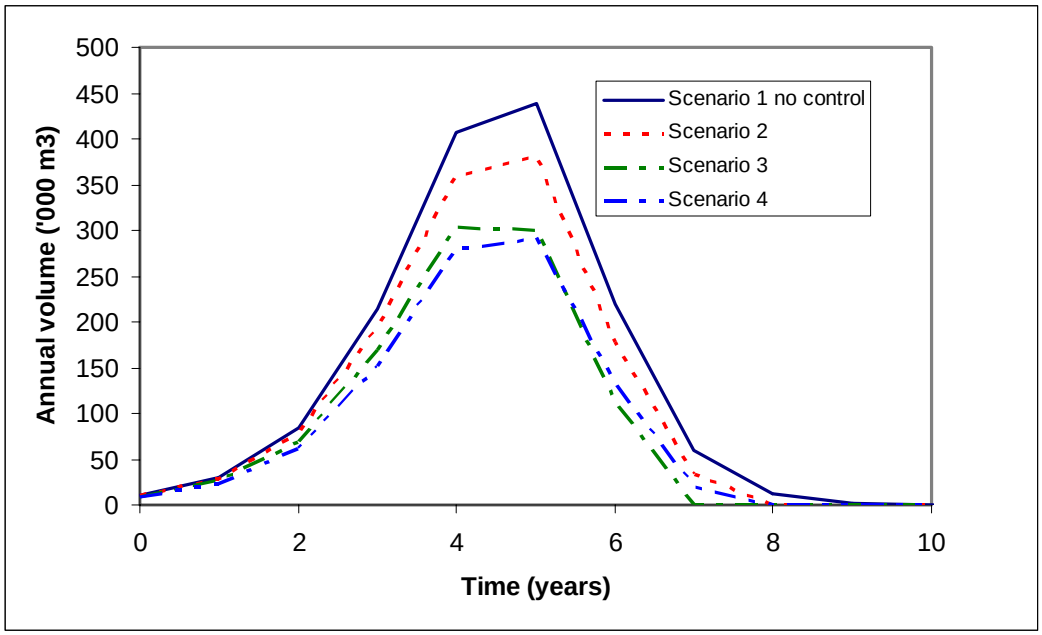
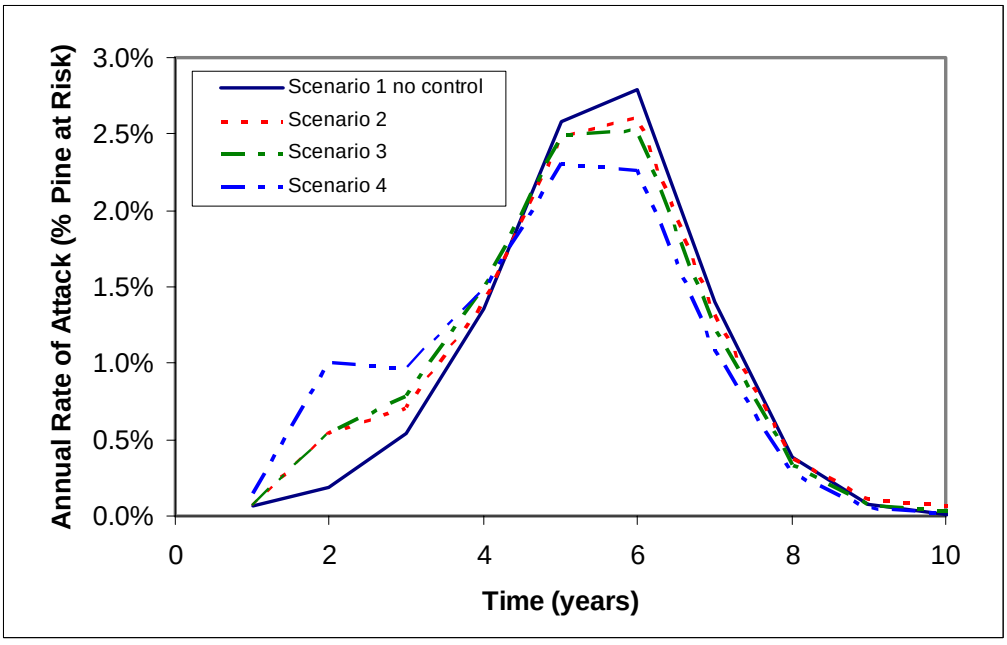


Figure A 5 Rate of Green Attack as a Percent of Total Pine at Risk



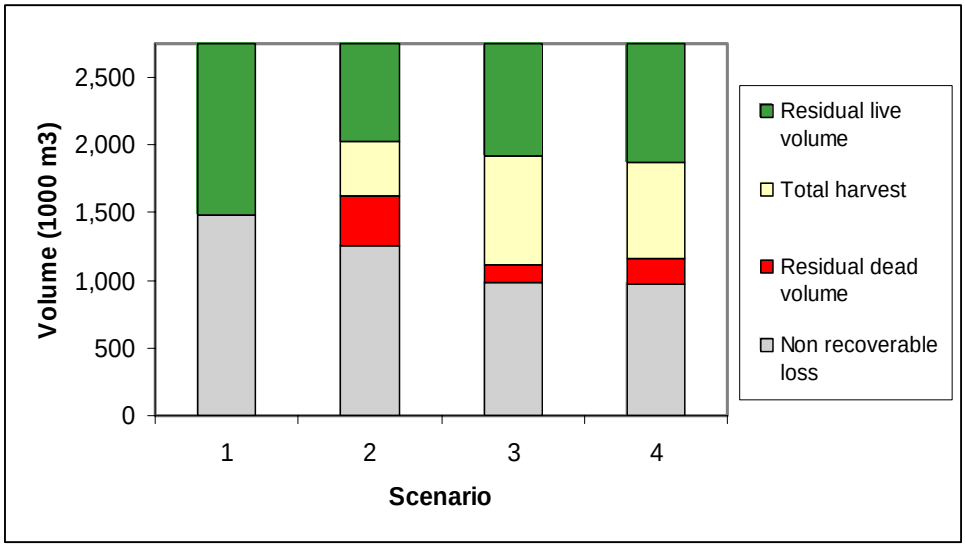
The apparent abnormality in Figure 5 (i.e., suggested by the step in year two (2) for Scenario 4) occurs because in this scenario harvesting occurs at time 0. Much of this harvesting is directed towards "pine at risk". Hence the "pine at risk" in year 1 is significantly reduced and the relative proportion of volume attacked in year 2 increases. These are the types of values most recently utilized by IFS in several FSSIM forest estate simulations, whereby a percent of the area in the pine at risk analysis units (AUs) are transferred to green-attack AUs. Each year over a 10-15 year period, the amount of area transferred from 'at risk' to 'green-attack' was adjusted according to the IFSBeetle output.

If minimizing NRLs was the objective of the control strategy, then an initial harvest level of approximately 700,000 m3 would liquidate all pine at risk in four (4) years. An unlikely preferred scenario if economic stability is a concern. Performance rating for different management or control strategies should be sensitive to:

a) Reductions in total mortality
b) Reductions in non-recoverable losses
c) Maximizing the residual stand or minimizing the total harvest required to achieve (a) and (b).

Figure 6 illustrates the comparison of scenario performance after 10 years of control effort.

Figure A 6 Comparison of Scenario Performance after 10 Years Control Effort



Summary

The forgoing has provided a cursory overview around IFSBeetle. Much has been left unsaid and the discussion could continue however, this paper should provide the reader with a synopsis about the model's design.

Appendix 9. Peace Forest District Communications Plan For 2006/2007.

PEACE FOREST DISTRICT
COMMUNICATIONS PLAN
For 2006/2007

SUBJECT:

On an ongoing basis, communicate actions the Peace Forest District and lead licensees are taking to help mitigate impacts of the infestation.

BACKGROUND:

Mountain pine beetles have reached epidemic levels several times over the last century in British Columbia. However past outbreaks were generally confined to limited geographic areas and were typically curtailed by cold weather.

B.C.'s current mountain pine beetle epidemic has now killed more than 400 million cubic metres of timber, covering about 8.7 million hectares in the central and southern Interior.

The Ministry of Forests and Range projects that the beetle could kill 80 per cent of the provincial lodgepole pine inventory by 2013. These trees are a major feature of many ecosystems, make up over half the Interior's annual timber harvest, and are critical to the economic, social and cultural well-being of British Columbia.

The mountain pine beetle is no longer just a forestry issue. Mitigating the impacts of the epidemic goes well beyond forestry activities or the scope of any one ministry. It is a key priority of the provincial government.

The Peace Forest District is now experiencing the beetle flow similar to the path already taken in the central interior.

Audiences:

a) External:

- Municipalities
    - Chetwynd
    - Dawson Creek
    - Fort St. John
    - Hudson's Hope
    - Tumbler Ridge
- Regional District
- MLA
- First Nations
    - McLeod Lake Indian Band
    - Halfway River First Nation
    - West Moberly First Nations
    - Saulteau First Nations
    - Doig River First Nation
    - Blueberry River First Nation
    - Prophet River First Nation
- Alberta Sustainable Resource Development
- Local licensees, including woodlot operators
- Residents in the beetle-affected area
- Firewood cutters, FUP holders
- Local clubs such as X-country skiers, Snowmobile, alpine ski
- Local media
    - Alaska Hwy News
    - Peace River Block News
    - Energy FM
- Workers in forestry, oil and gas
- Science community/academia

b) Internal:

- Regional Management Team
- District Management Team
- SCOT
- PriceWaterhouse Cooper
- BCTS
- Ministry of Environment
- Ministry of Tourism, Sports and Arts
- District First Nations Specialist
- District Range Officer
- Oil and Gas Commision

OBJECTIVES:

- To raise awareness about beetle biology and the best-available treatment options.
- To raise the pubic profile of the many beetle-related programs and projects being carried out to help mitigate the impacts of the infestation.
- To communicate tangible results and outputs from some of the significant beetle-related investments that government has made on an annual basis.
- To explain how the severity of the infestation has increased at a faster rate than forecasted by Minister of Forests and Range modeling projections. The beetle kill is peaking earlier than originally predicted.
- Regular email updates to stakeholders
- Public information forums
- Maps showing infestation and management areas

KEY MESSAGES:

- B.C.'s mountain pine beetle infestation is an unprecedented forest health crisis.
- The Province is taking action on many fronts to mitigate impacts and ensure sustainability for forest values, communities, and the provincial economy.
- We're working closely with all affected stakeholders – including First Nations – to ensure coordinated and effective responses.
- **Restoring the forests in areas affected by the beetle is one of our top priorities.**
- **The Canadian government is providing Feberal funding to assist private-landowners with the cost of removing beetle-infested wood.**
- **We are constantly researching and developing new products and new markets for beetle-affected timber.**
- The MoFR has adapted strategies and updated the Mountain Pine Beetle Action Plan as the complexity of the infestation has changed.
- **Continued and additional support from the Government of Canada is essential.**
- **Provide information and treatment options to residents and landowners in the Peace District as the beetle is affecting them for the first time in local history.**

ROLLOUT:

31 August 2006 RELEASE DATE	BRIEF DESCRIPTION OF ACTION	RESPONSIBILITY
Ongoing	With the recent unprecedented beetle flight into the H.H/FSJ area, public awareness is number one priority	Kopecky, Coombes, Hunt
Ongoing	To dispell rumours and mass paranoia by releasing legitimate and technically correct info to the public	Kopecky, Coombes, Hunt
	Web/Electronic Communications	
Oct. 1, 2006	Determine logistics and best place to locate web link with weekly updates from Beetle Trax	Coombes
Oct. 15, 2006	Feed website with updates weekly	Coombes
	Media interactions	
Sept. 30, 2006	Conduct news release (Victoria-reviewed) with local media in D.C. and FSJ	Kopecky, Coombes
Oct. 2, Dec 1, Feb.1, Apr.2	Bi-monthly status report to local newspapers	Kopecky, Coombes
On-going, weekly	Monitor local media coverage and file clippings	Laura Lea Gibson
	Industry interactions	
Sept. 30, 2006	Revise guidelines for Oil and Gas Industry	Coombes
Oct. 31, 2006	Prepare field presentation to Oil and Gas workers.	Coombes
Same dates as Internal	Bi-weekly status report to Canfor, WF mills	Coombes
	Community Outreach	
Sept. 1, 2006	Revise colored beetle brochure for public use.	Kopecky, Coombes
Sept. 2006	Meet with mayors of D.C. , H.H and FSJ	Kopecky, Coombes
Sept. 2006	Meet with Regional District	Kopecky, Coombes
Sept. 13, 2006	Meet with DC Nordic Ski Club	Coombes
Sept. 15, 2006	Meet with Alpine Ski Club	Coombes
Sept. 30, 2006	Mail out brochure to public	Coombes

Oct. 2, Nov 1, Dec 1, Jan2, Feb 1, Mar 1, Arp.2	Monthly status report to Municip., Reg. District, 1st nations	Kopecky, Coombes
	Internal Relations	
Oct. 2, 16,30 Nov. 14, 27 Dec. 11, 18 Jan 2, 15, 29 Feb. 12, 26 Mar. 12, 26 Apr. 10, 23	Bi-weekly status report to DMT, BCTS, RMT, SCOT, MoE, 1st Nations Specialist, AB gov., District Recreation	Coombes

APPROVED BY:

_____ _____

District Manager Date

Prepared by: Tracy Coombes
Aug. 31, 2006

Appendix 10. First Nation Contact List for the Peace Forest District.

Chief	Band	Address	Attention
Chief Roland Willson	West Moberly First Nations	Box 90 Moberly Lake, British Columbia V0C 1X0	Attention: Teena Demeulemeester
Chief Allan Apsassin	Saulteau First Nations	Box 330 Moberly Lake, British Columbia V0C 1X0	Attention: Monica Rice,R.P.F.
Chief Claire Gauthier	Kelly Lake First Nations	Box 116 Tomslake, British Columbia V0C 2L0	Attention: Chief and Council
Chief Alec Chingee	McLeod Lake Indian Band	PO Box 64 Chetwynd, British Columbia V0C 1J0	Attention: Vern Solonas
Chief Cliff Calliou	Kelly Lake Cree Nations	PO Box 326 Tomslake, British Columbia V0C 2L0	Attention: Chief and Council
Lyle Letendre	Kelly Lake Metis Settlement Society	#303 9804 100 Ave Grande Prairie, Alberta T8V 0T8	Attention: Lyle Letendre
Chief Dominic Frederic	Lheidli Tenneh Band	1041 Whenun Road Prince George, British Columbia V2K 5G5	Attention: Joe Gosnell
Acting Chief Gordon Pastions	Dene Tha' First Nation (Assumption)	Box 120 Assumption (Chateh), Alberta T0H 0S0	Attention: Chief and Council
Chief Liza Wolf	Prophet River First Nation	PO Box 3250 Fort Nelson, British Columbia V0C 1R0	Attention: Viva Wolf F.I.T.
Chief Norman Yahey	Blueberry River First Nations	Box 3009 Buick Creek, British Columbia V0C 2R0	Attention: Norma Pyle
Chief Kelvin Davis	Doig River First Nation	PO Box 56 Rose Prairie, British Columbia V0C 2H0	Attention: Carl Pouce Coupe
Chief Liz Logan	Fort Nelson First Nation	RR #1, Mile 295 Alaska Highway Fort Nelson, British Columbia V0C 1R0	Attention: Chief and Council
Chief Gerry Hunter	Halfway River First Nation	PO Box 59 Wonowon, British Columbia V0C 2N0	Attention: Blake Bowden
	Treaty 8 Tribal Association	10233 100 Avenue Fort St John, British Columbia V1J 1Y8	Attention: Kieran Broderick

Source: Edwards Pers. Comm. 2007

Appendix 11. Oil and Gas Sector Best Management Practices for Mountain Pine Beetle (MPB) in the Peace Forest District.

Oil and Gas Sector Best Management Practices for Mountain Pine Beetle (MPB) in the Peace Forest District

Well-Site, Road, and/or Pipeline and Facility Development

These are best management practices for companies to follow for well-site, road, and/or pipeline and facility development when operating in pine stands within the Peace Forest District, at this point restricted to south of the Peace River (map included).

1- Jointly with the Ministry of Forests and Range educate crew members on how to detect mountain pine beetle attacked trees. Be able to differentiate between the various stages of attack: grey, red, and green.
2- Where a qualified person confirms that there is no MPB infestation in trees, the trees can be marketed and delivered to a milling facility.
3- Notify the Ministry of Forests and Range Beetle Co-ordinator or the Oil and Gas Liaison Officer of **any** locations where projects transect a patch(es) of MPB attacked pine. These could be grey, red, or green-attack.
4- Wherever projects intersect # 3 any infested pine that is felled should be decked on site and bait traps placed to capture any beetles that fly. This wood can be delivered to mills in the winter period from **September 15th through to April 31st**. We do not encourage the burial or burning of these infested trees.

Geophysical Exploration

These are best management practices for companies to follow when conducting seismic exploration operations in pine stands within the Peace Forest District, at this point restricted to south of the Peace River (map included).

1- Jointly with the Ministry of Forests and Range educate crew members on how to detect mountain pine beetle attacked trees. Be able to differentiate between the various stages of attack: grey, red, and green.
2- Where a qualified person confirms that there is no MPB infestation in trees the trees can be marketed and delivered to a milling facility.
3- Notify the Ministry of Forests and Range Beetle Co-ordinator or the Oil and Gas Liaison Officer of **any** locations where seismic lines transect a patch(es) of MPB attacked pine. These could be grey, red, or green-attack.
4- Wherever lines intersect # 3, any infested pine that is felled should be bucked up into 18" bolts and scattered on the line such that the bolts receive maximum sun exposure. This is not needed for either non-infested or previously-attacked pine that is now grey or red.

By doing the above, beetle treatment should be limited to small portions of line where the extra treatment is needed.

Appendix 1

Map depicting the mountain pine beetle area of concern for oil and gas sector activity in the southern half of the Peace Forest District.

Note: Infestation patterns are not static and are highly dependant on seasonal flight patterns. Mountain pine beetle may be encountered outside the area indicated on the map and the map itself is subject to change as are the best management practices.

