The following are excerpts from R.W. Gray Consulting's 116 page report "Kimberley Fire Management Plan Phase II: Kimberley Nature Park and Nordic Ski Area. In these excerpts we have focused on the management units that lie in the Nature Park and the treatment options which apply to them. There is a great deal more information in the full report, including background information on fire effects and behaviour, graphs of fuel loading, pictures of areas in the Park and Nordic Trails etc. The full report is available from the City of Kimberley as a 7 megabyte .pdf file on a cd.

3.2. Fire Management Unit 2

Gross Area: **71.6 ha**

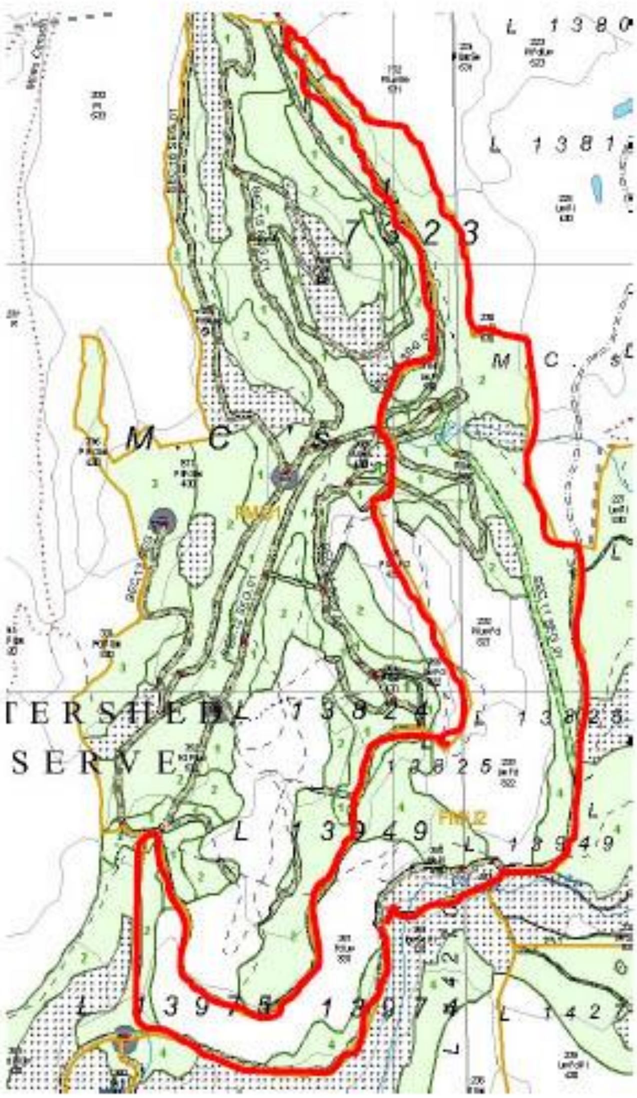

Figure 25. Location of FMU 2. This FMU comprises mostly sidehill topography below the Nordic Ski area.

FMU 2 (fig. 24) extends from the extreme north end of the project area south to directly below Myrtle Mountain in the central part of the nature park. Approximately half the area is characterized as steep, east-facing slopes of lodgepole pine and western larch while the other half is steep, south-facing aspects containing mostly Douglas-fir with western larch and ponderosa pine (fig. 25). Topography is mostly steep slopes (40-70%) with some areas of exposed rock. The HNFR for this FMU is Fire Regime II, while the Condition Class is all 3. Much of the structure is young (<120 years old), having regenerated after the late 1800's wildfires. Some scattered old larch and ponderosa pine can be found throughout the FMU.

Treatment Options

Current and Near-Future Fuel Conditions

This FMU is similarly pre-disposed to extreme fire behavior in its current condition as is FMU 1. The addition of steep slopes and warm aspects adds to the hazard by substantially extending or enlarging the available favorable "window" for wildfire activity. Wildfire resilience is minimal with all species exhibiting very high levels of mortality if burned under current conditions (fig. 30). The terrain characteristics in this FMU make for poor quality wood on the warmer aspects, which limits economic opportunities for active fuel mitigation, and limit the range of engineering options for accessing the wood (see fig. 25 indicating amount of proposed thinning area [light green] versus unthinned area [white]). These limitations, especially the engineering ones, will play a critical role in active fuel hazard mitigation costs and productivity, and have a significant role to play in wildfire suppression tactics.

The current population of lodgepole pine is infested with mountain pine beetle and will likely see an increase in infestation rate. The City has aggressively treated lodgepole pine-dominated stands along the eastern boundary of this FMU, in the process finding a significant increase in beetle activity over the short 6-month planning window associated with the project. Should the lodgepole pine-dominated portion of this FMU, which is the majority of the area of this FMU being treated by Tembec, not get thinned the result in the near future will be a significant increase in surface fuel load, fuel dryness, and overall fire hazard. Surface fuel load stemming from an influx of bark beetle-killed trees in the near future will be very similar to the quantity modeled for FMU 1.

Should a wildfire occur under current stand structure configurations the result would be very high mortality. The focus of management post-wildfire would be the capture of any remaining economic value from the burned forest. This, unfortunately, targets the most valuable trees (preferred species, DBH classes, extent of damage) and most easily accessible stands. The stands of lodgepole pine and western larch in the northeast portion of the FMU would be preferred over the poor quality stands of Douglas-fir, larch, and ponderosa pine on the southerly portions of the unit. There is a strong likelihood that these poor quality stands would not be salvaged leading to a future fuel hazard once the dead trees fall and accumulate on the forest floor. Following salvage, the forest would be re-stocked to high density plantations.

Treatment Strategies

The preferred treatment strategies for FMU 2 include: (a) a commercial thin where economically feasible, followed by species-specific slashing, clean-up of surface fuels resulting from the thinning, and the clean-up of all the pre-existing fuels that cannot be gathered by the thinning equipment; and, (b) extensive manual fuel treatments in areas deemed uneconomical or environmentally sensitive to mechanical treatment. It is not considered feasible or prudent to entertain any “isolation” strategies in this FMU due to slope and aspect and their influence on fire behavior. The proposed thinning prescription for commercial thinning areas in FMU 2 is a diameter-limit and species preference cut. These areas would see 250 stems/ha residual density of Douglas-fir and western larch. This prescription will focus on lodgepole pine removal with other conifers favored for retention. However, where homogeneous patches of lodgepole pine are encountered, pine will be retained at 250 stems/ha density.

A significant proportion of FMU 2 is not scheduled for commercial thinning (approximately 35 ha); primarily due to environmentally sensitive slopes and poor wood quality. Due to the size of the area, the fuels contained therein, and the proximity to values at risk, these fuels must be treated. The following section will outline the range of potential fuel treatment strategies that can be applied to this FMU. Estimated costs for the treatments and a recommended schedule are detailed in section 4.0.

Following commercial thinning the 250 stem/ha areas would exhibit crown characteristics similar to figure 31. A significant quantity of “bulk” has been removed from the mid-canopy but at the lower canopy there is still enough canopy mass to support a crown fire. This mass is comprised of unmerchantable diameter trees (<10 cm DBH) that are assumed to be untouched by Tembec. The upper canopy of very low CBD is comprised of well-spaced western larch and Douglas-fir. For modeling purposes the thinning targeted lodgepole pine and Douglas-fir ahead of western larch. Reality on the ground, due to a uniform spacing of residual trees, will see lodgepole pine still targeted foremost but may see a greater balance of Douglas-fir and western larch removed.

The extensive area that falls outside commercial thinning feasibility requires extensive treatment. Based on reconnaissance plots established by Tembec over the winter, stand structure includes approximately 1,400 trees/ha of Douglas-fir, 1,440 trees/ha of lodgepole pine, and 300 trees/ha of western larch, for a total density of 3,140 trees/ha. This density is widely distributed by species and DBH class. Almost 97% of the Douglas-fir density occurs in trees <12.5 cm DBH. Lodgepole pine has 81% of its density in small trees (<12.5 cm DBH), while western larch has the highest proportion of larger diameter trees at 72%. Canopy characteristics for this area (fig. 27) indicate the greatest “bulk” of canopy fuels are in the mid-canopy which correlates well with the middiameter class trees. Reducing the crown fire hazard and increasing wildfire resilience in this portion of FMU 2 means that the treatment must focus on removing a substantial portion of the smaller diameter Douglas-fir and lodgepole pine.

Following behind the Tembec thinning and spacing, all non-merchantable stems plus surface fuel clean-up would yield canopy characteristics similar to figure 32 and surface fuel characteristics similar to figure 20. The actual quantity of traditionally submerchantable stems left post-thinning is unknown ahead of time because Tembec often employs a “post and rail” operation along with their traditional thinning operations. A significant quantity of the <12.5 cm DBH lodgepole pine could be removed under this type of scenario. All remaining sub-merchantable-sized trees will need to be felled and either skidded or dragged to roadside for chipping or hand piled and eventually burned. Most surface fuels will also need to be chipped or piled.

Mitigating the fuel hazard conditions in the unthinned portion of FMU 2 will require the removal of large quantities of below-merchantability trees, these are typically trees less than 12.5 cm DBH. From a starting density of over 3,000 trees/ha this means "gaming" the fuel and stand structure conditions in the model until the best case for meeting the two fire management objectives are met. At a residual density of 493 trees/ha, an 84% reduction in density, there is a significant reduction in fire behavior. The minimum windspeed necessary to initiate crown fire increases to 89.6 km/h from only 8 km/h, and the minimum propagating windspeed increase to 124.8 km/h from 62.4 (Table 3). Crowning Index drops from moderate to low. These improved canopy conditions can be seen in figure 33.