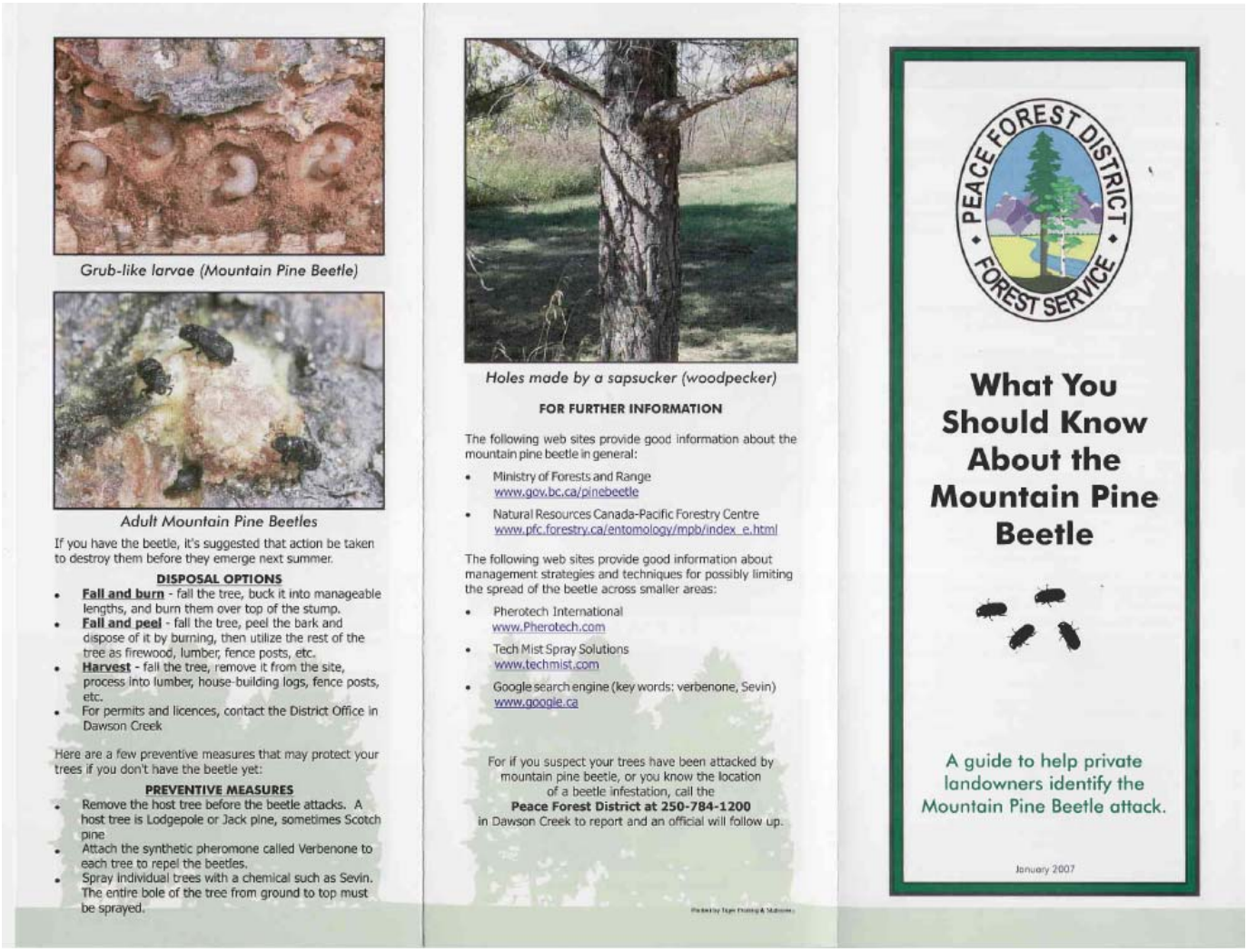
http://www.ogc.gov.bc.ca/documents/forms/forestry/mpb_for_ogc.pdf

Appendix 2

Information Poster

http://www.ogc.gov.bc.ca/documents/forms/forestry/MPB_poster.pdf

Appendix 12. Information Brochure on Mountain pine beetle Developed for the Peace Forest District.



Grub-like larvae (Mountain Pine Beetle)

Adult Mountain Pine Beetles

If you have the beetle, it's suggested that action be taken to destroy them before they emerge next summer.

DISPOSAL OPTIONS

- **Fall and burn** - fall the tree, buck it into manageable lengths, and burn them over top of the stump.
- **Fall and peel** - fall the tree, peel the bark and dispose of it by burning, then utilize the rest of the tree as firewood, lumber, fence posts, etc.
- **Harvest** - fall the tree, remove it from the site, process into lumber, house-building logs, fence posts, etc.
- For permits and licences, contact the District Office in Dawson Creek

Here are a few preventive measures that may protect your trees if you don't have the beetle yet:

PREVENTIVE MEASURES

- Remove the host tree before the beetle attacks. A host tree is Lodgepole or Jack pine, sometimes Scotch pine
- Attach the synthetic pheromone called Verbenone to each tree to repel the beetles.
- Spray individual trees with a chemical such as Sevin. The entire bole of the tree from ground to top must be sprayed.

Holes made by a sapsucker (woodpecker)

FOR FURTHER INFORMATION

The following web sites provide good information about the mountain pine beetle in general:

- Ministry of Forests and Range
  www.gov.bc.ca/pinebeetle
- Natural Resources Canada-Pacific Forestry Centre
  www.pfc.forestry.ca/entomology/mpb/index_e.html

The following web sites provide good information about management strategies and techniques for possibly limiting the spread of the beetle across smaller areas:

- Pherotech International
  www.Pherotech.com
- Tech Mist Spray Solutions
  www.techmist.com
- Google search engine (key words: verbenone, Sevin)
  www.google.ca

For if you suspect your trees have been attacked by mountain pine beetle, or you know the location of a beetle infestation, call the
Peace Forest District at 250-784-1200
in Dawson Creek to report and an official will follow up.

PEACE FOREST DISTRICT
FOREST SERVICE

What You Should Know About the Mountain Pine Beetle

A guide to help private landowners identify the Mountain Pine Beetle attack.

January 2007

MOUNTAIN PINE BEETLES IN THE PEACE FOREST DISTRICT

BC's mountain pine beetle infestation spread to new areas of the Peace Forest District in Summer 2006.

Extremely dry and windy weather conditions contributed to an unprecedented flight season that saw the beetle spread north of the Peace River for the first time ever.

This brochure provides general information about the mountain pine beetle, how to identify and confirm beetle attack, tree disposal options, and measures for possibly preventing further spread.

BEETLE BIOLOGY FACTS

- The general flight is July-August, although some pioneer beetles may emerge as early as May depending on weather.
- Beetles can detect weakened or stressed trees and will generally attack those first.
- The females attack the tree first and start building the vertical gallery. She emits a pheromone that attracts the male.
- Eggs are laid along each side of the gallery.
- The average 12-inch gallery has approximately 60-80 eggs.
- Between 7-10 days they hatch and develop into larvae, which build horizontal galleries.
- Beetles carry the blue stain fungi on their bodies. The fungi becomes established in the sapwood, but does not affect wood structure; it simply discolours it.
- The tree dies as a result of girdling from the gallery and fungi development.
- For effective beetle control, the trees must be destroyed or utilized prior to the next emergence.
- Beetles have a natural anti-freeze in their bodies which allow them to withstand cold temperatures.
- It takes two weeks of consistent -40 C temperatures to kill most beetles.
- With favourable wind conditions, beetles can travel 100 kilometres or more if they are able to stay aloft at higher altitudes for several hours.

THREE STAGES OF ATTACK

- **Green Attack** (Year 1) Adult beetles find new host trees and tunnel underneath the bark to spend the winter. The tree dies soon after, but the tree's pine needles stay green for several months.
- **Red Attack** (Year 2) The beetles have left the tree and the needles have turned red, indicating that the tree is dead.
- **Grey Attack** (Year 3 and Up) The pine needles have fallen off the trees and only the branches remain.

MOUNTAIN PINE BEETLE INDICATORS

Pitch Tubes

Sawdust at base of tree and in bark crevices

Beetles being "pitched out"

OTHER SYMPTOMS THAT MAY BE CONFUSED WITH THE MOUNTAIN PINE BEETLE

Example of drought

Example of sap caused by Sequois Pitch Moth

Example of IPS Bark beetle

Appendix 13. Park Use Permit.

BRITISH COLUMBIA

PARK USE PERMIT

LAND USE/OCCUPANCY

This Park Use Permit No. GP0510322/PG0610236 (the "Permit") is issued under the authority of the *Park Act*	**Monkman, Pine LeMoray, Wapiti Lake, Bearhole Lake, Gwillim Lake and Kakwa Provincial Parks** (the "Park")
FROM:	TO:
HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF BRITISH COLUMBIA, represented by the Minister responsible for the *Park Act* (the "Province") at the following address: Ministry of Environment **Environmental Stewardship Division** **Peace Region** **400 – 10003 – 110 th Avenue** **Fort St. John BC V1J 6M7**	**Ministry of Forests** **Peace Forest District** (the "Permittee") at the following address **9000 – 17th Street** **Dawson Creek BC V1G 4A4**

THE PROVINCE AND THE PERMITTEE AGREE AS FOLLOWS:

ARTICLE I - GRANT OF PERMIT

1.01 The Province, on the terms and conditions of this Permit, grants to the Permittee permission to enter upon and use that part of the Park (the "Permit Area") described, and for the purposes described, in the Management Plan Schedule.

ARTICLE II - DURATION

2.01 The duration of this Permit is for a term of **three (3)** years commencing on **April 21, 2006** (the "Commencement Date") and ending on **April 20, 2009** (the "Expiration Date"), unless cancelled, terminated or renewed in accordance with the terms and conditions of this Permit.

ARTICLE III - FINANCIAL

3.01 The Permittee must pay to the Province a fee (the "Permit Fee") of **NIL** (GST included if applicable) prior to Commencement date and on each anniversary of the commencement date during the term of this Permit.

3.02 The Province may, by notice to the Permittee not less than 30 days prior to each anniversary of the Commencement Date, increase the Permit Fee to an amount solely determined by the Province at its discretion, and the Permittee must pay the increased amount.

3.03 The Permittee must pay interest to the Province on money payable by the Permittee and owing to the Province under this Permit, at the rate of interest prescribed by the *Financial Administration Act* in respect of money owing to the Province, which interest will be calculated from the date that the money becomes payable to the Province.

ARTICLE IV - INDEMNITY

4.01 The Permittee will indemnify and save harmless the Province, its servants, employees and agents against all losses, claims, damages, actions, costs and expenses that the Province, its servants, employees and agents may sustain, incur, suffer to be put to at any time arising, directly or indirectly, from any act or omission of the Permittee, its employees, agents, contractors and licensees under this Permit, except for any liability arising from any independent, negligent act of the Province.

4.02 The Permittee will during the term of this Permit provide, maintain and pay for insurance in such form and amounts and with such deductibles, if any, as prescribed in the Insurance Schedule. **Not Required**

ARTICLE V - TRANSFER

5.01 The Permittee must not assign, transfer, sublicence or grant any of the rights or privileges granted by this Permit without the prior written consent of, and on the terms and conditions determined by, the Province.

5.02 If the Permittee is a corporation then a change in the control (as that term is defined in subsection 1(4) of the *Company Act*) of the Permittee without the prior written consent of the Province is deemed to be a breach of section 5.01.

ARTICLE VI - COVENANTS OF THE PERMITTEE

6.01 The Permittee must:

(a) pay the Permit Fee and other money payable under this Permit when due at the address of the Province first written above or at such place as the Province may specify from time to time;

(b) pay when due all taxes, levies, charges and assessments that relate to operations of the Permittee under this Permit;

(c) comply with all laws, bylaws, orders, directions, ordinances and regulations of any competent governmental authority in any way

affecting the Permit Area, the Park, its use and occupation or the Permittee's operations under this Permit;

(d) advise its employees, contractors, licensees, and agents of the laws and regulations respecting provincial parks and recreation areas and the conditions of this Permit respecting conduct in the permit Area;

(e) keep the Permit Area in a safe, clean and sanitary condition to the satisfaction of the Province and make safe, clean and sanitary any portion of the Permit Area that the Province may direct by notice in writing to the Permittee;

(f) remove from the Permit Area and the Park all garbage, debris and effluent resulting from its use of the Park and Permit Area under this Permit, except as otherwise permitted in the Management Plan Schedule;

(g) comply with all orders and directions made, verbally or in writing, by a park officer (as defined in the *Park Act*) relating to the Park, this Permit or the Permit Area;

(h) not construct, erect, place, repair, maintain or alter any building, fixture, equipment, structure or improvement in the Permit Area except as may be permitted by this Permit or with the prior written consent of the Province;

(i) take all reasonable precautions to prevent and suppress fires in the Permit Area;

(j) not interfere with free public access through, across and upon the Permit Area, unless otherwise specified in the Management Plan Schedule;

(k) not interfere with or disrupt the activities and operations of other permittee's or users in the Park;

(l) use and occupy the Permit Area only in accordance with the provisions of this Permit;

(m) not remove, destroy, damage, disturb or exploit any natural resource (as that term is defined in the *Park Act*) or any archaeological or cultural artefact found in or on the Permit Area except as may be permitted by this Permit, and only then in accordance with the *Park Act* and all other applicable laws;

(n) not commit or allow any wilful or voluntary waste, damage or destruction in or upon the Permit Area;

(o) pay for or repair, as determined by the Province, any damage caused to the property of the Province by the Permittee, its employees, agents, contractors, or licensees;

(p) upon the expiration, cancellation or termination of this Permit:

(i) peaceably quit and deliver up possession of the Permit Area to the Province,

(ii) remove all chattels and improvements of the Permittee from the Permit Area within 30 days of the expiration, cancellation or sooner termination of this Permit, unless otherwise advised in writing, by the Province,

(iii) deliver to the Province possession of all equipment, furnishings, fixtures, chattels and improvements owned by the Province in a state of good repair and working order, and

(iv) restore the Permit Area to the satisfaction of the Province;

(v) and to the extent necessary, this covenant will survive the expiration,cancellation or termination of this Permit; and

(q) comply with all provisions of the schedules to this Permit.

ARTICLE VII - RIGHTS OF THE PROVINCE

7.01 The Province retains all rights in respect of the Park and Permit Area which are not expressly granted to the Permittee under this permit, including, without limitation:

(a) the right at all times for the Province, its authorized representatives, employees, and agents to have unimpeded access over and along all portions of the Permit Area and to inspect any portions of the Permit Area;

(b) the right at all times to construct, repair, alter and maintain buildings, equipment, structures and improvements upon the Permit Area; and

(c) the right to grant further rights in respect of the Park and Permit Area, provided that such rights do not unreasonably impede, obstruct or compete with the rights of the Permittee under this Permit.

ARTICLE VIII - NOTICE

8.01 Any notice required to be given by either party to the other will be deemed to be given if it is in writing and is delivered by hand or prepaid registered mail to the address first written above or any other address that may be specified in writing by a party and a notice will be deemed to be delivered, if mailed, eight days after the time of mailing except, in the case of a postal interruption, actual receipt is required.

8.02 Notwithstanding section 8.01, any written notice to be given by the Province to the permittee under this Permit will be effectively given if it is posted in a conspicuous place on the Permit Area.

ARTICLE IX - RENEWAL

9.01 Not later than 30 days prior to the Expiration Date, the Permittee may, by notice in writing delivered to the Province, apply to the Province for a renewal of this Permit.

9.02 Provided that the Permittee is not in default under this Permit and subject to the terms of the *Park Act*, the Province may renew this Permit upon the terms and conditions determined by the Province.

9.03 The Permittee acknowledges that nothing in this Permit obligates the Province to renew this Permit and the Province's decision in that respect is entirely within its discretion

ARTICLE X - FINANCIAL GUARANTEE

10.01 The Permittee will, in accordance with the Financial Guarantee Schedule, deliver to the province security for the performance by the permittee of all its obligations under this Permit. **Not Required**

ARTICLE XI - MISCELLANEOUS

11.01 This Permit may be inspected by the public at such times and at such places as the Province may determine.

11.02 Time is of the essence in this Permit.

11.03 Nothing in this Permit will be considered to have been waived by the Province unless such waiver is in writing.

11.04 During the term of this Permit, the Permittee will be an independent contractor and not the agent, employee or partner of the Province.

11.05 The Province will not be liable for any loss, damage, cost or expense resulting from the destruction of or damage to the Permittee's property or a disruption of the Permittee's operations under this Permit which result from strikes, flooding or other acts of God, vandalism, or any other interference to the Permittee's operation or property.

ARTICLE XII - CANCELLATION

12.01 In the event that

(a) the Permittee defaults in the payment of the Permit Fee or other money payable under this Permit, and the default continues for 7 days after the giving of written notice of the default by the Province to the Permittee;

(b) the Permittee fails to perform or observe any of the terms or conditions of this Permit, other than the payment of money, and

the failure is not remedied within a period specified by the Province;

(c) the Permittee has wilfully misrepresented information:

(i) on the application form which led to the granting of this Permit, or

(ii) required to be provided under the terms and conditions of this Permit;

(d) the Permit Area is damaged or destroyed by any cause whatsoever;

(e) the Park is closed by the Province;

(f) the Permittee files a petition in bankruptcy, is adjudged bankrupt, is petitioned into bankruptcy, makes an assignment for the benefit of its creditors, becomes insolvent or takes the benefit or protection of any statute for bankrupt or insolvent debtors;

(g) any of the Permittee's assets is seized in execution from the Permit Area;

(h) the Permittee, its employees, agents, contractors or licensees performs any act which in the opinion of the Province, affects the good standing or reputation of the Park, or adversely affects any other permit holder or park user within the Park;

the Province may cancel this Permit immediately by written notice to the Permittee.

12.02 In the event that the Permittee and the Province mutually agree in writing to terminate this Permit, the parties will be released and discharged from their obligations under this Permit, except as otherwise provided in this Permit.

12.03 The obligation of the Permittee

(a) to pay the Permit Fee and other money payable under this Permit; and

(b) to comply with Sections 4.01, 6.01(e), 6.01(o) and 6.01(p);

will survive the expiration, cancellation or termination of this Permit.

12.04 The Permittee will not be entitled to any compensation from the Province, in damages or otherwise, in respect of a cancellation or termination of this Permit.

ARTICLE XIII- INTERPRETATION

13.01 In this Permit, unless the context otherwise requires, the singular includes the plural and the masculine includes the feminine, a corporation and body politic.

13.02 The captions and headings contained in the Permit are for convenience only and are not to be construed as defining or in any way limiting the scope or intent of the provisions of this Permit.

13.03 In this Permit, a reference to an enactment of the Province of British Columbia or of Canada includes a reference to any subsequent enactment of like effect, and unless the context otherwise requires, all statutes referred to in this Permit are enactments of the Province of British Columbia.