Under this scenario 97% of all Douglas-fir are removed as are 81% of pine, and 38% of larch. All cutting and removal is focused on the density of all species that are trees <12.5 cm DBH. This scenario only moves wildfire mortality from extreme to moderate. To move the stand from moderate to low mortality would require a much higher proportion of trees cut. Approximately 280 trees/ha of larger diameter (>18 cm DBH) lodgepole pine are retained under this scenario. Wildfire effects modeling indicates that all of these trees would be killed. It is also likely that they will all be lost to the mountain pine beetle. The trade-off with this area, which is a situation that will be repeated in other FMU's, is the cost and effectiveness of treatment balanced against end results.

The spacing (slashing) of over 2,500 trees/ha will result in an addition of 3.1 kg/m² of surface fuel to a pre-existing 1.8 kg/m². If the remaining density of lodgepole pine is added (2.4 kg/m²) the total surface fuel load rises to 7.3 kg/m². Due to poor access this volume of material will need to be hand piled, cured for a year, and burned over the winter. Hand piles will need to conform to the dimensions: maximum 1.5 m high by 1.5 m in diameter (fig. 34), in order to limit soil damage. Piles will also need to have fine woody debris placed on the bottom and coarse woody debris placed on top. Burning should take place in the winter on frozen soil. To put this project into perspective, to conform to these pile dimensions approximately 10 trees <12.5 cm DBH would make up a single pile while trees >12.5 cm DBH would make a single pile or perhaps 2 piles. Converting this to dollars/ha is outlined in section 4.0.

The result is significant from a strictly biomass utilization perspective. Cutting almost 2,500 trees/ha will produce approximately 55 tonnes/ha of biomass. Spread over the entire treatment area and over 1,912 tonnes of biomass (fuel) is in need of removal and use, or, conversion to CO and CO_2 through combustion. A summary of fuel conditions and potential fire behavior are provided in Table 3.

The 250 t/ha thinning area is broken down into three distinct states: initial condition, conditions following a commercial thin only treatment, and the desired condition following the commercial thinning ***plus*** additional fuel mitigation. The unthinned mixed conifer type is broken down into two states: the initial condition, and the desired condition following treatment. It is anticipated that there will be a significant quantity of dead downed material and density of sapling stems post-thinning that could contribute to a fuel hazard (more open stands post-thin exacerbating the situation by drying fuels sooner, producing more and taller grass, and affording higher average below-canopy windspeeds). These are structures that Tembec would not be able to address without a subsidy. Getting to the desired condition and maintaining that condition is discussed in the section on Budgets and Scheduling.

As can be expected the thin only treatment in the 250 tree/ha area has a positive effect on crown fire initiation, crown fire propagation, and ultimately Crowning Index. The significant reduction in CBD has much to do with this. The persistence of unmerchantable stems that contribute to fuel “ladders” affect crown fire initiation, which was not improved as much as crown fire propagation. The persistence of pre-thin fuels plus the addition of thinning-related fuels are the cause behind the very high mortality rates despite a lack of crown fire. There are few strategic fire management options related to the unthinned, mixed-conifer type. It cannot be isolated and managed as a persistent hazard due to its location and fuel structure. On the other hand, the inaccessibility and fuel characteristics make it a very labor intensive and potentially expensive area to treat. Model gaming produced what should be considered to be a good compromise of substantially reduced crown fire hazard, moderate improvement in wildfire resilience, and moderate project cost.

Excessive re-stocking in this FMU, especially in the southerly portion of it, should be discouraged.

Access

Vehicle access for fuel mitigation work and wildfire suppression is fair to poor in this FMU. A main access road (Centennial Trail) accesses portions of the upper part of the unit while the proposed new access road joining Centennial Trail to Army Road provides good access to the east portion of the unit. This main access road and Centennial would accommodate large engines and water tankers.

3.3. Fire Management Unit 3

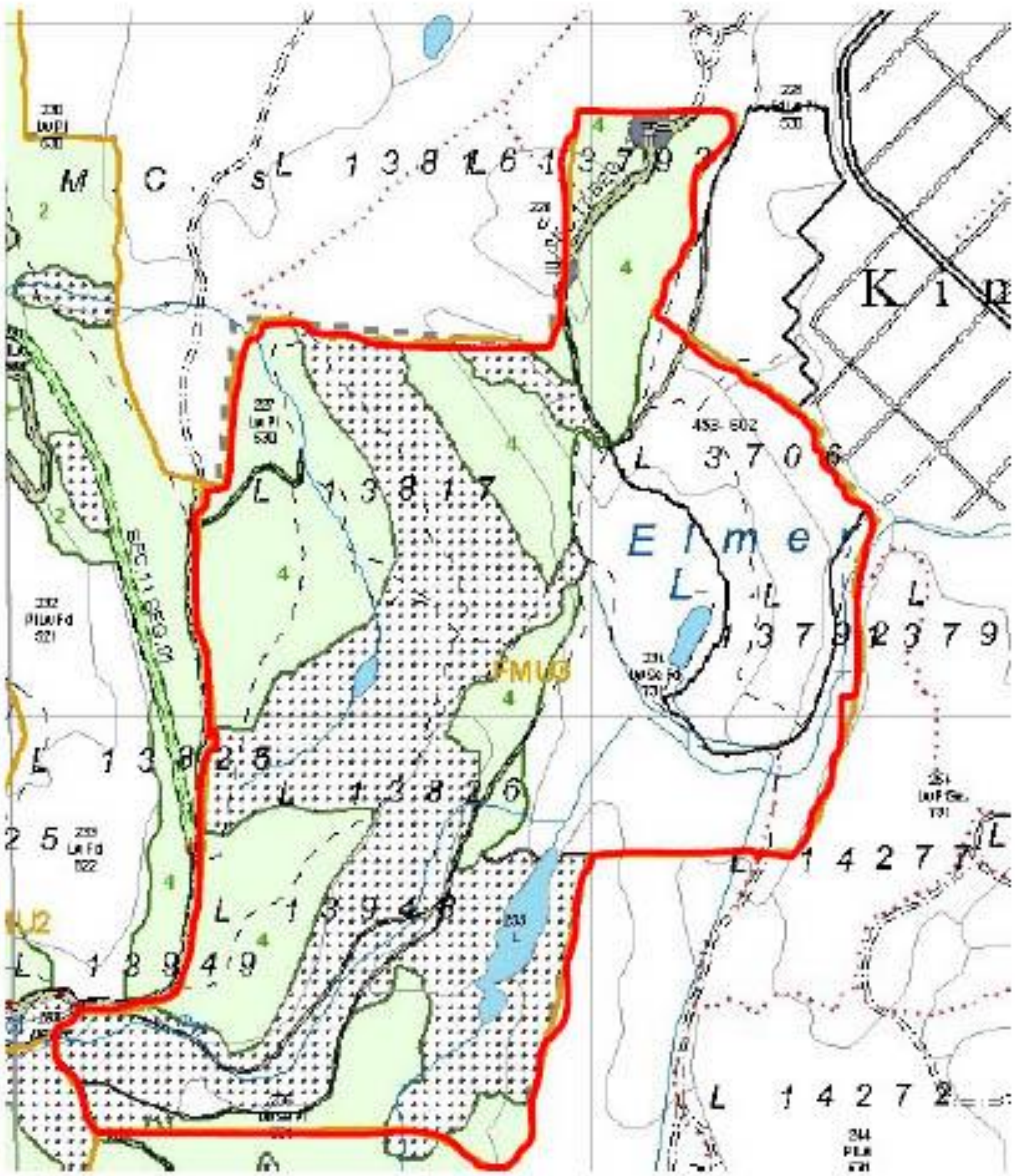

Figure 35. Location of FMU 3. The large white area around Elmer Lake contains some small areas of mechanical thinning that have recently been added.

Gross Area: **97.0 ha**

This FMU presents some of these most complicated issues for fire management of all FMU's in the project area. It lies directly adjacent to a high density part of town, it contains very complex terrain with limited access, forests are structurally diverse (fig. 36) and contain high fuel loads, and the area has high recreation and cultural value (fig. 35).

Current and Near-Future Fuel Conditions

This FMU is similarly pre-disposed to extreme fire behavior in its current condition as are FMU's 1 and 2. The addition of complex terrain with steep slopes and warm aspects, and the influence of terrain on wind movement and speed, adds to the hazard. Wildfire resilience is minimal with all species exhibiting very high levels of mortality if burned under current conditions (fig. 39). The terrain characteristics coupled with post-wildfire regeneration patterns (very high density stands) in this FMU make for poor quality wood on most of the steeper slopes with better material on shallower slopes. This limits economic opportunities for active fuel mitigation, and limit the range of engineering options for accessing the wood. These limitations, especially the engineering ones, will play a critical role in active fuel hazard mitigation costs and productivity, and have a significant role to play in wildfire suppression tactics.

The current population of lodgepole pine is infested with mountain pine beetle and will likely see an increase in infestation rate. The City has aggressively treated lodgepole pine-dominated stands directly to the north of this FMU, while Teck-Cominco pursued the same strategy to the south. Should the lodgepole pine-dominated portion of this FMU, which is the majority of the area of this FMU being treated by Tembec, not get thinned the result in the near future will be a significant increase in surface fuel load, fuel dryness, and overall fire hazard. Surface fuel load stemming from an influx of bark beetle-killed trees in the near future will be very similar to the quantity modeled for FMU 1.