13.04 If any part of this Permit is found to be illegal or unenforceable, that part will be considered separate and severable and the remaining parts will be enforceable to the fullest extent permitted by law.

13.05 If all or part of the Permit Area is in a recreation area established or continued under the *Park Act*, this Permit is deemed to be a resource use permit as that term is defined in the *Park Act*.

13.06 All schedules to this Permit form an integral part of this Permit.

IN WITNESS WHEREOF the parties have duly executed this Permit.

SIGNED and **DELIVERED** on behalf of the Province by a duly authorized representative of the Province.

Duly Authorized Representative

Date

SIGNED and **DELIVERED** on behalf of the Permittee (or by an authorized signatory of the Permittee if a Corporation) signature of Permittee or Authorized Signatory.

Signature of Permittee or Authorized Signatory

Date

MANAGEMENT PLAN SCHEDULE

PERMIT AREA DESCRIPTION

The Permittee is authorized to enter the Permit Area described below:

Monkman, Pine LeMoray, Wapiti Lake, Bearhole Lake, Gwillim Lake and Kakwa Provincial Parks

PURPOSE

This Permit is issued to the Permittee for the purpose of **Mountain Pine Beetle control.**

SPECIAL PROVISIONS

1. The Permittee shall recognize that the activity being permitted is within a Provincial Park and the conduct of the Permittee, the staff and contractors shall be consistent with the natural values of the Park and will adhere to the management objective for the Park.

2. This permit is for the fall and burn of beetle infested trees and the associated activities necessary to implement the activity.

3. Falling and burning of beetle infested trees must meet the control standards specified by the Ministry of Forests and Range.

4. Fall and burn crews may only access beetle infested sites by helicopter or by walking-in – no roads are permitted to be developed.

5. The use of snowmobiles is permitted in Kakwa Provincial Park.

6. Only trees that are to be felled should be marked with paint.

7. No metal tags are to be used – only flagging tape.

8. Flagging, associated with this MPB management treatment project, can remain up until audits are complete.

9. All ribbon, regardless of the reason it was hung, must be removed upon completion of the project unless other wise instructed.

10. All garbage is to be removed.

11. All stumps are to be cut flush with the ground when ever possible but shall not exceed 30 cm in height above the ground measured on the upslope side of the stump.

12. All trees scheduled to be piled and burned shall be burned so that all of the bark including the cambium layer is completely destroyed.

13. Fall and burn operations are to be carried out with minimal disturbance to the site and to uninfested trees.

14. Sites are to be monitored to ensure fall and burn size is kept to a minimum and to ensure visuals are maintained.

15. The Permittee is responsible to ensure all approved sub-contractors are in compliance with all required government insurance and WCB coverages.

16. Copies of report and results are to be forwarded to BC Parks, Peace Region upon completion of the project.

17. Prior approval must be obtained from the Park Area Supervisor before any camp may be set up.

18. All felled trees or portions there of that are not disposed of shall be cut to lie flat on the ground and all slash shall be scattered throughout the treatment area to avoid any accumulations.

19. No impact to existing structures and facilities – trails and campgrounds.

20. Maintain Visual Quality objectives. Falling and removal of beetle attacked trees adjacent to trails is permissible however, where practicable, burn locations associated with those trees should be located to prevent negative visual impact from trails and viewpoints. Burn sites are not permitted on existing trails.

21. Selected burn sites must be sufficiently set back from the high water mark to prevent material from entering water body.

22. Any proposed works adjacent to the Monkman Park campground, park compound, and falls viewpoint must be communicated to, and approved by the Area Supervisor, Rob Bressette, prior to any activity taking place in these locations. Prior to approval of works in these locations, a written plan must be provided to Rob Bressette for review and comment. Approval must then be documented in written form.

23. Any proposed works adjacent to a campground or park compound within one of the Provincial Parks listed in this permit must be communicated to, and approved by the Area Supervisor, Rob Bressette, prior to any activity taking place in these locations.

Prior to approval of works in these locations, a written plan must be provided to Rob Bressette for review and comment. Approval must then be documented in written form.

24. The Area Supervisor, Rob Bressette, or Regional Manager, Andy Ackerman, must be contacted if modifications to existing fall and burn activities are proposed prior to the commencement of any treatment activities. Contact Information:

Rob Bressette:	Cell: (250) 261-3917
	Office: (250) 787-3562
	Home: (250) 785-3116
Andy Ackerman:	Cell: (250) 262-1878
	Office: (250) 787-3411

Appendix 14. Treatment options within park boundaries.

Allowing natural processes to prevail (i.e. do nothing)

No on the ground tactics are applied in the allowing natural processes to prevail scenario. However, aerial overview surveys are conducted in all areas of the province including areas where no follow up tactics will be applied and thus monitoring of pest populations does occur on a yearly basis.

Pheromone baits and traps

The use of aggregating semiochemicals (pheromone baits) has greatly facilitated efforts to reduce losses caused by the mountain pine beetle. Any placement of baits ***must*** have a subsequent treatment plan in place and must always be followed by actions to remove or eradicate the concentrated beetle populations. There are three general uses for aggregating baits including;

1. Contain and concentrate. Baits are used to restrict beetle dispersal within an area.
2. Use with single tree treatments. Baits are used to localize residual beetles and facilitate subsequent treatments such as falling and burning treatments.
3. Monitoring. Baits can be used to monitor the timing and duration of beetle flight in conjunction with funnel traps. As with all baiting follow up procedures must be in place to deal with spill over attack.

Individual tree fall and burn

When beetle populations are small, treatments such as fall and burn are highly effective in controlling populations, although treatments must be applied consistently over the course of several years to be effective.

This direct treatment is used to eradicate small spots or patches of infested trees in lightly infested areas, scattered attack on the periphery of larger infestations, and in areas where other resource constraints limit other treatment options. The following criteria apply:

- Infested trees (that contain live beetle broods) should be felled.
- Infested portions of the trees should be bucked, piled and burned. Ensure that all infested bark area is well burned.
- Stumps should be burned or treated if possible.

This treatment can be applied throughout the year, exclusive of fire season.

Large-scale prescribed burn

Prescribed fires are controlled fires that burn the forest to achieve the objectives of land and resource management prescriptions. In the case of Monkman Provincial Park a

prescribed burn would have two main objectives in terms of mountain pine beetle management.

1. Long Term Control: High Hazard Host Removal

The major objective of a large-scale prescribed burn would be to burn areas of highly susceptible pine stands to reduce the available host and thus reduce future mountain pine beetle population increases.

2. Short Term Control: Beetle Removal

An additional objective would be to remove current mountain pine beetle populations. Recent work (Safranyik *et al.* 2001) verified that fire can be effective at killing mountain pine beetle, thus reducing beetle populations if fire is of sufficient intensity. However, pines along the periphery of a prescribed fire may experience high levels of attack as where fire intensities are low and these trees can still be optimal hosts (Stock & Gorley 1989).

This should be a secondary objective to high hazard host removal since only a portion of the beetle population will be killed during a high intensity crown fire (Rank 4). Burning must occur prior to beetle flight to be most effective.

3. Other Benefits: Development of Fuel Breaks

A third objective of a large-scale prescribed burn would be the creation of fuel breaks to reduce future fire risks, especially as a result of increased fuel due to mountain pine beetle incidence.

Appendix 15. Aerial and radar measurements of mountain pine beetle undergoing transport above the forest canopy over the Rocky Mountains

1. Who prepared the proposal and contact numbers (phone, fax, email);

Dr. Peter L. Jackson
University of Northern British Columbia
3333 University Way
Prince George, BC, V2N 4Z9
Phone: (250) 960-5985
Fax: (250) 960-6533
Email: peterj@unbc.ca

2. List of financial contributors, their contributions by year and contact numbers.

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Phone: (780)538 7739
Fax: (780)538-7800
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Sunil Ranasinghe, Forest Entomologist

Alberta Sustainable Resource Development

Public Lands and Forests Division ,Forest Health Section

8th Floor, Great-West Life Building

9920 - 108 Street

Edmonton, Alberta T5K 2M4

Phone: (780) 422-8000

Fax: (780) 427-0084

E-mail: Sunil.Ranasinghe@gov.ab.ca

Contributions	
Alberta SRD:	$26,220
Canfor:	$5,000
Weyerhaeuser:	$5,000
Total:	**$36,220**

3. Introduction

The potential for long range (100's of kilometers) movement of mountain pine beetle (MPB) from areas of heavy infestation in the BC Central Interior, over the Rocky Mountains into the BC Peace River district and Alberta, is an important consideration for managing the eastward spread of the epidemic. Since 2002, MPB have been found east of the Rockies in the Chetwynd area. It is not known for certain whether the 2002 and subsequent MPB attack areas are due to the increase in local (endemic) populations or due to long-range transport of MPB from more heavily infested areas west of the Rocky Mountains. Our atmospheric numerical modelling work (e.g. Jackson et al, 2005) has demonstrated using trajectory analysis that the 2002 and subsequent attack areas could have been the result of long-range transport of MPB across the Rocky Mountains from areas of known infestation to the west, as long as the MPB were able to fly in the atmospheric boundary layer (ABL) below 1000 m above ground.

This proposal will measure the number of MPB undergoing long range transport in the atmospheric boundary layer over the Rocky Mountains near Pine Pass using two methods: 1) in-situ by direct capture from a fixed-wing aircraft (successfully carried out in 2005 near Prince George, BC, see below), and 2) remotely, using a vertically scanning X-band radar system, as well as potentially using Environment Canada Doppler weather radar. The results of this research will be a verification of whether MPB are flying over the Rocky Mountains and an estimate of the flux of MPB undergoing this type of long-range movement.

4. Background Information

Mountain pine beetles (MPB) can undergo short-range dispersal within the forest canopy over distances of a few kilometers by **active** flight. This sort of motion is used for host-seeking within a stand, but cannot result in long-range movements. If MPB are carried above the tree canopy and fly just enough to maintain altitude, they may be carried **passively** by the mean winds in the atmospheric boundary layer over distances of more than a hundred kilometers. Flight mill studies indicate that MPB are capable of flying for up to 11 hours. Wind speeds within the atmospheric boundary layer (ABL - lowest kilometer or so of the atmosphere above the ground) can be 10 m/s or more. Therefore passive transport could potentially carry MPB as far as 400 km in a single day, although shorter distances are more likely. Until recently, it was not known whether or not MPB underwent this mode of transport. However in 2004 we noticed “clear air returns” attributable to insects, below about 1000m above ground level on the Meteorological Service of Canada Prince George Doppler weather radar, that corresponded to days when we had observed MPB emerging in vast numbers. We suspected, but had no way of verifying, that these “insect returns” were generated by MPB. In order to provide this verification, in 2005 we mounted an aerial capture experiment by attaching a drogue net to the wing strut of a Cessna 172 fixed-wing aircraft, and collecting insects at various elevations in a transect near the Prince George Radar (southwest of Prince George). The experiment was a success, and the results of this work are currently being written up as a peer-reviewed publication. We found MPB as high as 760 m above ground level, and calculations based on the mean wind speed in the layer below 760 m AGL and a conversion of the number of MPB captured to a volume density, resulted in an estimated 9 million beetles per hour crossing a 1 km line perpendicular to the wind.

This proposal seeks to build upon the successful work done in 2005 (Straussfogel et al, 2006). In 2006 we propose to conduct aerial capture flights over the Rocky Mountains – in the Pine Pass area – in order to assess the flux of MPB crossing the Rockies. We will conduct up to 60 hours of flight sampling (we had 20 hours of sporadic sampling in 2005), to be able to more systematically examine the MPB undergoing long-range flight. We will have access to some additional instruments that will also be used: an X-band vertically scanning radar system that is primarily being used by Ken Otter to track migrating birds in the Pine Pass region will be used for MPB sensing during this experiment. This radar is of a type often used for entomological studies and should be able to give us detailed vertical profiles of insect density with the insect species and density verified by the aerial flight capture data. In addition, I will be installing my Doppler sodar system in the area – this will give us detailed vertical profiles of the horizontal wind that can be used to refine the beetle flux estimates.

5. Benefits of the project to the forest resource, resource management or sustainability of resources;

This project will verify whether or not MBP are flying in the ABL over the Rocky Mountains, and will further quantify the density of MPB undergoing flight in this layer using both direct measurements and radar. This information, in combination with wind speed and direction measurements from a Doppler sodar system to be installed nearby, will allow calculation of the flux of MPB crossing the Rockies. The results of this research will inform forest resource managers and those interested in controlling the MPB infestation movement eastward. If the flux of MPB across the Rockies is the main, or a significant source of new MPB attack east of the Rockies, then this would entail a

different control strategy than one dealing with the local growth of endemic MPB populations. By optimizing control strategies to account for the actual mode of MPB movement, it is more likely that forest resource managers will be able to control spread of the epidemic.

6. Application of project results to management of forest resource(s);

The results of this project will be widely made available to forest resource managers by presentation at workshops and conferences, by publication in the peer-reviewed literature and by a web page (http://cirrus.unbc.ca/mpbi/). It will be up to forest resource managers to utilize the information and results provided, along with other information, to adjust or improve management of the MPB threat east of the Rockies.

7. Description of project by task;

Methodology

Emergence observations

A number of lodgepole pine trees infected with Mountain Pine Beetle larvae will be selected from an infested area near both the University of Northern British Columbia, and near the Pine Pass, to monitor MPB emergence To facilitate the observation of MPB emergence holes, a patch of white outdoor latex paint, 125 cm high by 20 cm wide, will be painted on the east and west sides of each tree. The patch on the east side of the tree will be situated to maximize exposure to sunlight and daytime heating. New MPB emergence holes will be counted and marked on a daily basis in order to identify periods of peak emergence, usually during the evening hours when emergence activity is low.

Synoptic weather monitoring

During the MPB emergence season, we are able to predict periods of peak emergence with some precision, up to several days in advance, based upon our synoptic climatology work (Murphy and Jackson, 2004; Murphy et al, 2004) and the relationship between beetle emergence, air temperature, surface pressure and upper level atmospheric ridge location. We will monitor the weather and numerical weather forecasts in order to plan intensive flight dates for aerial capture, emergence monitoring, and intensive radar observation periods.

Aerial sampling apparatus

Following the method of White (1970) a drogue-net apparatus has been constructed and will be attached to a Cessna 172 aircraft and used for the aerial capture of MPB. The net apparatus is comprised of a 110 cm long conical nylon net attached at its open end to a 38 cm diameter steel ring. The ring and net will be attached to the aircraft's right-hand-side wing strut with an 244 cm length of 3.2 mm (1/8 in) aircraft cable. The net will be deployed and retrieved in flight through the passenger door using a nylon cord attached to the net ring. Before the net is deployed, a sheet of standard size (8 1/2 x 11 in) writing paper, loosely crumpled into a ball, will be dropped into the net to provide the captured insects with shelter from the airstream and thus avoid having them compressed into an unidentifiable mass.

Based on drag measurements and momentum analysis of different nets, the sampling efficiency of the drogue-net to be used is calculated to be approximately 82%, meaning that 82% of the incident airstream passes through the net material with the remainder diverted around the outside of the net. This efficiency will be used to estimate the airborne insect density given the amount of air sampled and number of insects caught.

Radar measurements

In previous work (Jackson et al, 2005; Straussfogel et al, 2006) we have focused on using Meteorological Service of Canada Doppler Weather Radar data from the Prince George radar to detect MPB as “clear air returns”. This was useful in the vicinity of the radar, but because the radar beam altitude increases with distance from the radar location, and the MPB are restricted to the atmospheric boundary layer (below about 1000 m above ground level), the Doppler Weather Radars are of limited use in detecting insects over the Rocky mountains. We are fortunate in having access to a vertically-scanning X-band radar through our association with the UNBC Center for Wind Energy and the Environment (CWEE) that we can use in the Pine Pass area during the MPB flight period. This radar can scan in a vertical arc and detect insects and insect density with height below about 1000 m above the radar, and should give very detailed information over time on insect density. Until now, the radar data had to be manually viewed in real-time, however the CWEE is the recent recipient of an NSERC SRO grant that will allow data capture capabilities to be added, increasing the utility of the system for our purposes and allowing semi-automatic operation. The species and densities of insects detected by the radar will be validated and calibrated by comparison with the aerial capture data.

Sodar measurements

A SCINTEC FAS64 phased array Doppler sodar system that I have will be installed at the Pine River Gas plant for the duration of the experiment. This system gives a vertical profile of the horizontal wind in the atmospheric boundary layer below 500-1000 m above ground level. The wind speed and direction information from the sodar will be important in knowing where the wind is carrying the insects and how fast/far and is necessary to calculate the flux of MPB.

Scientific design and sampling protocols

Aerial sampling procedure
The aerial capture flights will be conducted from mid-July until early August, which historically represents the period of peak emergence in this region. We will “fine tune” the specific dates of the star of the experiment, based on our emergence monitoring and synoptic weather interpretation. Previously we only sampled on days of known or forecast peak emergence. In 2006 we plan to sample on most days during the emergence period, with more intensive sampling on days when emergence is maximal.

Our previous work sampled over a 35 km-long transect located approximately 25 km southwest of Prince George, BC, between West Lake and Punchaw Lake (Straussfogel et al, 2006). The transect had an approximate north-south orientation and was located just east of the Baldy Hughes radar site. The surface elevation below the transect varied between 700 m and 900 m above sea level (ASL). Sampling periods were 15 minutes

long and were flown at true airspeeds from 108 km/hr to 126 km/hr at altitudes from 850 m to 2000 m ASL or approximately 100 m to 1200 m above ground level (AGL). Sampling at the lowest altitude was done following the elevation of the terrain, approximately 100m to 200m above the forest canopy.

The sampling runs proceeded in the following manner. Once stabilized on altitude and airspeed, a net was deployed and the sampling transect flown for a fifteen minute period. At the end of the sampling period, the net was retrieved, removed from the steel support ring, and its open end quickly tied in a loose knot. The net was then sealed in a numbered "zip-lock" plastic bag. The aircraft was stabilized at a new altitude and the process repeated, flying the transect in the reciprocal direction.

Typically, sampling was started at a minimum safe altitude above the forest canopy, then increased in 150 m increments until above the top of the insect layer, determined when insects were no longer being caught. The sampling altitude was then decreased in 150 m increments down to the minimum safe altitude. At the beginning of each sampling run, sampling altitude, outside air temperature (OAT), indicated airspeed (IAS), time-of-day (TOD), and sample bag number were recorded. Following each flight, the captured insects were removed from the nets and placed in freezer storage for later counting and identification.