Should a wildfire occur under current stand structure configurations the result would be very high mortality. The focus of management post-wildfire would be the capture of any remaining economic value from the burned forest. This, unfortunately, targets the most valuable trees (preferred species, DBH classes, extent of damage) and most easily accessible stands. Following salvage, the forest would be re-stocked to high density plantations.

Treatment Strategies

The preferred treatment strategies for FMU 3 include: (a) a commercial thin where economically feasible, followed by species-specific slashing, clean-up of surface fuels resulting from the thinning, and the clean-up of all the pre-existing fuels that cannot be gathered by the thinning equipment; (b) extensive manual fuel treatments in areas deemed uneconomical or environmentally sensitive to mechanical treatment, and, (c) retaining untreated, appropriate areas of low hazard conditions, or isolating minor areas of moderate hazard. The proposed thinning prescription for commercial thinning areas in FMU 3 is a diameter-limit and species preference cut to KBLUP "managed forest" standards. These areas would see 100-200 stems/ha residual density of Douglas-fir and western larch. This prescription will focus on lodgepole pine removal with other conifers favored for retention. An unfortunate consequence of this designation is its requirement to re-stock the area to 1200 stems/ha. Currently, trembling aspen is not an acceptable species.

A significant proportion of FMU 3 (almost 50%) is not scheduled for commercial thinning (approximately 50 ha); primarily due to environmentally sensitive slopes, poor wood quality, and cultural/recreational concerns. Due to the size of the area, the fuels contained therein, and the proximity to values at risk, these fuels must be treated. The following section will outline the range of potential fuel treatment strategies that can be applied to this FMU. Estimated costs for the treatments and a recommended schedule are detailed in section 4.0.

Following commercial thinning the 100-200 stem/ha areas (for model purposes referred to as **managed forest type**) would exhibit crown characteristics similar to figure 40. A significant quantity of “bulk” has been removed from the mid-canopy but at the lower canopy there is still enough canopy mass to support a crown fire. This mass is comprised of unmerchantable diameter trees (<12 cm DBH) that are assumed to be untouched by Tembec. The upper canopy of very low CBD is comprised of well-spaced western larch and Douglas-fir. For modeling purposes the thinning targeted lodgepole pine and Douglas-fir ahead of western larch. Reality on the ground, due to a uniform spacing of residual trees, will see lodgepole pine still targeted foremost but may see a greater balance of Douglas-fir and western larch removed.

The extensive area that falls outside commercial thinning feasibility requires extensive treatment. Based on reconnaissance plots established by Tembec over the winter, stand structure includes approximately 2,700 trees/ha of Douglas-fir, 260 trees/ha of lodgepole pine, and 1,500 trees/ha of western larch, for a total density of 4,500 trees/ha. This density is widely distributed by species and DBH class. Almost 97% of the Douglas-fir density occurs in trees <12.5 cm DBH. Lodgepole pine has 77% of its density in small trees (<12.5 cm DBH), while western larch has 94% of its density in small trees. Canopy characteristics for this area (fig. 41) indicate the greatest “bulk” of canopy fuels are in the lower-canopy which correlates well with the smallest diameter class trees. Reducing the crown fire hazard and increasing wildfire resilience in this portion of FMU 3 means that the treatment must focus on removing a substantial portion of the smaller diameter Douglas-fir, western larch and lodgepole pine.

Following behind the Tembec thinning and spacing, all non-merchantable stems plus surface fuel clean-up would yield canopy characteristics similar to figure 42 and surface fuel characteristics similar to figure 20. The actual quantity of traditionally submerchantable stems left post-thinning is unknown ahead of time because Tembec often employs a “post and rail” operation along with their traditional thinning operations. A significant quantity of the <12.5 cm DBH lodgepole pine could be removed under this type of scenario. All remaining sub-merchantable-sized trees will need to be felled and either skidded or dragged to roadside for chipping or hand piled and eventually burned. Most surface fuels will also need to be chipped or piled.

Mitigating the fuel hazard conditions in the unthinned portion of FMU 3 will require the removal of large quantities of below-merchantability trees, these are typically trees less than 12.5 cm DBH. From a starting density of over 4,500 trees/ha this means “gaming” the fuel and stand structure conditions in the model until the best case for meeting the two fire management objectives are met. At a residual density of 298 trees/ha, a 93% reduction in density, there is a significant reduction in fire behavior. Both passive crown fire and active crown fire cannot be attained if canopy characteristics mimic those modeled in figure 42.

Under this scenario 96% of all Douglas-fir are removed as are 34% of pine, and 94% of larch. All cutting and removal is focused on the density of all species that are trees <12.5 cm DBH except lodgepole pine. The diameter distribution of pine in this area indicates a higher density of trees in larger diameter classes. Trees <18 cm DBH were removed in the model leaving approximately 90 trees/ha >18 cm DBH. This scenario improves the outlook for wildfire resilience by moving wildfire mortality from extreme to low. Approximately 90 trees/ha of larger diameter (>18 cm DBH) lodgepole pine are retained under this scenario, which means that they would likely be killed in the event of a wildfire and will more than likely be lost to the mountain pine beetle. The trade-off once again is the cost and effectiveness of treatment balanced against end results. The spacing (slashing) of over 4,000 trees/ha will result in additional surface fuels and if the remaining density of lodgepole pine is added the total surface fuel load rises significantly. The goal at the end of the treatment is stand structure and fuel characteristics illustrated in figure 43.

Access for fuel mitigation work is generally better here than in most other parts of the project area. This means that there should be a lesser reliance on pile burning for fuel reduction and a higher emphasis on actual fuel removal (yard to roadside, chip, and haul away). In a few difficult areas hand piling and burning will likely be the best tactic. Wherever larger diameter lodgepole pine are in close proximity to roads or trails (being used for yarding and chipping) they should be targeted for removal. In other areas they will have to be felled, piled and burned.

A summary of fuel conditions and potential fire behavior are provided in Table 5. The managed forest type area is broken down into three distinct states: initial condition, conditions following a commercial thin only treatment, and the desired condition following the commercial thinning ***plus*** additional fuel mitigation. The manual treatment area is broken down into two states: the initial condition, and the desired condition following treatment. It is anticipated that there will be a significant quantity of dead downed material and density of sapling stems post-thinning that could contribute to a fuel hazard (more open stands post-thin exacerbating the situation by drying fuels sooner, producing more and taller grass, and affording higher average below-canopy windspeeds). These are structures that Tembec would not be able to address without a subsidy. Getting to the desired condition and maintaining that condition is discussed in the section on Budgets and Scheduling.

The thin only treatment in the managed forest area has a positive effect on fire behavior (rate of spread, flame length, fireline intensity) but no effect on crown fire initiation, crown fire propagation, and ultimately Crowning Index due to the untreated small-diameter Douglas-fir. The persistence of unmerchantable stems that contribute to fuel “ladders” affect crown fire initiation, which was not improved. The persistence of pre-thin fuels plus the addition of thinning-related fuels are also contributing to this continued crowning vulnerability and also affect stand-level mortality. There are few strategic fire management options related to the manual thinning areas. These areas cannot be isolated and managed as a persistent hazard due to their location and fuel structure. On the other hand, the inaccessibility and fuel characteristics make it a very labor intensive and potentially expensive areas to treat. Model gaming produced what should be considered to be a good compromise of substantially reduced crown fire hazard, moderate improvement in wildfire resilience, and moderate project cost.

Access

Vehicle access for fuel mitigation work and wildfire suppression is fair to poor in this FMU. A main access road (Army Road) accesses portions of the southern part of the unit while access from the city owned area behind Levirs Avenue in the north is good.

These main access roads would accommodate large engines and water tankers. Access for fuel work could be developed (upgraded) to accommodate ATV's and or gators[5]. This would improve the cost forecasting for this unit.