In 2006 we plan to use a similar scheme and will sample on a two fixed transects, one will be parallel to the Rocky Mountains, along the Parsnip River Valley southeast of Mackenzie. We may reduce our sampling period from 15 minutes to 10 minutes in order to be able to sample more levels and better resolve the vertical distribution of MPB. We plan to sample nearly every day at least in the mid-afternoon period, found to be the time most likely to capture MPB. On peak emergence dates, we will add sampling runs in late morning and late afternoon/early evening to better characterize the temporal variability of MPB flight, and to assess the numbers of MPB in flight east of the Rocky Mountain divide. The Parsnip River transect will be flown nearly every day of the experiment, between 14:00 and 16:00 PDT. On days that are expected or observed to have more MPB emergence, one or two additional transects will be added. A transect from 17:00 until 19:00 will be added in the Pine River valley east of Pine Pass, and the transect along the Parsnip River will be repeated at 11:00-13:00.

Justification and rational for design and protocols

The above protocols worked well in 2005, so we plan to essentially repeat them in 2006, with the exception that we will make more collections and they will be more systematic. The locations of transects were chosen to be able to monitor the numbers of MPB approaching the Rocky Mountains, and also crossing over the mountains.

8. Work schedule by task (include commencement and completion dates)

#	Task	Start	End
1	Plan experiment, familiarize with radar	2006-06-05	2006-06-30
2	Install Doppler Sodar at Pine River Plant	2006-06-19	2006-06-23
3	Prepare and start MPB emergence monitoring	2006-07-03	2006-08-04
4	Radar install and make observations	2006-07-10	2006-08-04
5	Aerial capture flights	2006-07-17	2006-08-04
6	Post experiment processing of data	2006-08-07	2006-09-02
7	Analysis and write-up of results in draft form	2006-08-07	2006-12-31
8	Production of final papers for peer-reviewed submission	2007-03-31	

Notes: specific dates for aerial capture flights will depend on the 2006 emergence pattern and weather conditions.

9. Deliverables (includes reports) and submission schedule;

See above work schedule. Draft report/paper available 2006-12-31 and final report/paper available 2007-03-31.

10. Project management – personnel and responsibilities; responsibilities (curriculum vitae in appendix);

#	Name	Role
1	Peter L. Jackson, PhD Associate Professor Natural Resources and Environmental Studies Institute UNBC Environmental Science & Engineering Programs	Project Leader
2	Dennis Straussfogel, PhD Research Associate UNBC Environmental Science & Engineering Programs	Project Manager and Research Associate Aerial Flights, Doppler Sodar, Data Analysis
3	Victoria Prigmore, LLB Research Assistant UNBC Co-op Student	Research Assistant MPB Emergence Radar Operation Aerial Flights, post

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experiment data reduction		
4	Staffan Lindgren, PhD Professor Natural Resources and Environmental Studies Institute UNBC Ecosystem Science & Management Program	Consultant on MPB biology, identification of insects
5	Ken Otter, PhD Associate Professor Center for Wind Energy and the Environment Natural Resources and Environmental Studies Institute UNBC Ecosystem Science & Management Program	Consultant on Radar use

11. Permits, licenses or other authorizations required to conduct the work;

None required to our knowledge as there will be no adverse effects on the environment.

12. Project budget by task identified in #7 above, and including budgetary notes;

Budget for Aerial Capture / Radar experiments -- northern Rockies -- summer 2006

Peter Jackson updated: 6/2/2006

1 Salary, senior research associate (Dr. Dennis Straussfogel)

hours	hourly rate	hourly merc	Total
210	$25.00	$3.00	$5,880.00

2 Salary, junior research assistant (Victoria Prigmore)

420	$15.00	$1.80	$7,056.00

3 Flight Costs. Cessna 172, Guardian Aerospace

hours	hourly rate	GST	Total
60	$250.00	$17.50	$16,050.00

4	Travel / Field costs to Mackenzie - Pine Pass area	$4,000.00
5	Overhead (25% of Salary)	$3,234.00
6	**Grand Total**	**$36,220.00**

NOTES: Normal overhead rate is 25% of total contract. I have confirmed with the UNBC VP Research that excluding non-salary costs is acceptable.

Field costs are based on staying at the Mackenzie airport for $250/week for three weeks plus food, living and travel costs for 3 people plus the pilot, as well as costs for misc. supplies (nets, bags, paint, etc.)

13. Proposed payment schedule to Applicant

90% upon project initiation, 10% upon receipt of final deliverable (March 31, 2007).

14. Peer Review

The final deliverable will be a publication submitted to the peer-reviewed scientific literature.

15. Statement that the project payables represent fair market value

This is a very cost-effective proposal, building upon infrastructure already in-place through other funding (the Doppler sodar system is a $100K device purchased from CFI funds; the X-band radar is already in place in the CWEE and is being loaned for this project). The main costs are for aircraft fights. We have an aircraft dedicated to our use for the 2-3 week period of the experiment and have negotiated an hourly charge of $250 with a 4 hour minimum per day.

16. References

Jackson, P.L, B.D. Murphy, B. Moore, 2005: Atmospheric modeling of mountain pine beetle transport. Paper presented at International Union of Forest Research Organizations, D7 Forest Health, Prince George, July 11-14.

Murphy, B.D., P. L. Jackson, and B.S. Lindgren, 2004: A synoptic climatology for emergence and flight of the Mountain Pine Beetle, *report submitted to CFS / NRCan Mountain Pine Beetle Initiative,* 95pp.

Murphy, B.C. and P.L. Jackson, 2004: A synoptic climatology for the emergence and flight of the mountain pine beetle (*Dendroctonus poonderosae* Hopkins) in the central-interior of British Columbia, *Preprints, 16th Conference on Biometeorology and Aerobiology*. American Meteorological Society, Vancouver August 22-26, 6pp.

Straussfogel, D., P. L. Jackson, S. Mitchell, B. D. Murphy, B.S. Lindgren, 2006: Radar observation and aerial capture of Mountain Pine Beetle, *Dendroctonus Ponderosae* Hopk. (Col., Scolytidae) in flight above the forest canopy. Manuscript in preparation, draft available upon request. 28pp.

Appendix 16. An Analysis of the Feasibility of Storing Green-Attack" Mountain Pine Beetle Logs Under Insulated Snowpacks in Alberta.

AN ANALYSIS OF THE FEASIBILITY OF STORING "GREEN-ATTACK" MOUNTAIN PINE BEETLE LOGS UNDER INSULATED SNOWPACKS IN ALBERTA

Submitted by:

Richard Krygier

And

Dr. Barry Cooke

Natural Resources Canada
Canadian Forest Service
Fibre Centre

October 13, 2006

FRIAA Open Funds Proposal
FRIAA 2006-07 Provincial Projects Initiative

1.1 Proposal Overview

Project Title: An analysis of the feasibility of storing "green-attack" mountain pine beetle logs under insulated snowpacks in Alberta

Applicant: **Natural Resources Canada**
Canadian Forest Service
Fibre Centre
5320- 122 Street
Edmonton, AB
T6H 3S5

Prepared by:

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Project Leaders:

Richard Krygier, **Intensive Fibre Management Specialist**

Dr. Barry Cooke, **Ph.D.**
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Other Participants:

Brian Martell RPFT (Operations Superintendent, Canadian Forest Products Ltd., 9401-108 Street, Postal Bag 100, Grande Prairie, Alberta, T8V 3A3 780-538-7739 brian.martell@canfor.com) will be the industry co-operator liaison for the project.

Sunil Ranasinghe Ph.D. (Forest Entomologist, Alberta Sustainable Resource Development (SRD), Forestry Division, Forest Health Section, 8th Floor, Great-West Life Building, 9920 – 108 Street, Edmonton, Alberta, T5K 2M4, Telephone: (780) 422-8000; Facsimile: (780) 427-0085, E-mail: Sunil.Ranasinghe@gov.ab.ca) contributed the scientific review and is a co-operator in the project.

Roger Whitehead (Research Silviculturist, Canadian Forest Service, Fibre Centre, 506 West Burnside Road, Victoria, BC. V8Z 1M5 rwhitehe@nrcan.gc.ca) will lead the British Columbia funded portion of the project

Dr. Bill Wagner (Research Economist, CFS, Fibre Centre, Victoria, BC wwagner@nrcan.gc.ca) will provide economic and policy expertise during collection and analyses of data and participate in preparation of the final report.

Tony Sauder RPF (Group Supervisor, Harvesting Operations Research, Forest Engineering Research Institute of Canada (FERIC) – Western Division. 2601 East Mall, Vancouver, BC. V6T 1Z4. tony-s@vcr.feric.ca) will coordinate liaison with forestry operations and participate in discussions, analyses and preparation of the final strategic analysis report.

Dr. Joseph Nader (Senior Researcher, Fibre Recovery and Quality, Forest Engineering Research Institute of Canada – Eastern Division. Point Clare, PQ. joseph-n@mtl.feric.ca) will coordinate liaison with eastern Canadian operations and participate in discussions and preparation of the final synthesis.

Applicant's Background Information:

Natural Resources Canada, Canadian Forest Service (CFS) is a national research agency of the Government of Canada. It has a long and rich history of conducting forest research nationally and internationally. The CFS has five regional labs with personnel that can bring a variety of scientific disciplines and experience to bear against a research problem. The CFS often works co-operatively with other research organizations and with universities. This project is an example of researchers from two CFS facilities and from FERIC working together to address an urgent problem.

Richard Krygier has been working in forestry in Alberta for the past 12 years. He joined the CFS in August of 2001 as the Forest Research Field Co-ordinator and became Intensive Fibre Management Specialist in August of 2005. Prior to that, he spent eight years working for Millar Western Forest Products where his main responsibility was developing and implementing an enhanced silviculture management program. He has over 19 years experience with planning and executing large-scale operational and research forestry projects. Mr. Krygier earned an M.Sc. degree in Forestry from Lakehead University in 1988.

Dr. Barry Cooke is an expert on forest insect population dynamics, and has significant experience in insect pest modeling and decision support. He joined the CFS in January 2002 after receiving his Ph.D. degree from the University of Alberta in 2001. He has been working on mountain pine beetle in Alberta since September 2005, focusing on developing modern, process-based risk analysis tools applicable to the unique Albertan context.

Detailed Site Selection Information:

The strategic analysis portion of the project consists of consultations with companies operationally storing logs under snowpacks in Canada and Scandinavia. The results of these consultations and of the literature review will be shared with the forest industry primarily within the Upper and Lower Foothills Natural Sub-regions in Alberta (highest MPB risk area) and with government.

The experimental part of this study will be undertaken in the Canfor mill yard in Grande Prairie Alberta. Grande Prairie is one of the areas newly infested by mountain pine beetle in Alberta. The Canfor mill yard has space in which to build the snow-cached log decks, access to water and is close to the sawmill for quick and efficient processing of the logs at the termination of the project.

Description of Potential Application of Results:
The project consists of:
a strategic analysis of the potential for long-term storage of beetle-killed logs under a snowpack; and,
an experimental analysis of mountain beetle growth and development within logs stored under an insulated snowpack for one and two summers.

The results of this project will enable communities and forest operations in affected areas, and provincial governments to:
assess the potential for storing logs under a snowpack to extend the timeframe for economic recovery of logs from beetle-affected stands;
maintain the highest value of fibre recovered;
extend the storage time of infested logs before processing; and,
defer mill wood supply falldown,
all of which would benefit communities, industrial operations and provincial revenues.

Relevant References and Reference Information:
The large volume of trees killed by mountain pine beetle (MPB) has disrupted orderly harvesting plans and log inventory management in affected forest regions of British Columbia. With the discovery of a significant MPB outbreak near Grande Prairie the potential exists for similar disruptions in Alberta.

The Beetle Strategy (Anonymous, 2006) requires that all beetle-infested logs be processed before adult MPB emerge and fly. This could present logistical wood processing problems for sawmills in Alberta or reduce the amount of area harvested to control active MPB infestations. As ground suitable for summer-harvesting in Alberta is limited, harvesting is concentrated over the winter months when the ground is frozen. Winter-harvested log inventories usually supply the sawmills from break-up in the spring until the following winter. Without a means of risk-free storage of "green-attack" MPB-infested logs, the sawmills will be obliged to harvest uninfested trees to carry them through the late summer months. This could result in a reduction of the area harvested to control MPB.

Additionally, if the epidemic spreads, large areas of MPB-killed trees will need to be salvaged. This creates two additional concerns, that of reduced fibre quality of standing dead trees and the impacts on long-term fibre supply (AAC).

Long-term storage of beetle-killed logs has been proposed to help mitigate future AAC fall down, to reduce volume loss and increase recovery value. Investigations have focused primarily on storage under water or sprinklers, but studies like the one by R&S Rogers (2001) suggest that environmental issues associated with mill yard runoff from extended storage under sprinklers and economics of storing large volumes in water are not promising, and have recommended that beetle-killed trees be stored as standing dead. However, both recovery volumes and log value decrease with the amount of time that dead trees are left standing (Byrne *et al.* 2006), and effective and economical long-term storage in affected areas remains an imperative need.

Storage of logs under an insulated snowpack is a well-established operational tool for log inventory management in the Scandinavian Region, where it is used to prevent deterioration of log value through drying or decay when logs cannot be processed immediately (Anonymous, 2005). Up to 250,000 m^3 of wood harvested in winter has been stored at some mills until processed in late summer or fall. Recent FERIC research assessed the potential to integrate this storage method into forest operations in eastern Canada and found that wood stored under snow remained frozen throughout the summer and retained properties that resulted in higher lumber yields and savings in processing cost that more than offset the cost of storage (Nader 2003). As a result, several companies have integrated this technique into their operations.

Further study (Nader 2005) examined the economics of wood storage under snow and identified benefits in both forestry operations and at the mill. Reported benefits to forestry operations were mainly from maximizing winter transportation which reduced road maintenance costs associated with hauling during summer and fall. In Alberta, maximizing winter harvest may have even more significance if hydrologic effects of MPB damage result in the loss of summer logging ground in affected areas as it has in BC (Heile *et al.* 2005). Benefits to sawmills resulted primarily from reduced energy consumption during sawing and prolonged working life of equipment. For pulp mills, fresher chips required less energy and less bleaching during processing.

There is anecdotal evidence that logs have been stored under snow for up to 2 years in Quebec operations (pers. comm. E. Heidersdorf, Research Director, FERIC Eastern Division). This suggests that it may be possible to extend the timeframe for extracting high value from beetle-attacked logs for at least that long if stored logs are rotated regularly.

We propose to:
assess the strategic potential to store beetle-killed logs under insulated snowpacks in forest operations located in Northern British Columbia and western Alberta; and,
examine requirements and implications of applying this technique to log inventory management to maintain high fibre quality, extend timeframe for economic recovery from affected stands and to defer potential timber supply fall down in some affected areas.

We will also assess the potential for aiding efforts to control expansion of the epidemic in areas where the infestation is still building, where green attacks harvested in winter might be stored under snow at temperatures too low to allow development and emergence of adult beetles, until transport and milling can be coordinated. We propose to monitor the phenology and survival of beetles in "green-attack" logs stored under an insulated snowpack over one and two summer seasons.

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R. & S. Rogers Consulting Inc. 2001. West central British Columbia mountain pine beetle strategic business recommendations report for British Columbia Ministry of Forests, Resource Tenures and Engineering Branch, Victoria, BC. 69 p.

1.2 PROPOSAL OBJECTIVES

Aspects of Forest Resource Management Benefiting From This Proposal:

This project will contribute to the protection of the forest resource of Alberta by increasing our understanding of the effects of insulated snowpack storage of logs on beetle phenology and survival. If beetle development in the insulated piles is retarded or stopped, we could harvest more ""green-attack"" mountain pine beetle stands and extend the processing of the ""green-attack"" trees into the late summer months. This will contribute to the Control Strategy as articulated in the Mountain Pine Beetle Action Plan for Alberta (Alberta SRD, Forest Management Branch, September 2006)

This project will also contribute to the sustainability of the fibre supply, the forest industry and communities by providing information to forest and sawmill managers about the benefits and methods of long-term storage of logs using insulated snowpacks. Such storage has been proven to maintain fibre quality. Long-term storage of green, red and gray attack logs without fibre quality loss would improve value of lumber (less degrade due to drying effects), would reduce sawmill and pulpmill costs (Nader, 2005), would even out the flow of fibre to the mill and would contribute to the Salvage Strategy as articulated in the Mountain Pine Beetle Action Plan for Alberta (Alberta SRD, Forest Management Branch, September 2006)

Objectives or Activities Beyond Company Responsibility:

The objectives of the project are:
To review and analyze the strategic potential to integrate log storage under insulated snowpacks into harvest scheduling and log inventory management in mountain pine beetle affected areas by identifying critical factors for success, and any information gaps or potential impediments to implementation.

To conduct a biological assessment of the effects on beetle phenology and survival of storing "green-attack" logs under an insulated snowpack for one and two summers.

1.3 REQUIRED INFORMATION

Project Objectives Compared to FRIP Objectives:

The management of the forest resources of Alberta will benefit when the objectives of this project are met. Forest land managers and mill managers will better understand the potential for using insulated snowpacks for long-term storage of MPB infested logs and the operational and logistical requirements of making this tool a success. This benefit extends to the use of non-infested logs in terms of the impacts of frozen storage on fibre quality and mill processing.

The potential of harvesting larger areas of "green-attack" trees and alleviating seasonal wood supply problems to the mills, by extending the time infested trees can be processed, increases the chances that the beetle epidemic can at least be slowed and at most arrested. Impacting on the severity of the beetle attack and mitigating the effects of the attack on the forest landscape, the industry and communities benefits the forest resources of Alberta.

Project Design:

There are two components to this project:
review and analysis of the potential for storage of logs under an insulated snowpack in Alberta; and,
building of insulated snowpacks of ""green-attack"' MPB logs to study the effects on beetle phenology and survival.

First Component

We will review the literature and locate industrial operations nationally and internationally where log storage under an insulated snowpack has been successfully implemented at a large scale. Woodland and mill yard managers using insulated snowpack storage will be interviewed to identify the key elements for successful integration into forest operations and factors that might aid or impede implementation in western Canada.

The results of our review and interviews will be presented to woodland and mill yard managers in targeted workshops in Northern British Columbia and western Alberta (Upper and Lower Foothills Natural Sub-regions). We will discuss our results and obtain local perspectives on how these elements might be adapted to western Canadian operations and any information gaps or impediments to successful implementation that must be addressed.