3.4. Fire Management Unit 4

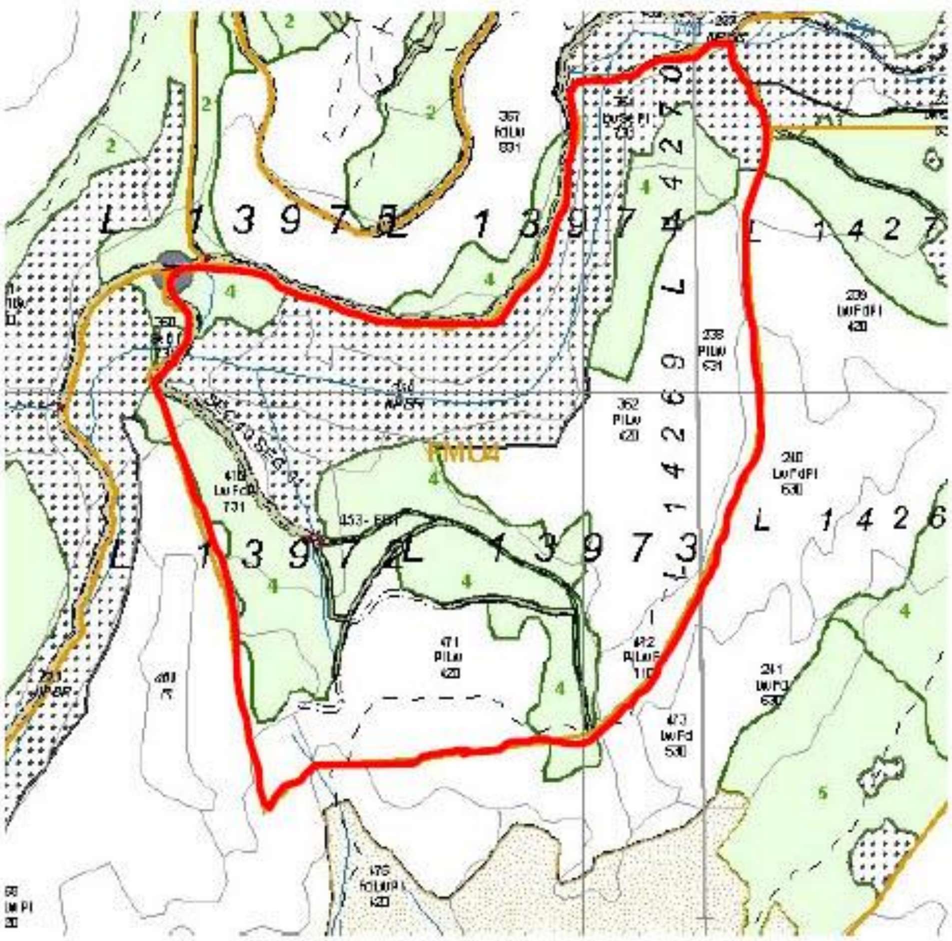

Figure 44. Location of FMU 4. The majority of this FMU consists of a steep, north aspect, mixed-conifer forest.

Gross Area: **64.3 ha**

Fire Management Unit 4 is comprised primarily of the northerly aspects of Myrtle Mountain (fig. 44). This unit is characterized by steep slopes, and cool aspects (fig. 45) with forests inhabited by western larch, lodgepole pine, Douglas-fir, Engelmann spruce and subalpine fir (fig. 46). The inventory information graphically presented in figure 46 does not include spruce or subalpine fir because none of the inventory plots landed in these very mixed forest types.

Treatment Options

Current and Near-Future Fuel Conditions

Current and near-future stand structure in FMU 4 can support extreme fire behavior under moderate burning conditions. Under even moderate fire behavior the outcome would be almost complete overstory mortality (fig. 50). Fire effects modeling for current conditions suggests that even most of the overstory larch would be killed. This would leave the FMU in a salvage situation. Under salvage situations the highest value trees are removed (i.e., largest diameter, tallest, least fire damage) and the rest are left. The subsequent forest is a plantation planted or naturally regenerated through slash. This condition would likely be unacceptable socially, economically, and environmentally.

Forecasting the surface fuel load from dead lodgepole pine several years into the future yields a significant increase in loading of large material due to bark beetle attack. Should a fire burn under these conditions all overstory trees would be killed and it is likely that there would be soil chemical, biological, and structure impacts. Once again the post-fire management regime would include salvaging any remaining value. Under this scenario there would be even less remaining value than the previous scenario because it is assumed that a wildfire would burn even hotter.

It is not advisable to manage the threat toward the potential for catastrophic loss of the stand, economically-driven salvage, and the re-establishment and management of a single-storied plantation. All current diversity is lost as is esthetic quality, site productivity, and hydrologic integrity.

Treatment Strategies

The preferred treatment strategies for FMU 4 include: (a) a commercial thin where economically feasible, followed by species-specific slashing, clean-up of surface fuels resulting from the thinning, and the clean-up of all the pre-existing fuels that cannot be gathered by the thinning equipment; and, (b) where appropriate, the spatial isolation of small areas of moderate to high fuel hazards. The proposed thinning prescription for commercial thinning areas in FMU 4 is a diameter-limit and species preference cut to KBLUP “managed forest” standards. These areas would see 100-200 stems/ha residual density of Douglas-fir and western larch. This prescription will focus on lodgepole pine removal with other conifers favored for retention. An unfortunate consequence of this designation is its requirement to re-stock the area to 1200 stems/ha.

A significant proportion of FMU 4 (almost 50%) is not scheduled for commercial thinning; primarily due to environmentally sensitive slopes, poor wood quality, and cultural/recreational concerns. Actively treating this area through manual tactics would be expensive and treatment options complex. Due to the size of the area and where it is located it is recommended that at this time it be left in its current state and not actively treated. At a landscape-scale the threats posed by this stand can be mitigated by treating all adjacent areas to the north, east, and south and “isolating” this area. Future treatments will be outlined for stands to the west (this area falls outside the realm of this current plan). The following section will outline the range of potential fuel treatment strategies that can be applied to this FMU. Estimated costs for the treatments and a recommended schedule are detailed in section 4.0.

Following commercial thinning the 100-200 stem/ha areas (for model purposes referred to as **managed forest type**) would exhibit crown characteristics similar to figure 51. A significant quantity of "bulk" has been removed from the mid-canopy but at the lower canopy there is still enough canopy mass to support a crown fire. This mass is comprised of unmerchantable diameter trees (<12 cm DBH) that are assumed to be untouched by Tembec. The upper canopy of very low CBD is comprised of well-spaced western larch and Douglas-fir. For modeling purposes the thinning targeted lodgepole pine and Douglas-fir ahead of western larch. Reality on the ground, due to a uniform spacing of residual trees, will see lodgepole pine still targeted foremost but may see a greater balance of Douglas-fir and western larch removed.