A final report will be prepared and submitted to all funding agencies and participants in this component of the project.

Roger Whitehead, CFS Victoria has received funding from the Government of BC to conduct the majority of the work associated with this component of the study. Additional funding is required to execute this component in Alberta.

Second Component

The second component of this project involves the establishment of insulated snow packed log decks and the assessment of beetle phenology and survival. There are two factors whose effects we wish to analyze: the length of time of storage (one summer versus two), and beetle attack

density on the stored logs. In addition, there are two random covariates – temperature and relative humidity – which could influence the outcomes.

Ten tree-length log decks a minimum of two metres high and ten metres long will be built in the Canfor log yard in Grande Prairie, Alberta in the winter of 2006. The log decks will be composed of both "green-attack" and non-attacked lodgepole pine tree-length logs harvested in the Grande Prairie area. At least 20 percent of the logs in each deck must be "green-attack".

To ensure that at least the acceptable number of "green-attack" logs are present in each deck, "green-attack" trees will be located and thoroughly spray painted while still standing in the cutblocks. After skidding and delimbing we expect that a sufficient amount of spray paint will remain on the trees to enable us to determine if we have enough "green-attack" logs present in the log decks at roadside in the cutblocks. The sides and butt of marked (infested) trees will be painted again either in the bush or in the mill yard. If required, green-attack logs will be preferentially sorted onto the trucks at the time of loading.

Trucks with the marked logs will be designated for offloading into the treatment log decks in the yard. As the treatment decks are being built, four sensor arrays of paired thermocouples and humidity sensors will be placed in the middle of the log deck at least two metres from each end, with two metres between each of the arrays in the pile. Some trial and error will be required to ensure the sensors are placed in the spaces between the logs rather than being crushed between them. An additional four thermocouples will be placed on the outside of the pile, in the middle of each side. The sensors will be connected to Hobo® U12 data loggers stored in water proof Pelican® cases. The dataloggers will gather readings every three hours. Data will be downloaded at least every four months.

A sample of 10 infested-logs going into each pile will be assessed for beetle numbers and phenology. An area of bark 20 cm by 20 cm square will be removed from each log, 1.5 metres from the stump. All beetle eggs, larvae, pupae and adults will be collected from the sampling area and stored in separate vials by sample. These logs will be incorporated into the deck.

After all 10 log decks are built, a Silent Storm by SMI Inc., or equivalent snow making machine, will be used to make snow to cover the log decks. Water for snowmaking will be sourced from fire hydrants (city water) in the log yard. Five of the log decks will be covered with one metre of packed snow and five of the decks will be covered with 1.5 metres of packed snow. A Snowcat or small tracked dozer will be used to pack the snow. The decks with one metre of snow will be opened in the late summer of 2007 (one summer of storage). The decks with 1.5 metres of snow will be opened in the late summer of 2008 (two summers of storage). All the decks will be covered with at least 1 metre of a homogenous mulch-like mix of wood chips, sawdust or bark. The mulch will be applied using a small tracked loader.

FERIC will assess the production and costs associated with the building of the insulated snowpack using a snow making machine. A snow making machine was not used in the FERIC east studies cited in the Relevant References section above.

The mulch layer and snow will be removed from the log decks in mid-August with a back-hoe or front end loader. The mulch layer will be salvaged for re-use or for use in the co-generation plant on the Canfor mill site. The piles must be opened 4-6 days before the wood is required for milling in order to allow ice to melt and to facilitate removal of logs. The time required is temperature dependent. Some of the logs not in direct contact with snow and ice (e.g. logs within the centre of the pile) will be checked to determine if beetle development has progressed to the point that the

beetles can emerge and fly immediately after opening. If this has occurred, these logs will need to be milled immediately in order to prevent the release of adult beetles. If this has not occurred, the logs in the decks will be milled as soon as they are free of ice and snow.

Soon after each log deck is opened, the loader will set aside at least 10 beetle attacked logs from each deck. The logs will be sampled for beetles using the same procedure as above.

The age structure of the populations of beetles in logs before storage will be compared to the samples of the same populations after one and two summers storage. This will tell us if the beetle population has advanced any in phenology (age). These phenology measurements will be compared with predictions from a MBP phenology model that is currently being customized for Alberta.

The results of this component of the project will be presented in an annual and final report to FRIAA and Canfor (the industry supporter of the project). The final results of the study will be published either in a refereed journal or as a CFS Information Report.

Scientific Review:

The project proposal was reviewed by Dr. Sunil Ranasinghe Ph.D., Forest Entomologist Alberta Sustainable Resource Development, Forestry Division ,Forest Health Section. His suggestions have been incorporated into this document. SRD is also a contributor to this project.

The concept of constructing the insulated snowpacks using snow making machines has been discussed with Josef Nader of FERIC Eastern Division. He feels that costs may be lower and the quality of the snowpacks may be greater with the snow making machines than with using scavenged snow from the mill yard. Tony Sauder, FERIC Western Division, will be evaluating the use of the snow making machine to create the snowpack.

Funding Requested and Detailed Budget:

This project will require a total of $270,917 to complete over two years, of which a total of $133,869 is requested from FRIAA Open Funds Initiative**. The detailed annual budget is shown in Table 1.**

Table 1. Budget for project.

Category	FERIC	CFS	FRIAA	AB. SRD	Canfor	Totals
Wages	$2,875	$74,757	$13,350	$0	$0	$90,982
Travel	$0	$6,048	$11,452	$1,800	$0	$19,300
Meals & Accommodations	$0	$0	$41,710	$0	$0	$41,710
Supplies	$0	$0	$6,800	$4,382	$0	$11,182
Equipment Purchase	$0	$0	$0	$12,000	$0	$12,000
Equipment Rental	$0	$0	$9,188	$0	$0	$9,188
Harvesting/Hauling/Log Yard Logistics	$0	$0	$0	$0	$25,000	$25,000
Contract Snow Making	$0	$0	$39,200	$0	$0	$39,200
Total	$2,875	$80,805	$121,700	$18,182	$25,000	$223,561
Overhead	$288	$8,080	$12,170	$1,818	$0	$22,356
Funding Source Totals	**$3,163**	**$88,885**	**$133,869**	**$20,000**	**$25,000**	**$270,917**
Grand Total						**$270,917**

Description of Other Funding:

Of the total required for this project, the CFS, Fibre Centre, Edmonton will contribute $88,885 in services in kind.

Canfor, Grande Prairie, our industry partner, is contributing approximately $25,000 in-kind support in the form of yard space, access to water, mulching material and accommodation in harvesting, processing, hauling and mill yard activities.

Alberta Sustainable Resource Development will contribute $20,000 in cash in support of the project.

FERIC will contribute in-kind wages of $3,163 to the project.

Total other funding for Alberta portion of project: $137,048

The majority of the review and analysis component of this project is funded jointly by FERIC, CFS- Victoria and the BC Forest Service under a separate research proposal. Total cash and in-kind funding is $176,800.

Total combined other (Alberta and BC) funding to complete this project: $313,848

Subcontracting of Activities:

Due to the specialized nature of snow making, this component of the project will be subcontracted. There are several snow making contractors in the Grande Prairie area. These contractors will be asked to provide a per diem all found rate (except water supply) to make snow based on a 24 hour day. A combination of bid price, experience, references and type of snow making equipment will be used in the selection of the successful bidder.

Schedule of Activities:

The following schedule of activities is planned:

Task	Time Period
Component 1	
Literature Review	Oct-Nov 2006
Interviews of operations currently using snowpack storage	Nov-Dec 2006
Compilation of Literature Review and Interviews	Dec-Jan 2006-07
Workshops/Discussions in Alberta	Jan-Feb. 2007
Draft Final Report	Mar. 2007
Final Report	May 2007
Component 2	
Collaborator Meetings, site visit, reconnaissance, site planning	Nov. 2006
Tree Marking	Dec./Jan. 2006-07
Logging, hauling, beetle sampling and pile building	Jan.-Feb. 2007
Snow Making and Mulching	Jan.-Feb. 2007
Datalogger download	May 2007
One summer storage treatment log deck deconstruction, beetle sampling, datalogger download	Aug. 2007
Interim Report Preparation and Submission	Sept.-Dec. 2007
Datalogger download	Oct, 2007/Jan 08/April 08
Two summer storage treatment log deck deconstruction/beetle sampling, datalogger download	Aug. 2008
Final Report Preparation and Submission	Sept. 2008-March 2009

Project Management

Richard Krygier, Intensive Fibre Management Specialist, Canadian Forest Service, Fibre Centre will co-manage this project with Dr. Barry Cooke, Research Scientist, Spatial Dynamics of Forest Insects, Canadian Forest Service, Fibre Centre

Mr. Krygier will be responsible for the operational components of the project. This includes tree marking, log deck construction, insulated snowpack construction and instrumentation. He will also co-ordinate the Alberta portion of the first component of the project- the strategic analysis of the potential to use insulated snow packs for log storage.

Mr. Krygier has over 19 years experience as a silviculturist in three provinces. He has successfully managed major operational silviculture programs in the forest industry. Over the past two years he successfully established a willow biomass production research site using subsurface drip irrigation with municipal sewage waste water. The logistics of establishing this research site are similar in magnitude to the design of this proposed project.

Dr. Cooke will be responsible for the assessment of beetle phenology and survival. He will assist with the identification of MPB attacked trees and co-ordinate all field work related to the assessment of beetle populations in the “green-attack” trees in the experimental log decks.

A technician will assist Mr. Krygier and Dr. Cooke in the successful execution of this project.

Mr. Tony Sauder, Group Supervisor, Harvesting Operations Research, FERIC West, will lead the targeted workshop portion of the first component of this project and asses the use of snow making machines in the construction of the snowpack. Mr. Sauder has extensive experience in the establishment and analysis of operational forestry research projects and is known by most operational field personnel in the forest industry.

Permits, licenses or Other Authorization:
No permits or licenses other than the harvesting approvals obtained by Canfor are required to complete this work.

Impacts on Other Resources or Users:
There will be no impacts on other forest resources or users.

Deliverables to FRIAA and for Public Use
The deliverables for this project are:
A summary document of the literature review and interviews of operations using insulated snowpacks for storage of logs.

Targeted workshops in Alberta to:
Present the results of the literature review and interviews; discuss the results; and, obtain local perspectives on how the results might be adapted to Alberta conditions.

A final report incorporating the results of the literature review, interviews and Alberta workshops. The report will identify key operational factors and requirements for the successful integration of insulated snowpacks into forest operations in Alberta and discuss knowledge gaps or other impediments to implementation. This report will be provided to all workshop participants and to FRIAA.

A report presenting the results of the study investigating the effects of using insulated snowpacks for storage of "green-attack" logs on MPB phenology and survival. This report will be made available to the general public by publication as either a CFS Information Report or in a referred scientific journal.

The combination of the two reports will provide forest managers with the information needed to determine if they can use insulated snowpacks for the storage of "green-attack" and other logs under insulated snowpacks.

External Endorsement of the Proposal:

The following companies have endorsed this proposal:

- ✓ Canadian Forest Products Ltd., Grande Prairie
- ✓ Weyerhaeuser Company, Grande Prairie

The following government departments have endorsed this proposal:

- ✓ Alberta Sustainable Resource Development, Forest Management Division, Forest Health Section

1.4 REQUIRED SCHEDULES

Progress Reporting and Payment Schedule:

The following table shows the date and type of report to be submitted by the CFS to FRIAA. The amount and date of each payment is also shown.

Activity	Report Date	Payment Date	Report Type	Payment Amount
Component 1- Literature Review, Interviews, Compilation and Workshops		On approval of funding		$20,000
	Mar. 15, 2007	April 1, 2007	Component 1 Final Report	$3,170
Component 2- Site Meetings, site reconnaissance, tree marking, insulated snow pack log deck construction		On approval of funding		$75,000
	April 15, 2007	May 1, 2007	Component 2- Establishment Progress Report	$11,000
Deconstruction of one summer storage log decks, beetle sampling	Dec. 15, 2007	Jan. 15, 2008	Component 2- Progress Report/ Preliminary results	$11,000
Deconstruction of two summer storage log decks, beetle sampling Data Analysis/Report Preparation	Jan. 30, 2009	Mar. 1, 2009	Component 2- Final Report to FRIAA	$13,699
Total				$133,869

Work Schedule:

The following work schedule is anticipated for completion of this project.

Task	Time Period
Component 1	
Literature Review	Oct-Nov 2006
Interviews of operations currently using snowpack storage	Nov-Dec 2006
Compilation of Literature Review and Interviews	Dec-Jan 2006-07
Workshops/Discussions in Alberta	Jan-Feb. 2007
Draft Final Report	Mar. 2007
Final Report	May 2007
Component 2	
Collaborator Meetings, site visit, reconnaissance, site planning	Nov. 2006
Tree Marking	Dec./Jan. 2006-07
Logging, hauling, beetle sampling and pile building	Jan.-Feb. 2007
Snow Making and Mulching	Jan.-Feb. 2007
Datalogger download	May 2007
One summer storage treatment log deck deconstruction, beetle sampling, datalogger download	Aug. 2007
Interim Report Preparation and Submission	Sept.-Dec. 2007
Datalogger download	Oct, 2007/Jan 08/April 08
Two summer storage treatment log deck deconstruction/beetle sampling, datalogger download	Aug. 2008
Final Report Preparation and Submission	Sept. 2008-March 2009

Appendix 17. West Fraser Hauling and Milling Strategy.

July 13, 2006

Chetwynd Forest Industries a Division of West Fraser Mills Ltd. Hauling Strategy 2006

Introduction

West Fraser Mills Ltd. harvests timber under various Forest Licenses within the Dawson Creek TSA. There is a Mountain Pine Beetle (MPB) infestation in portions of the TSA and West Fraser has committed to harvesting infected pine stands to help suppress the spread of the MPB.

In the past two years we have shut down the hauling of beetle infested wood during peak beetle flight times to prevent the spread of beetles into areas that did not have any attack. This has greatly reduced the amount of Pine that we can deliver to the mill. We are targeting 70% pine deliveries to our mill this year and in order to do that we need to extend our hauling timelines.

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Risk assessment

West Fraser has assessed the risk and the consequences of moving beetle infected wood into the Chetwynd Mill and has determined that the risk of spreading the infestation is low. Infestation percents in our stands are estimated at 3% and we feel that this is significantly low to be of little risk of providing enough beetles coming out of the trucks to mass attack a tree. Due to our warm spring and hot summer the beetles have already flown with the peak flight taking place in the last week of June, 2006 so there is little risk

of any further attack this year. There are now beetles in the Tumbler Ridge area so the consequences in that area will be low and the corridor from Tumbler to Chetwynd is approx 8 Km East of the current attack with attack anticipated along the corridor this year. We will monitor the pine along this route and either modify our hauling and/or deal with infect trees as needed.

Stratification

Blocks or part blocks that have high levels of beetle attack will not be transported during the flight period. Currently we have only one Permit in this category and that is CP 815-1. If during harvesting activities we discover other pockets of heavy attack they will be left in decks and moved after the flight period.

Uninterrupted hauling of infested wood

Drivers will be instructed to proceed uninterrupted to the mill once their load has been placed. This is to avoid the transport of infested wood from the infestation site to an area without current MPB attack where it could be left for a period of time during a time of potential emergence. This will reduce the risk of spreading the infestation to new areas. Areas where the trucks are required to stop by Law such as Brake Check Stops will be monitored to beetle attack annually and the infestations dealt with prior to flight.

Hauling delay contingency

Normally beetle wood will be processed within 24 hours of entering the yard. However, if there are interruptions in the milling process, the risk of escape from this wood will be addressed. All infested wood will be placed on the paved area of the yard and will be watered using the sprinkler system. This will be performed to cool the decks and prevent MPB emergence and escape.

Hot Milling

During the potential flight period beetle wood will be "hotmilled". This will entail that loads entering the yard are placed on the paved section that is easily accessible and scheduled for immediate debarking and processing. The estimated timeline for beetle wood entering the yard to processing will be 12 to 14 hours. Infested wood will not be present in the yard for greater than 24 hours during this period.

Log Yard Beetle Management Program

We have 45 Lindgren funnel traps strategically placed in 15 triple-trap clusters throughout the yard. During each site visit, these traps will be inspected, their MPB catches removed, and the required maintenance will be performed. Pheromone-baited funnel traps are been used to determine flight period information within the yard, identify areas that require additional attention, and to monitor the success of the Logyard and to trap any beetles that fly from wood in the Yard.

Milling Shutdown Contingency

Normally beetle wood will be processed within a day of entering the yard. However, if there are interruptions in the milling process, the risk of escape from this wood will be addressed. All infested

wood will be placed on the paved area of the yard and will be watered using the sprinkler system. This will be performed to cool the decks and prevent MPB emergence and escape.

Buffer Area Inspection

Susceptible timber within 3 km of the mill site will be inspected with a walkthrough survey near the end of the season. This should provide enough time to treat any infestations that did escape. Prior to November 15, 2007, a helicopter flight will be performed to locate and obtain the GPS coordinates of any red pine trees within a 10 km radius of the mill. This aerial survey will produce a baseline of infestation level and will contribute to assessments of the hauling and milling strategy.

Appendix 18. Canfor Chetwynd's Hauling and Milling Strategy.

DRAFT
2006 Mountain Pine Beetle Infested Timber Hauling and Storage Strategy

Chetwynd Division
Canadian Forest Products Ltd.

PO Box 180
Chetwynd, BC
V0C 1J0

May 29, 2006

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Introduction

Hauling and milling Mountain Pine Beetle (MPB)-infested wood during the potential flight period presents a risk of spreading the beetle and introducing it into areas that are not currently under attack. The objective of this plan is to make harvest and hauling activities more beetle effective by risk ranking blocks based on individual infestation levels and manage to a low risk level rather than managing for zero risk by not hauling through the beetle flight.

These procedures allow the licensee to reduce the potential 12 week "no haul window" to approximately 4 weeks.
Benefits of implementing a hauling and storage strategy for Canfor include:

- Providing a longer, more stable supply of timber to the mill to keep it operating at normal levels.
- Increasing the amount of sanitation harvesting available.
    - removing and processing heavily infested stands is the most economical and effective means of beetle control.
    - Harvesting current attacked stands and not being able to transport the wood to the mill for processing before flight, results in wasted resources.
- Protecting the financial stability of the local community.

The risk of spreading MPB during transport and storage of the wood however demands an appropriate plan be implemented to avoid compounding the problem due to judgments based on poor or a lack of information. This program provides the required data on which to base sound hauling and storage decisions. Clear information is given by site on predicted flight periods to base the beginning of the "no haul window" on the most severely infested portions of beetle blocks and actual flight data is presented to accurately determine when this period has ended. Furthermore, operational recommendations in combination with newly enhanced pheromone-bated funnel traps provide protection against escape at the mill.

A successful hauling and milling strategy for MPB-infested timber over the summer months relies on the MPB Field Monitoring Program which involves determining when MPB brood is about to emerge from infested timber. This information enables the Licensee to maximize the time available for sanitation harvesting while minimizing the risk of dispersal through transportation of infested wood during the flight period.

The second component is a MPB Logyard Management Program to ensure that infested inventory is milled prior to emergence. Pheromone-baited Lindgren funnel traps positioned strategically enable monitoring for assessment and to identify areas of the logyard that require additional attention. Recent advances in pheromone technology will allow for mass trapping of any MPB beetles that

escape the milling process thereby providing additional protection for the surrounding habitat.

Hauling Thresholds

The objective of this proposal is to make harvest and hauling activities more beetle effective by stratifying and risk ranking blocks based on individual infestation levels and manage to a low risk level rather than managing for zero risk by not hauling through the beetle flight. Once block stratification is complete Canfor will identify where each unit falls in the matrix of infestation intensity and distribution and based on these criteria decide whether a block can be hauled during the beetle flight with or without constraints.

Currently, infestation levels in Canfor Chetwynd blocks is generally low (majority are less than 5% infested) with some exceptions.

The method Canfor will implement to accomplish this objective:

No Haul Window/Peek Beetle Flight

- Is to stratify it's planned harvest blocks into areas having varying levels of infestation using overview flight, ground probing and walkthrough data.
- Identify the peek beetle flight period through field monitoring (Field Monitoring Section)
- Areas having infestations above the 5% threshold maybe harvested but not hauled during the 'no haul window' or peak beetle flight period.
- Areas having less than 5% infestation will be hauled during the 'no haul window,
- All processed decks under the 5% threshold will be walked to identify concentrations of infested logs (identified by blue stain) and they will be marked and sorted for transport following the peek flight

Haul Outside the Beetle Flight Window

- Is to stratify it's planned harvest blocks into areas having varying levels of infestation using overview flight, ground probing and walkthrough data.
- Identify the peek beetle flight period through field monitoring (Field Monitoring Section)
- Follow Table 1. All loads infested above the threshold numbers must be marked as infested and hauled and milled within 24 hours.

Table 1			
Distribution of Infestation	**Infestation Level % within block**		
	0-5	5-10	10+
Clumped*	No hauling restriction	Ribbon out infestations centers and haul that portion of the block outside the flight window. The remainder of the block will have no hauling restrictions	If infestations can be ribboned out and that portion of the block hauled outside the flight window and this brings the overall infestations level in the remainder of the unit below 5% then hauling can proceed
Even Distribution**	No hauling restriction	No hauling restriction outside the peek flight window. Infested logs must be milled within 24hours	No hauling during beetle flight

* Clumped is defined as greater than 70% of infestations within the block are in discreet units that can be readily identified during overview flights and subsequent probing.

** Even Distribution is defined as not having distinct discernable patches with infestations exhibiting a 'salt and pepper' pattern over the block.

Field Monitoring Program

A monitoring system will be set up in specified operating areas (where mountain pine beetle infested timber above endemic levels is being harvested) to assess the emergence and flight period of MPB throughout the summer. At each monitoring site that will be representative of the area being harvested, bark patch samples will be taken weekly from infested pine trees to determine the status of brood development. This also enables estimation of the population percent that has yet to fly for the season.

Information generated from weekly visit data will be used to characterize the risk and potential timeline for MPB emergence. The MPB field Monitoring Program provides a complete information source on which to base operating decisions and reduce the period of restricted hauling. It also determines when peak flight has passed and when it is safe to lift the "restricted hauling window".

Hauling and storage practices are generally controlled one week after the first beetle hole is observed. This timeline can be modified however when bark patch

analysis data and temperature monitoring information are consulted. Restrictions are lifted two weeks following the main flight.

Methods

Bark Patch Sampling

Bark patch samples will be taken from **five** nearby MPB infested trees during each site visit. Two bark patches will be taken on each tree to determine the number and development stage of the MPB brood. These 15cm x 15cm bark squares will be removed from the north and south sides of the sampled tree. Two samples per tree are taken as sun exposure and environmental variation can have a significant impact on brood development. The two samples provide a better estimate of the average of MPB brood development of the site. Weekly samples will be removed top to bottom on the trunk and will leave a small buffer of intact bark between if the total number of infested trees necessitates resampling. This will minimize the impact of collecting a bark sample on the development of the remaining brood in the tree. During each site visit, exit holes will be counted to estimate the percentage of beetles that have flown.

Results

After each weekly monitoring visit, a note to file will be generated that details the findings from the bark patch sampling. The following will be included:

Bark Patch Sampling

- a table identifying the average number of MPB in each life stage (parent adults, larvae, pupae, callow adults and mature brood adults)
- observations of the bark patch trees and the bark patch samples
- a chart indicating the percent of the population and the mean number of beetles at each life stage
- a notation from the exit hole count on the percentage of the adults having flown from the site.

This information will be used on which to base implementation of the “no haul window”. The current threshold for restricting hauling will be when 60% of the brood remaining in the tree is estimated to be within one week of emergence.

MPB Logyard Management Program

Storage of infested wood requires a sound risk management plan that is based on identification and prioritization for milling of infested inventory. The main focus for the 2006 logyard management program is to monitor mountain pine beetle flight and brood development and mill mountain pine beetle decks before they pose a flight risk.

The Log Yard Program will consist of the use of Lindgren funnel traps at targeted locations throughout the logyard for the basis of the program. Furthermore, the

increased effectiveness of pheromone trap lures in 2006 will enable a mass trapping control of beetles that do emerge.

Milling Prioritization

Canfor plans to have all wood identified as beetle infested through the mill within a 24 hour period. Canfor will also not have a beetle inventory in the log yard after May 15th.

Pheromone-baited Lindgren Funnel Trap Monitoring and Mass Trapping

Pheromone-baited funnel traps have been used historically in a MPB Logyard Management Program for several functions. Trap catch data is used to determine flight period information within the yard, identify areas that require additional attention, and to monitor the success of the Logyard Program. Until now, the trap lures have not been attractive enough to provide a significant level of control.

Advances in MPB pheromone technology during 2004 have led to an improved trap lure available for the 2006 season. This new pheromone component dramatically increase trap effectiveness in capturing MPB and can be utilized to provide a level of control against emerging beetles escaping the yard.

Lindgren funnel traps will be strategically placed in several locations throughout the yard. During each site visit, these traps will be inspected, their MPB catches removed, and any required maintenance will be performed.

Buffer Area Inspection

An adequate area surrounding the mill yard should be inspected following peak flight to investigate and spill over that escaped milling and was not contained by the trapping system. Key areas comprised of susceptible timber within 3 km of the mill site will be inspected with heli-overview flights late in the summer season. Treating infested sites within the buffer zone prior to the next beetle flight will be a priority of the strategy.

Milling Delay Contingency

There is an estimated 50 loads of MPB-infested wood expected per day entering the mill yard with a milling capacity of 75 loads per day. Therefore, all wood entering the yard will be through the debarker and fed into the mill within 24 hours of arrival.

If, however, there is an interruption in the milling operation, wood present in the yard will be addressed. Watering will be employed to reduce temperature in infested decks and to reduce potential emergence and flight of MPB. Wood may be milled at West Fraser if necessary.

Transportation Corridor Risk Management and Log Hauling

Loads must also be clearly identified to ensure the wood is handled properly once it reaches the mill yard. The following procedures will be followed:

- In the field, wood will be identified as beetle vs. non-beetle decks.
- Beetle infested decks will be painted with a green "B"
- Minimum of 4 trees/load will have a green "B" at the butt and top ends.
- Scale slips must have the words **"Beetle Wood"** in the comments section.

Truck drivers/contractors who do not follow these procedures risk having their contract suspended during the hauling window of May 15 – September 15.

Uninterrupted Transport of Infested Wood

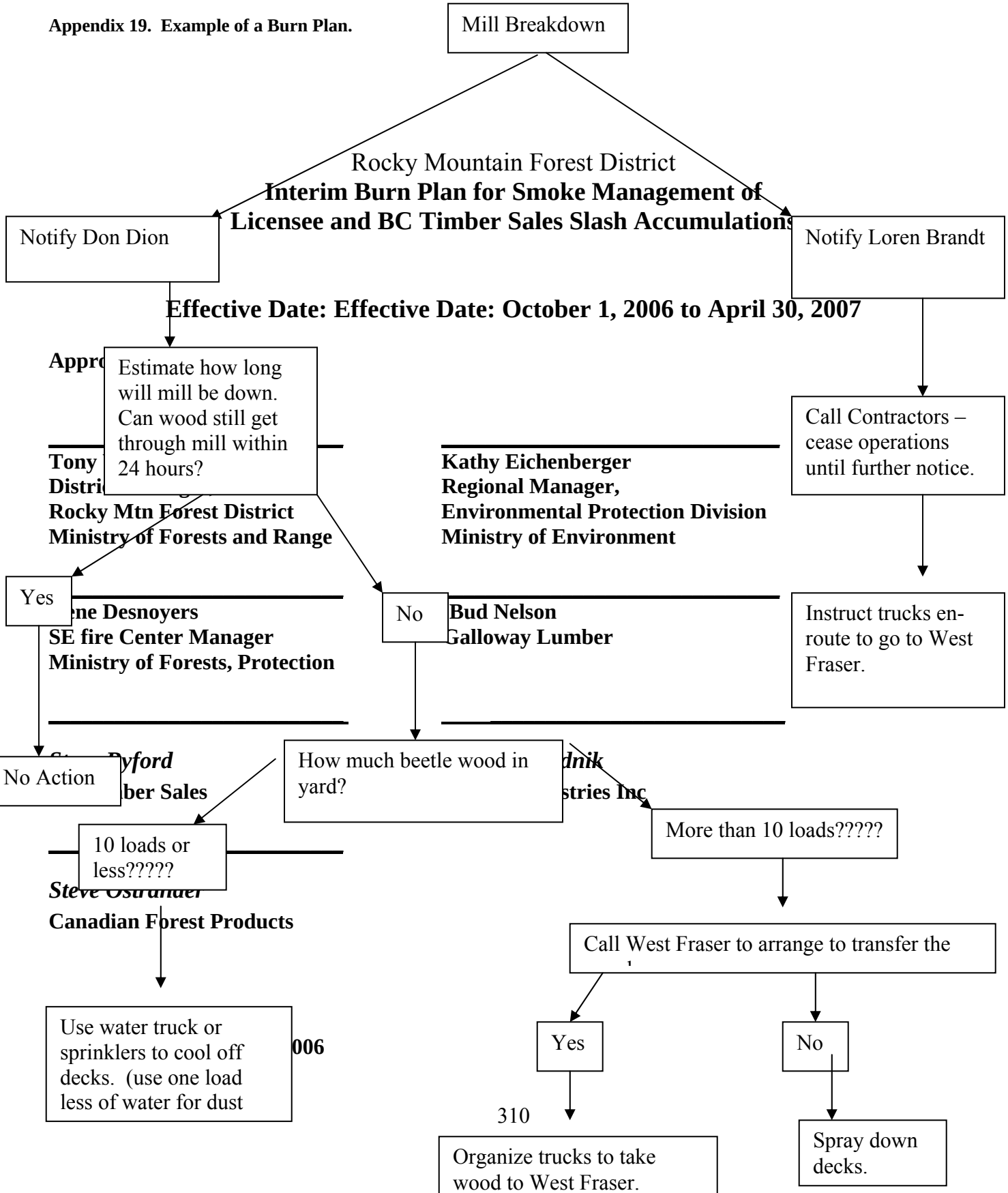
Drivers will be instructed to proceed uninterrupted (except for safety stops) to the mill once their load has been placed. This is to avoid the transport of infested wood from the infestation site to an area without current MPB attack where it could be left for a period of time during a time of potential emergence. This will reduce the risk of spreading the infestation to new areas and increase the effectiveness of sanitation harvesting efforts.

Mill Shutdown Contingency

If the mill experiences any difficulties that result in shutdown, hauling will cease. An agreement will be in place between West Fraser and Canfor to mill one another's infested wood that is in log yard inventory in the case of a mill break down. Instruction will be given to Contractors that infested timber will remain at the harvesting or infield log storage site until the mill reopens

Mountain Pine Beetle Wood Contingency Plan for Mill Breakdowns

Appendix 19. Example of a Burn Plan.



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1.0 INTRODUCTION

Each year in the Rocky Mountain Forest District it is necessary for BC Timber Sales and Licenses to burn machine piled logging debris and small hand piles from fall and burn beetle infested trees, to reduce the fire hazard or to remove habitat for forest pests, such as the mountain pine beetle. Smoke is the most visible product of this controlled burning. Large amounts of smoke may affect air quality and may have serious consequences such as poor visibility for aircraft and increased occurrence of respiratory ailments in communities adjacent to the smoke source.

The Ministry of Forests and Range is mandated through the Wildfire Act and Wildfire Regulation to manage and regulate the fire activities (open burning) of individual citizens, agriculture and the forest industry on or within 1 km of forestlands or grassland. Thus this plan is the Rocky Mountain Forest District's commitment to managing the smoke produced by mandated open burning sources in the Rocky Mountain Forest District.

In addition to the Ministry of Forests and Range regulations surrounding fire activities, the Ministry of Environment has the mandate to regulate smoke emissions from open burning under the Environmental Management Act and the Open Burning Smoke Control Regulation (OBSCR). The Ministry of Environment uses a generic Smoke Management Forecast from Environment Canada and spot forecasts from the South East Fire Centre, in Castlegar, to regulate where and when burning is permitted. Licensees are responsible to obtain current information and make appropriate burning decisions.

All resource management burning must comply with the requirements of both the MOF&R and MOE in order for licensees to maintain their ISO14000 certification.

2.0 PURPOSE

The intent of this plan is to maintain acceptable air quality in inhabited areas during the period that pile burning is normally done, generally between October 1st to April 30th, and to provide some flexibility for burning. This is to be accomplished through:

- Identifying smoke sensitive areas in the Rocky Mountain Forest District (and adjacent regions) and classifying other areas as either moderate or low sensitivity
- Identifying open burning guidelines in each sensitivity area
- Identifying the maximum # of open burns (pile burns) that may occur per day per licensee, dependent on weather conditions and sensitivity rating

This plan is considered a 'burn plan' under the OBSCR sec. 8 (1) of schedule B. This means that the venting requirements in this plan supersede the venting requirements of the Open Burning Smoke Control Regulation. It is important to note that this plan is intended as a guide and in most cases the requirements of this plan were developed to complement and assist the OBSCR and not to add extra policies or requirements.

In addition to following this burn plan, licenses planning to conduct open burning must review and comply with the OBSCR Regulations and sections of Wildfire Act (WFA) relating to open burning.

It should be noted that this plan is intended solely for the purpose of pollution[9] prevention. The plan should not be construed as a means of promoting the burning of logging residues, beyond what is strictly required for fire and pest hazard abatement.

[9] Pollution is defined as 'the presence in the environment of substances or contaminants that substantially alter or impair the usefulness of the environment', source Environmental Management Act.

2.1 Scope
This plan applies to the entire Rocky Mtn Forest District.

This plan shall be in effect from October 1, 2006 to April 30, 2007.

3.0 GUIDELINES FOR EFFECTIVE SMOKE MANAGEMENT

In order to improve the potential to conduct burning in a more efficient manner, the area within the Rocky Mountain Forest District was assigned smoke sensitivity ratings and burning guidelines were developed for each classification (see Table 1). The smoke sensitivity classes within the Rocky Mountain Forest District are shown on the attached map which forms an integral part of this burn plan for smoke management. The classification is based on proximity to communities or rural residences, known geographic barriers to smoke drift, and the prevailing wind direction.

The boundaries of the Municipal Airsheds have also been incorporated onto the smoke management plan map. The operating areas closest to the Municipal air sheds are classed as high sensitivity, and any proposed burning would be done according to the *Open Burning Smoke Control Regulation* and the *Open Burning Smoke Control Code of Practice.*

The following procedures will be followed within each sensitivity class in the Rocky Mountain Forest District:

- In ***high*** *sensitivity* areas, for machine piles generally larger than 2 metres height and 3 meters width, unrestricted open burning is permitted in accordance with the requirements of the *Open Burning Smoke Control Regulation* and the *Open Burning Smoke Control Code of Practice*. Ignition of piles are allowed when the ventilation index is "good" for the day of ignition and are forecast to be "fair" or better for the following day. On Day One of Fair, ignition of 2 piles per licensee per area (defined as Elk Valley, South Country, Cranbrook, Creston, Canal Flats and Parson) are allowed, provided the forecast is to be good, fair or poor for the following day. Under conditions identified as "poor", no ignition is allowed. See conditions outlined in Table 1

- In ***moderate*** *sensitivity* areas, for machine piles generally larger than 2 metres height and 3 meters width, unlimited open burning is allowed when venting conditions are "good" for the day of ignition and forecast to be "fair" or better for the following day (follow the requirements of the OBSCR). On Day One of Fair or Poor venting conditions, burning of piles can only be undertaken under the conditions outlined in Table 1.

- In ***low*** *sensitivity* areas, for machine piles generally larger than 2 metres height and 3 meters width, unlimited open burning is allowed when venting conditions are "good" for the day of ignition and forecast to be "fair" or better for the following day (follow the requirements of the OBSCR). Conditional open burning is also allowed under "fair" or "poor" venting conditions as outlined in Table 1.

In implementing the guidelines above, if local winds or air currents move the smoke into a higher Sensitivity rating area, the guidelines for that sensitivity area must be followed.

Spot Forecasts[2]: Burning restrictions for any sensitivity area in the Rocky Mountain Forest District may be modified if a qualified meteorologist provides a venting index forecast or a Rocky Mountain Venting and Weather Forecast for a specified area that is better than the published Rocky Mountain Generic

Smoke Management Forecast as provided by Environment Canada. This service is typically accomplished through the South East Fire Centre in Castlegar BC.

Note:

- All other conditions of the OBSCR still apply to all open burns (e.g. set-back distances, initiation of burns under poor local air flow, duration of burns, etc)
- All conditions of the Wildfire Act (PART 4 – PERMISSABLE OPEN FIRES) apply.

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[2] For spot forecasts phone 1-250-365-4030, Fax 1-250-365-9926 Request needs to provide elevation, aspect and lat /long. There is a fee of $35 for a faxed report.

Table 1. Rocky Mountain Forest District
Guidelines apply to the allowable cumulative total for all licensees in any given smoke management area.

Sensitivity Rating	**Venting Conditions on day of Ignition**		**Ignition Guidelines ***	**Fall and Burn Ignition Guidelines****
	Day one	**Day two forecast**		
High	Good	Good or Fair	Unrestricted burning as specified in the OBSCR	Unrestricted
	Fair	Good or Fair or Poor	Ignition of a maximum of 2 piles per licensee per areas (Elk Valley, South Country, Cranbrook, Creston, Canal Flats and Parson) at any time. Only material dried in piles over at least one summer: no ignition within 1 km of residences. No ignition of new piles if smoke is blowing into a High sensitivity area. No new ignition 3 hours prior to sunset.	No burning within 1 km of a residence; 50 trees per day within 10 km radius. No new ignitions 3 hours prior to sunset.
	Poor	Good or Fair or Poor	No burning allowed	No burning allowed
Moderate	Good	Good or Fair	Unrestricted burning as specified in the OBSCR	Unrestricted
	Fair	Good or Fair or Poor	Only material dried in piles over at least one summer. No ignition within 1 km of residences. No ignition of new piles if smoke is blowing into a High sensitivity area.	No burning within 1 km of a residence; 100 trees per day within 5km radius.

	Poor	Good or Fair or Poor	Ignition of a maximum of 2 piles per Licensee per area (Elk Valley, South Country, Cranbrook, Creston, Canal Flats and Parson) at any time. Only material dried in piles over at least one summer. No ignition within 1 km of residences. No ignition of new piles if smoke is blowing into a High sensitivity area	No burning within 1 km of a residence; 100 trees per day within 10 km radius.
Low	Good	Good or Fair	Unrestricted burning as specified in the OBSCR	Unrestricted
	Fair	Good or Fair or Poor	Unrestricted burning	No burning within 1 km of a residence; 200 trees per day within 2 km radius.
	Poor	Good or Fair or Poor	Unrestricted unless the VI remains in the Poor category for three consecutive days; at this point no further ignition of piles can occur until the VI improves to at least the Fair category.	No burning within 1 km of a residence; 200 trees per day within 5 km radius.

* Applies only to piles generally larger than 2 metres height and 3 meters width, machine piled.

**Apply only to small hand-piled fall and burn beetle infestation trees. Individual piles are generally smaller than 2 meters in height and 3 meters in width.

- Follow "General Ignition Guidelines for all sensitivity areas."
- For "High" sensitivity areas, the MOE will be monitoring smoke saturation levels of high sensitivity air sheds. For machine piles generally larger than 2 metres height and 3 meters width, licensees are to contact the Zone and District MOE offices prior to light up, with information on number of piles to be burned, elevation, lats and longs of each landing pile. For Fall and Burn, a general Long and Lat for a 5 km radius will be adequate ***prior to light up.***
- For Moderate and Low zones, the MOE requires a general Lat and Long for a 5 km radius and number of landing piles or Fall & Burn sites to be submitted to the MOE offices at the beginning of each week.
- MOE Contacts are: Garry Bell (garry.bell@gov.bc.ca) and Paul Willis (paul.willis@gov.bc.ca)

The above guidelines apply to BC Timber Sales and Licensee burning of all slash accumulations. These guidelines will be reviewed and updated annually or when related legislation changes.

The above procedures are valid for the period of October 1st. to April 30th. These procedures will be reviewed and updated annually.

Appendix 20. Example of Open Burning Smoke Control Regulation Exemption.

OPEN BURNING SMOKE CONTROL REGULATION
OMINECA and PEACE REGIONS
REQUEST FOR EXEMPTION
CHETWYND FOREST INDUSTRIES
BURNING OF MOUNTAIN PINE BEETLE INFESTED TREES

Background

There currently is a large mountain pine beetle infestation attacking pine stands in the Peace Region of B.C. This infestation has the potential to damage and destroy valuable stands of pine on productive forestlands and Parks in British Columbia and to spread into other Provinces. A multi-agency group has been formed to gather information and develop and implement effective control strategies to deal with this infestation. One of the traditional control strategies being employed is "fall and burn". Another strategy being used is to pile and burn the beetle-killed timber using helicopters. Helicopter assisted burning will be our primary treatment tool. We plan on burning approximately 100,000 infested trees, utilizing approximately 250 pre-selected burn sites, within the treatment work units described below.

Areas of Operation – Work units.

- **Kakwa River in Kakwa Park**
- **Kakwa in Kakwa Park**
- **Narraway**
- **Belcourt**
- **Lower Red Deer**
- **Red Willow**
- **Wapiti**
- **Honeymoon Creek**
- **Feller's Creek**
- **Bearhole Bearhole Lake Provincial Park is contained within this work area**

NB – a PDF map is attached and shows the work units (orange areas on bottom half of the map).

The project will be starting January 15, 2007 and running through until approximately May of 2007. We will be treating the Park areas (Bearhole and
Kakwa) first due to timing constraints for mountain caribou then moving on to the other work units.

Legislative Requirements

As these operations will be releasing smoke into the environment, they fall under the "*OPEN BURNING SMOKE CONTROL REGULATION*".

1. With regards to the definition for "parcel of land" in the regulation, it is agreed that the land being used to conduct the heli-burning operation is consistent with the definitions for "parcel of land" for crown land covered by a licence (Forest Licence) and Parks as defined in the regulation.

2. With regards to the ventilation index and other smoke dispersion requirements of Sections 8 and 9 of the regulation, all areas planned for burning under this Plan are considered to be low smoke sensitivity areas. As such, as allowed for under Section 8 and Section 9 of the *Open Burning Smoke Control Regulation*, we request an exemption from the ventilation index requirements of the regulation.

3. In the event that any burning under this plan occurs within 15 km of the Municipality of Tumbler Ridge, we will treat that burning as Category A and follow all requirements of the *Open Burning Smoke Control Regulation* for Category A burns.

4. All other provisions of the *Open Burning Smoke Control Regulation* must be met unless otherwise approved by Ministry of Environment

5. All burning will be covered by a burn reference number and will be available upon request.

Mike Cleaver
For and on behalf of Chetwynd Forest Products

Exemptions to Sections 8 and 9 of the *Open Burning Smoke Control Regulation* approved.

Mellissa Winfield-Lesk
for Director, *Environmental Management Act*
Ministry of Environment
Omineca and Peace Regions
Prince George, BC

Date: January 29, 2007

Appendix 21. Example of Burning Registration Number Application.

BURN REGISTRATION NUMBER APPLICATION
WEST FRASER
CHETWYND FOREST INDUSTRIES
BOX 330
CHETWYND,B.C.
V0C 3JO

CLIENT INFORMATION		CONTACT INFORMATION	
Number	5608 (COMPANY)	Number	11153
Name	WEST FRASER MILLS LIMITED, CHETWYND FOREST INDUSTRIES	Name	Pate, Brian

Address	BOX 330 CHETWYND BC VOC 1J0 Canada	Address	
Phone	(250) 788-2686	Phone	(250) 788-2686
Alternate Phone		Alternate Phone	
Fax	( )		
Email		Email	
Comments		Comments	

WORK UNITS BEING APPLIED FOR

REGISTRATION INFORMATION Kakwa River			
Latitude	54 05.585	Longitude	120 03.305
Geographic Description	Kakwa River R06-G1816		
Burn Category Code	3	Description	Category 3 Open Fire (Windrows or industrial pile burning)
Burn Area (ha)	0	Number of Piles or Windrows	50 +-
Legal Description	FL A13840		
Comments	mountain pine beetle burn piles constructed by helicopter		

REGISTRATION INFORMATION Kakwa			
Latitude	54 16.407	Longitude	120 12.161
Geographic Description	Kakwa R06-G1817		
Burn Category Code	3	Description	Category 3 Open Fire (Windrows or industrial pile burning)
Burn Area (ha)	0	Number of Piles or Windrows	50 +-
Legal Description	FL A13840		
Comments	mountain pine beetle burn piles constructed by helicopter		

REGISTRATION INFORMATION Narraway			
Latitude	54 20.784	Longitude	120 05.902
Geographic Description	Narraway R06-G1818		
Burn Category Code	3	Description	Category 3 Open Fire (Windrows or industrial pile burning)
Burn Area (ha)	0	Number of Piles or Windrows	50 +-
Legal Description	FL A13840		
Comments	mountain pine beetle burn piles constructed by helicopter		

REGISTRATION INFORMATION Belcourt			
Latitude	54 27.450	Longitude	120 11.991
Geographic Description	Belcourt R06-G1819		
Burn Category Code	3	Description	Category 3 Open Fire (Windrows or industrial pile burning)
Burn Area (ha)	0	Number of Piles or Windrows	50 +-
Legal Description	FL A13840		
Comments	mountain pine beetle burn piles constructed by helicopter		

REGISTRATION INFORMATION Lower Red Deer			
Latitude	54	Longitude	120 23.958

	36.082		
Geographic Description	Lower Red Deer R06-G1820		
Burn Category Code	3	Description	Category 3 Open Fire (Windrows or industrial pile burning)
Burn Area (ha)	0	Number of Piles or Windrows	50 +-
Legal Description	FL A13840		
Comments	mountain pine beetle burn piles constructed by helicopter		

REGISTRATION INFORMATION Wapiti			
Latitude	54 39.877	Longitude	120 26.068
Geographic Description	Wapiti R06-G1821		
Burn Category Code	3	Description	Category 3 Open Fire (Windrows or industrial pile burning)
Burn Area (ha)	0	Number of Piles or Windrows	50 +-
Legal Description	FL A13840		
Comments	mountain pine beetle burn piles constructed by helicopter		

REGISTRATION INFORMATION Fellers			
Latitude	54 44.563	Longitude	120 146.985
Geographic Description	Fellers R06-G1822		
Burn Category Code	3	Description	Category 3 Open Fire (Windrows or industrial pile burning)
Burn Area (ha)	0	Number of Piles or Windrows	50 +-
Legal Description	FL A13840		
Comments	mountain pine beetle burn piles constructed by helicopter		

REGISTRATION INFORMATION Honeymoon			
Latitude	54 50.489	Longitude	120 41.654
Geographic Description	Honeymoon R06-G1823		

Burn Category Code	3	Description	Category 3 Open Fire (Windrows or industrial pile burning)
Burn Area (ha)	0	Number of Piles or Windrows	50 +-
Legal Description	FL A13840		
Comments	mountain pine beetle burn piles constructed by helicopter		

REGISTRATION INFORMATION Red Willow			
Latitude	54 53.892	Longitude	120 11.988
Geographic Description	Red Willow R06-G1824		
Burn Category Code	3	Description	Category 3 Open Fire (Windrows or industrial pile burning)
Burn Area (ha)	0	Number of Piles or Windrows	50 +-
Legal Description	FL A13840		
Comments	mountain pine beetle burn piles constructed by helicopter		

REGISTRATION INFORMATION Bearhole			
Latitude	55 02.290	Longitude	120 30.689
Geographic Description	Bearhole R06-G1825		
Burn Category Code	3	Description	Category 3 Open Fire (Windrows or industrial pile burning)
Burn Area (ha)	0	Number of Piles or Windrows	50 +-
Legal Description	FL A13840		
Comments	mountain pine beetle burn piles constructed by helicopter		

Appendix 22. Number and area of infested and susceptible forest cover polygons and percent infested for the Peace Forest District broken down by BMU, 2006.

District	Responsibility	BMU	Infested Polygons	Susceptible Polygons	Infested Area (ha)	Susceptible Area (ha)	Percent Infested
DDC	TFL48	Boucher	240	1,855	3,170.54	17,635.41	*12.94%*
DDC	TFL48	Carbon	522	4,347	6,749.62	38,003.84	*12.01%*
DDC	TFL48	Club Creek East	252	1,686	3,181.31	13,897.95	*14.95%*
DDC	TFL48	Club Creek West	24	522	224.98	4,353.20	*4.60%*
DDC	TFL48	Dickebush	275	2,283	3,350.78	17,069.54	*12.05%*
DDC	TFL48	Dunlevey	43	2,573	558.84	21,570.39	*1.67%*
DDC	TFL48	East Pine	68	404	761.52	2,973.56	*16.83%*
DDC	TFL48	Falling Creek	218	1,208	2,282.53	8,224.46	*18.05%*
DDC	TFL48	Gething	412	4,548	6,096.56	40,463.40	*9.06%*
DDC	TFL48	Gulf	92	495	843.74	3,403.93	*18.59%*
DDC	TFL48	Hart Highway	45	293	465.98	1,760.09	*15.36%*
DDC	TFL48	Highhat	207	1,364	2,501.07	9,699.49	*15.18%*
DDC	TFL48	Kowen Hills	291	1,606	3,629.75	13,719.57	*18.12%*
DDC	TFL48	Lemoray	59	242	690.99	1,846.98	*24.38%*
DDC	TFL48	Lower Burnt	456	2,617	3,977.84	15,752.19	*17.42%*
DDC	TFL48	North Hasler	333	2,100	4,157.85	14,852.88	*15.86%*
DDC	TFL48	Rocky Creek	389	1,616	4,287.92	13,311.15	*24.07%*
DDC	TFL48	South Hasler	211	687	1,860.89	4,504.38	*30.71%*
DDC	TFL48	Sukunka-Bluff	378	2,074	4,351.99	14,678.04	*18.23%*
DDC	TFL48	Upper Burnt	112	311	595.40	1,824.45	*36.01%*
DDC	TFL48	Westcoast-Caron	336	2,861	4,229.77	20,045.21	*11.74%*
DDC	TFL48	Willow	110	1,097	1,260.83	6,873.40	*10.03%*
DDC	TFL48	Wolverine	518	2,576	6,048.20	20,483.91	*20.11%*
TFL48			***5,591***	***39,365***	***65,279***	***306,947***	***14.20%***
DDC	TSA	Bearhole	608	3,569	23,336.78	64,829.12	*17.04%*
DDC	TSA	Belcourt			6,581.90		*11.99%*

			207	1,727		29,642.52	
DDC	TSA	Bullmoose	665	1,357	22,199.83	27,972.31	*49.01%*
DDC	TSA	Dawson Creek	13	582	768.80	12,999.28	*2.23%*
DDC	TSA	Feller's Creek	352	864	9,401.68	16,681.95	*40.74%*
DDC	TSA	Honeymoon Creek	353	1,464	8,317.73	19,478.21	*24.11%*
DDC	TSA	Hudon's Hope	211	920	7,407.38	17,010.20	*22.93%*
DDC	TSA	Kakwa	126	452	4,391.39	8,673.77	*27.88%*
DDC	TSA	Kiskatinaw	46	914	1,594.23	16,848.71	*5.03%*
DDC	TSA	Lone Prairie	868	3,135	24,622.76	53,211.69	*27.69%*
DDC	TSA	Lower Moberly	58	374	2,142.54	6,698.05	*15.51%*
DDC	TSA	Lower Red Deer	288	2,336	12,763.52	42,168.68	*12.33%*
DDC	TSA	Murray-Monkman East	272	1,122	5,748.15	12,868.67	*24.24%*
DDC	TSA	Murray-Monkman Mid	721	907	14,788.35	16,655.35	*79.49%*
DDC	TSA	Murray-Monkman West	297	355	6,118.36	6,973.88	*83.66%*
DDC	TSA	Narraway	141	913	5,158.88	16,791.54	*15.44%*
DDC	TSA	One Island	642	4,259	26,823.12	89,079.41	*15.07%*
DDC	TSA	Pine LeMoray	9	74	290.93	1,080.67	*12.16%*
DDC	TSA	Pine Pass North	52	201	2,813.37	4,815.28	*25.87%*
DDC	TSA	Pine Pass South	35	154	2,125.23	3,544.56	*22.73%*
DDC	TSA	Pine River	143	650	6,053.32	12,500.49	*22.00%*
DDC	TSA	Puggins	815	2,813	31,136.08	58,048.41	*28.97%*
DDC	TSA	Redwillow	406	3,939	15,700.12	67,011.68	*10.31%*
DDC	TSA	Septimus	54	225	1,230.52	4,577.40	*24.00%*
DDC	TSA	Upper Moberly	1,128	2,457	47,109.93	58,162.54	*45.91%*
DDC	TSA	Upper Red Deer	40	254	759.17	3,684.89	*15.75%*
DDC	TSA	Upper Sukunka/Gwillim East	84	160	3,086.89	3,844.18	*52.50%*
DDC	TSA	Upper Sukunka/Gwillim West	21	28	457.39	485.46	*75.00%*
DDC	TSA	Wapiti	303	2,425	10,275.73	36,570.63	*12.49%*

DDC	TSA	Williston Lake	-	59	-	31.26	*0.00%*
Dawon Creek TSA41			***8,958***	***38,689***	***303,204***	***712,941***	***23.15%***
DJO	TSA	Blueberry	59	15,002	3,197.61	233,414.04	*0.39%*
DJO	TSA	Crying Girl	117	4,424	1,887.47	43,322.61	*2.64%*
DJO	TSA	Elleh	-	37	-	218.11	*0.00%*
DJO	TSA	Graham	2	7,719	20.17	91,041.48	*0.03%*
DJO	TSA	Halfway	48	8,350	1,227.05	100,173.85	*0.57%*
DJO	TSA	Kahntah	-	1,429	-	47,428.00	*0.00%*
DJO	TSA	Kobes	81	2,651	3,637.12	43,791.87	*3.06%*
DJO	TSA	Lower Beatton	5	1,718	252.13	30,175.15	*0.29%*
DJO	TSA	Milligan	-	3,440	-	96,966.86	*0.00%*
DJO	TSA	Sikanni	-	1,419	-	45,620.92	*0.00%*
DJO	TSA	Tommy Lakes	-	18,524	-	267,953.87	*0.00%*
DJO	TSA	Trutch	-	15,005	-	180,478.44	*0.00%*
Fort St. John TSA40			***312***	***79,718***	***10,222***	***1,180,585***	***0.39%***
Peace Forest District			***14,861***	***157,772***	***378,705***	***2,200,473***	***9.42%***

*It should be noted that the total polygon area is included if the polygon is infested.

Appendix 23. Alberta Municipal Grant Program Details.

Ministry Logo

Alberta

Sustainable Resource Development

Forest Health Section
Forest Management Branch

Mountain Pine

Beetle Control Program

2006/2007 Program Guidelines

Mountain Pine Beetle Control Program Guidelines

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1.0 PROGRAM OVERVIEW

1.1 Department's Mandate

Alberta Sustainable Resource Development (SRD or the department) is mandated to deliver programs and services that support the following key resource areas of the environment:

(a) Forest Protection,

(b) Fish and Wildlife Management, and

(c) Land Management.

1.2 Forest Protection Vision

The department recognizes that all land managers must cooperate if we are to stop mountain pine beetle infestations from spreading further into Alberta. The only effective method of preventing a large outbreak of infestation is to control all infested trees while the population is small.

SRD is implementing aggressive mountain pine beetle surveillance and control programs on provincial public lands, and is asking municipalities to manage mountain pine beetle problems on municipal and private lands. A mountain pine beetle outbreak will have a significant effect on municipalities including reduced aesthetics, property values, tourism and recreation opportunities, human safety, wildlife habitat, timber value, watershed quality; and increased fire hazard.

The department identifies municipalities that have a risk of infestation and offers financial assistance for the mountain pine beetle control program. These guidelines provide information on eligibility and how to complete a grant funding proposal for the control of active infestations.

2.0 ROLES AND RESPONSIBILITIES

2.1 Sustainable Resource Development

The department undertakes to do the following:

1. Identify and/or confirm the presence of current/historic mountain pine beetle attacked trees on an annual basis and inform eligible municipalities about the availability and requirements of the beetle control program.
2. Provide eligible municipalities with the aerial survey results progressively between August 15 and October 15 each year to help with project planning.
3. Assist with the preparation of grant application and provide advice on all aspects of program delivery and reporting requirements.
4. Review the applications and report grant decisions in a timely manner.
5. Provide financial assistance to eligible municipalities to develop, implement, and report on a mountain pine beetle control program.
6. Reserve the right to request additional information on any aspect of the proposal including the budget and compliance reporting.
7. Reserve the right to audit or require an audit of the books and accounts of the municipality with respect to the grant funding.
8. Review the program annually and make changes that add value and effectiveness to the control program. As a result, beetle risk priority, eligible activities and the extent of funding may change each year, depending on funding availability, municipality's performance, control actions required, and the beetle population.

2.2 Grant Applicant

The eligible municipality undertakes to do the following:

1. Partner with the department and submit a funding request according to program guidelines.

2. Enter in to a grant agreement to receive the approved funding.
3. Deliver the control program according to the terms and conditions of the grant agreement.
4. Comply with all applicable laws, licensing, reporting and other requirements.
5. Report results and other details to the Minister as required or requested.
6. Multiple municipalities may coordinate their programs and apply for one grant for the entire program. Recipient municipalities must include a council resolution appointing a lead municipality from the partner municipalities with the grant application.

3.0 GRANT ELIGIBILITY & FUNDING

3.1 Eligibility Requirement

This grant is available to municipalities that are pre-identified by SRD as having active pine beetle infestations. These municipalities are asked to partner with the department in addressing this important issue.

SRD contacts these municipalities and notifies them of the problem and the assistance available from the department. Program representatives are available to help with the preparation and submission of a duly completed application for grant funding to implement the approved control activities. The department offers financial assistance for the development and implementation of the control program.

Multiple municipalities may co-ordinate their programs and apply for one grant for the entire program. Recipient municipalities must include a council resolution appointing a lead municipality from the partner municipalities.

3.2 Eligible Purposes

The purpose of the program is to treat beetle-infested trees in order to control the spread of beetle infestation. The grant program is designed to help control the mountain pine beetle infestations in partnership with eligible municipalities. However, it is not designed to compensate for losses arising from the mountain pine beetle infestations and/or control actions.

Funding will be available in the fall prior to the commencement of the program year.

The following activities and costs are eligible for a grant:

(a) Development of the management plan.
(b) Training for municipal staff and staff contracted for the beetle project on SRD ground survey and control techniques and standards and other directly applicable training needs.
(c) Pine beetle ground surveys (eg. walk through, concentric, transect)
(d) Treatment of infested trees (eg. milling, debarking, falling and burning, or peeling standing).
(e) Communication, education and outreach efforts.
(f) Quality control costs.
(g) Project management costs (separate from reasonable municipal administrative costs, and includes project manager and/or other necessary project management staff).
(h) Final report preparation.
(i) Prevention (use of anti-aggregation chemicals may be approved on a case-by-case basis by the Provincial Pine Beetle Coordinator).

(j) Administrative costs to manage the grant (reasonable costs up to 8% of the total cost of the approved activities). Costs can include office assistance, photocopying, etc.

(k) Cost of audit or verification done by an independent public accountant.

3.3 Emergency Control Activities (ECA)

In the event it is necessary to implement control activities on previously undetected trees before beetle flight, an Emergency Control Activity Program can be carried out from July 1 to August 14.

The costs associated with ECA must be budgeted, tracked and accounted for separately. After completion of the emergency control activities, a report on program results and costs must be filed with SRD by September 14 for reimbursement of costs.

3.4 Funding Allocation

The funding allocation is based on the beetle-risk priority rating, which falls into high, medium or low risk. Applications from high risk, medium risk and low risk areas will be given primary, secondary and tertiary considerations for funding. Beetle risk in a particular area is determined by a number of factors; the number of confirmed beetle attacks, the amount of susceptible pine, and the proximity of known beetle infestations. It is advisable to discuss your particular situation with the local Forest Health Officer before applying for funding.

4.0 APPLICATION REQUIREMENTS

4.1 Information Requirements

The detailed proposal in Part 3 of the application should be organized under the following headings, references and supporting information:

(a) Maps of the Survey Area

The general areas to be surveyed within the municipality must be included. The maps must include the following details:

(i) Municipal boundary.

(ii) Private and municipal owned lands.

(iii) Roads and access corridors.

(iv) Parks and other tree stands (if available). Each municipality will have varying degrees of 'green space' that may be affected.

(v) General area to be surveyed and the potential type of survey for each area (eg. walk through surveys, concentric ground surveys, transect ground surveys).

(vi) Scale and North arrow.

This map will be a preliminary overview of the survey program, and will change based on ground inspections.

(b) Methodologies and Survey Techniques

The local Forest Health Officer can assist with the survey planning or the municipality can refer to the SRD's Mountain Pine Beetle Management Guide for survey techniques.

There is a mandatory training requirement for municipal staff and staff contracted for the beetle project on SRD ground survey, control techniques, standards. All surveyors used or hired to do surveys must attend and

successfully complete SRD's Mountain Pine Beetle Training Program. Funding and time for this training is an acceptable expenditure under this grant program.

SRD will require a copy of the GPS locations (paper or electronic) of all infested trees (or patches of infested trees) as well as other information related to the beetle population. The local Forest Health Officer can provide a list of the data that must be collected. These data must be submitted to the Forest Health Officer bi-weekly. All data must be in the datum NAD83 and the location recorded in degrees minutes decimal. A handheld GPS unit is suitable for data collection. Location data is important for a provincial reporting database, and consistent standards will ensure the data collected meets minimum reporting standards.

SRD will provide the following resource information and the preparation of this component of the proposal must follow SRD's survey standards:

- Survey type (eg, walk through surveys, concentric ground surveys, transect ground surveys). Type of survey will depend on location – acreage with scattered trees, windbreak, etc.
- Infested tree marking and numbering method.
- Timelines.
- SRD will provide data collection sheets for municipal use. Should a municipality choose to use their own data collection sheet, the information collected must be consistent with SRD requirements.

(c) Control Techniques

All treatments must be completed by May 31 of the year of survey. If treatment can not be completed by May 31, an application for a time extension can be made to the local Forest Health Officer. Reasons for the extension and projected completion date must be indicated.

The local Forest Health Officer can assist with the control tactic that is the most appropriate, efficient and cost-effective. Tactics such as fall and burn, fall and peel, whole tree chipping, debarking and composting of residue are approved. The local Forest Heath Officer may approve other tactics. Refer to the Mountain Pine Beetle Management Guide for more information. A summary of proposed control tactics by area is to be included in the proposal, with confirmed control actions detailed in the final report.

SRD will require a copy of the GPS locations (paper or electronic*)* of all controlled trees (or patches of infested trees) with the same accuracy as the surveys. The local Forest Health Officer will provide a list of the data that must be collected and a form for municipal use.

If the trees are to be sold for milling, SRD reserves the right to place conditions on the sale. These conditions may change annually, and will generally involve transportation, milling and debris disposal timelines (that is complete prior to May 15th). It is, therefore, advisable to contact the local Forest Health Officer or refer to the SRD website for the latest restrictions at http://www.srd.gov.ab.ca/forests/managing.

(d) Communication, Education and Outreach Strategy

The proposal must outline how information is to be presented and relayed to the community and other stakeholders to raise public awareness of this destructive pest of pine, beetle life cycle, hosts and damage, management strategies and what landowners and stakeholders can do to help contain and alleviate the problem.

SRD has a list of publications that can aid with the communication and education efforts. These resource materials are under Publications on the website at www.srd.gov.ab.ca/forests/index.html.

(e) Quality Control Technique

The proposal should identify how the surveys and control operations will be checked and monitored. This process should also indicate how deficiencies would be corrected.

SRD will also check the quality of the surveys and control measures. The quality control will be conducted under the supervision of the local Forest Health Officer. The quality control may proceed in any area with infested trees in the municipality; however, the local Forest Health Officer will check with the municipality prior to beginning any quality control activity to ensure the proper landowner communication procedure is conducted.

A quality control audit for survey and control will consist of the following:

(i) Resurvey an area to determine if any trees were missed.

(ii) Check the marked trees to ensure the data was collected and recorded properly.

(iii) Check to ensure mountain pine beetle attacked all marked trees.

(iv) Check the burn pines to ensure all beetle life stages are killed.

(v) Check the peeled logs to ensure all beetle life stages are killed.

(vi) Ensure chemical treatments are preformed by a certified applicator. Ensure all chemical treatments are completed adequately to kill all beetle life stages.

(vii) Ensure the logs are sold to an approved processing facility.

(viii) Ensure the logs are processed in a timely manner and the debris is treated adequately to kill any remaining beetle life stages.

If any aspect of the survey or control operation is inaccurate or incomplete, the municipality will receive a *Notice of Deficiency* within two weeks of the quality control inspection. The municipality then has two weeks to write a corrective action plan and submit it to the local Forest Health Officer.

(f) How Work is to be Completed

The proposal must identify the number of staff and/or contractors hired or assigned to the project.

For contracts, the tendering and awarding process must meet acceptable provincial, municipal requirements. The department can provide a list of contractors in the local area who have the expertise to complete the survey or control work. In addition, SRD will provide training and technical expertise to the contractors/staff members as required.

4.2 Project Budget

The budget must clearly indicate the amount of funding requested. The cost estimates should be prepared with due regard to economy, efficiency and effectiveness. The budget should be broken down by major cost categories as outlined below and further broken down in to the costs of contracts, wages, equipment, supplies, rentals and administration costs. The major cost categories include, but are not limited to, the following:

(i) Development of the management plan.

(ii) Project management.

(iii) Pine beetle ground surveys.

(iv) Treatment of infested trees.

(v) Prevention (use of anti-aggregation chemicals may be approved on a case-by-case basis by the Provincial Pine Beetle Coordinator).

(vi) Communication and outreach efforts.

(vii) Quality control costs.

(viii) Administration costs (including reasonable costs for preparation of final report).

(ix) Cost of audit or verification done by an independent public accountant.

Please note administration costs for the project cannot exceed 8% of the total cost of approved control activities.

If a funding shortfall is discovered during the project implementation phase, a municipality may request additional funding by submitting a revised proposal, clearly explaining the rationale for additional funding. The revised proposal must include an updated budget and implementation schedule. The deadline for submitting the revised proposal is January 15th of the program year.

4.3 Implementation Schedule

The proposal should include an action plan of beetle control activities to be undertaken, with specific start and end dates for each major activity.

The proposal should also identify any risks involved in completing each activity, mitigation steps and results to be achieved.

5.0 APPLICATION TIMELINES

5.1 Application Deadline

1. The eligible municipality must prepare the written proposal in accordance with the department's program guidelines. Local Forest Health Officers will be available to assist with the preparation of the application.

2. The municipality must submit the completed application to the local Forest Health Officer by or before **November 30** or by the extended deadline as approved by the local Forest Health Officer.

5.2 Review and Funding Decisions

1. The Provincial Pine Beetle Coordinator will review the applications with the local Forest Health Officer and Forestry Manager within two weeks of receiving all grant applications and advise if any additional information is required to formulate funding decisions.

2. Application review and funding decisions will be based on three key factors: the beetle-risk priority factor (high, medium, or low), the technical quality factor (completeness of informational attachments) and the information quality factor (completeness and relevance of information provided).

3. The Provincial Pine Beetle Coordinator will recommend funding allocation, and the Minister or his representative will review and approve recommended grants with or without revision.

4. The Provincial Pine Beetle Coordinator (PPBC) will communicate funding decisions to respective local Forestry Manager who will then advise municipalities within two weeks of application review. If the grant is approved, the PPBC will send three original grant agreements for appropriate municipal signature and return of all three originals for processing.

5. After the Minister or his representative signs the grant agreements, the grant payments will be processed and one signed original grant agreement will be returned to each respective municipality.

6.0 GRANT AGREEMENT

6.1 Each approved applicant must enter into a grant agreement with Sustainable Resource Development regarding the use of the grant before the funds will be released.

6.2 The terms and conditions of the grant agreement will include, but will not be limited to, the use of the grant for the approved project only, revenue treatment, reporting and accountability requirements, the Minister's right to audit the grant project, and the Minister's right to require a refund of any excess grant funds or funds not used in accordance with the grant agreement.

6.3 The municipality must use the approved grant by June 30th or by the approved extended project completion date.

6.4 Full compliance with the grant agreement, including meeting the project timeline and project terms and conditions (also detailed in Schedule A as attachment to the signed grant agreement), and the conditions that apply after completion of the project, will be required.

7.0 COMPLIANCE REQUIREMENTS

7.1 Acknowledgement of Compliance

Within one month of completing the treatment (by May 31 or by the approved extended project completion date), municipalities are required to submit a duly completed Acknowledgement of Compliance form and the various required reports as attachments. The required reports are listed under "Final Reports" in section 8.0 below.

7.2 Project Accountability

Within a month of completing the treatment (by May 31 or by the approved extended project completion date), the Chief Administrative Officer (CAO) of the municipality receiving the grant must submit a full accounting of the project cost, certifying that the grant was used for the approved project in accordance with the terms and conditions of the grant agreement.

7.3 Income Earned Accounting

Municipalities are required to account for and apply any income earned (which includes interest, capital gains, dividends, etc.) on the approved grant to the project. The income also includes any revenue received from the sale of logs to an approved processing facility.

Where significant time extensions, project changes, high grant amounts, or other circumstances warrant, municipalities may also have to account for such income if so advised by program representatives in circumstances such as:

(i) projects that are approved for a significant time extension and the specific situation warrants it;

(ii) grants are relatively large amounts; and

(iii) other situations as specified from time to time by the Minister or his representative.

A requirement to apply and account for the income earned is included in the grant agreement.

7.4 Time Extension

1. The department recognizes that the entire project or some aspects of the project may be delayed on occasion due to factors that are beyond the municipality's control. It is, therefore, the department's intent to accommodate reasonable project delays and problems, where possible. However, to meet program accountability and compliance requirements, municipalities requesting completion date extensions must **submit a request in writing** that includes at least the following:
   (a) the project funds expended as at the date of the request;
   (b) the reason for the delay; and
   (c) the revised completion date and any revised project components.
2. Program staff may require other useful information to evaluate the request and these may include:
   (a) an updated project implementation schedule;
   (b) a contingency plan to mitigate further project delays; and
   (c) a listing of the contract and/or other resources that will be used to complete the project.
3. Upon receipt of such a request, the Provincial Pine Beetle Coordinator will consider the request and provide recommendations to the Deputy Minister or his designate.

   If the request is approved, the Provincial Pine Beetle Coordinator will then prepare an amending grant agreement to amend the appropriate project conditions in the original documentation and forward it to the municipality for authorized signature(s) in order to process the requested changes.

7.5 Notice of Deficiency [section 4.2.2(e)]

The municipality will receive a *Notice of Deficiency* within two weeks of the quality control inspection if any aspect of the survey or control operation is inaccurate or incomplete. The municipality then has two weeks to write a corrective action plan and submit it to the local Forest Health Officer.

7.6 Follow-Up

The program guidelines and the grant agreement both emphasize the terms and conditions of Mountain Pine Beetle Control Program funding. Provincial government's accountability framework for grants requires that program staff must ensure an acceptable level of municipal compliance with these conditions. While program staff will be practically helpful when problems arise, staff will employ follow-up and collection procedures to deal with municipalities that do not make reasonable efforts to meet the terms and conditions of the grant agreement.

Program staff will continue to conduct site visits to inspect completed projects.

8.0 FINAL REPORTS

8.1 Submission Deadline

The department requires a final report to be submitted by June 30 which is one month after the control work is completed. If a time extension for project completion was approved, the report must be submitted within one month of the approved extension to the project completion date.

8.2 Reporting Requirements

The final report must include Acknowledgement of Compliance and the following attachments:

1. Summary of the Survey Areas and the Final results
2. Summary of the Controlled Trees.
3. Summary of Communications, Outreach and Education Completed.
4. Summary of Quality Control Actions.
5. Final Data Sheets of Survey and Control Information.
6. Suggestions for Future Improvements.
7. Financial Statements as per the Grant Agreement (see 8.3)
8. Business plan review including a description of outcome of the program that clearly shows how the program goals and objectives were met, and also identifies any expected results that were not achieved and why.
9. Samples of departmental recognition.

8.3 Financial Requirements

The Recipient must keep appropriate accounting records of all transactions with respect to the Program and shall, upon request, make all such records available to any or all of the following persons, or their authorized representatives:

(a) the Department;
(b) the Auditor General of Alberta; and
(c) the Minister of Finance

as they may require, and the Recipient must permit the examination and taking of copies and extracts of and from those accounting records. Records are subject to audit by an officer or agent of Alberta at any reasonable time from the date of the Agreement until three years from the date of the termination of Agreement.

If SRD requires a formal audit by an independent financial institution, the costs associated are applicable under the grant.

9.0 PROGRAM STAFF

The Forestry Manager or his/her designate at the field level will assist municipalities with the development and implementation of the Mountain Pine Beetle Control Program. If technical assistance regarding the Grant Guidelines is needed, contract Erica Lee at (780) 644-1734 or Erica.Lee@gov.ab.ca.