Following behind the Tembec thinning and spacing, all non-merchantable stems plus surface fuel clean-up would yield canopy characteristics similar to figure 52 and surface fuel characteristics similar to figure 20. The actual quantity of traditionally submerchantable stems left post-thinning is unknown ahead of time because Tembec often employs a "post and rail" operation along with their traditional thinning operations. A significant quantity of the <12.5 cm DBH lodgepole pine could be removed under this type of scenario. All remaining sub-merchantable-sized trees will need to be felled and either skidded or dragged to roadside for chipping or hand piled and eventually burned. Most surface fuels will also need to be chipped or piled. The resultant impact of these treatments on fire behavior and fire effects is detailed in Table 6.

The "isolated" fuel hazard is modeled under current conditions plus the near future condition of increased fuel load due to beetle killed lodgepole pine. The actual fall rate of beetle killed pine is unknown for this area. How long trees remain standing after being killed by various causes is not well understood for most species. Clark et al. (1998), working in lodgepole pine and spruce in B.C., Ganey and Vojta (2005) working in southwestern ponderosa pine and mixed-conifer in Arizona, and Kearns et al. (2005), working in pinyon pine in Colorado, found that the durability and variation of snag structure (broken, intact, decay class, etc.) was affected by stand age, characteristics of the pre-disturbance forest, and the type of disturbance. It is recommended that the rate of fuel input be monitored and future decisions of hazard mitigation be based on how quickly this condition changes relative to how quickly the adjacent hazards are mitigated. The summary of fuel conditions and potential fire behavior select treatment options in FMU 4 are provided in Table 6. It should be recognized that these are only preliminary estimates of hazards and solutions. Because this is crown land a much higher level of inventory and analysis will need to be conducted both before and after treatment to determine the best possible fuel mitigation strategy.

The managed forest type area is broken down into three distinct states: initial condition, conditions following a commercial thin only treatment, and the desired condition following the commercial thinning ***plus*** additional fuel mitigation. The "isolated" treatment area is broken down into two states: the initial condition, and the potential future condition following beetle attack and eventual snag fall. It is anticipated that there will be a significant quantity of dead downed material and density of sapling stems postthinning that could contribute to a fuel hazard (more open stands post-thin exacerbating the situation by drying fuels sooner, producing more and taller grass, and affording higher average below-canopy windspeeds). These are structures that Tembec would not be able to address without a subsidy. Getting to the desired condition and maintaining that condition is discussed in the section on Budgets and Scheduling.

The thin only treatment in the managed forest area has a positive effect on fire behavior (rate of spread, flame length, fireline intensity) but no effect on crown fire initiation, crown fire propagation, and ultimately Crowning Index due to the untreated small-diameter Douglas-fir. The persistence of unmerchantable stems that contribute to fuel “ladders” affect crown fire initiation, which was not improved. The persistence of pre-thin fuels plus the addition of thinning-related fuels are also contributing to this continued crowning vulnerability and also affect stand-level mortality. There are strategic fire management options related to the more inaccessible portions of the FMU. These areas can be isolated and managed as a persistent hazard due to their location and overall cost of treatment. Inaccessibility and fuel characteristics make treating these areas very labor intensive and potentially expensive to treat. Model gaming produced what should be considered to be a good compromise of substantially reduced crown fire hazard, moderate improvement in wildfire resilience, and moderate project cost. If concerns persist for these areas and this proposed fire management strategy, it is suggested that landscape-scale fire modeling (FARSITE) be used to determine the probabilities of these areas contributing to a fuel hazard.

Access

Vehicle access for fuel mitigation work and wildfire suppression is fair to poor in this FMU. A main access road will be upgraded to the top of Myrtle Mountain in order to access portions of the southern and western end of the unit. This access is to be obliterated once the thinning is completed. It should in fact be maintained until all fuel mitigation work is completed. It is unlikely that an engine or water tender could access this road system. The area designated for treatment in the northeast corner will be accessed via Army Road and will consist of a long skid; there will not be any road constructed here. This will present access difficulties for post-commercial thin fuel clean-up. It may be possible in this case to maintain a primitive access condition that would allow ATV’s and or “gators” to operate here. Once the work is completed any access could be obliterated.

In the event of a wildfire the untreated portions of the FMU would have to be accessed by the Army Road which is to stay in a permanent access state. This would not provide direct access for engines or water tenders. Due to the hazardous fuel conditions, poor access for much of the FMU, and the need to put fire fighter safety foremost, indirect attack will likely be the best wildfire suppression strategy in this FMU.

3.5. Fire Management Unit 5

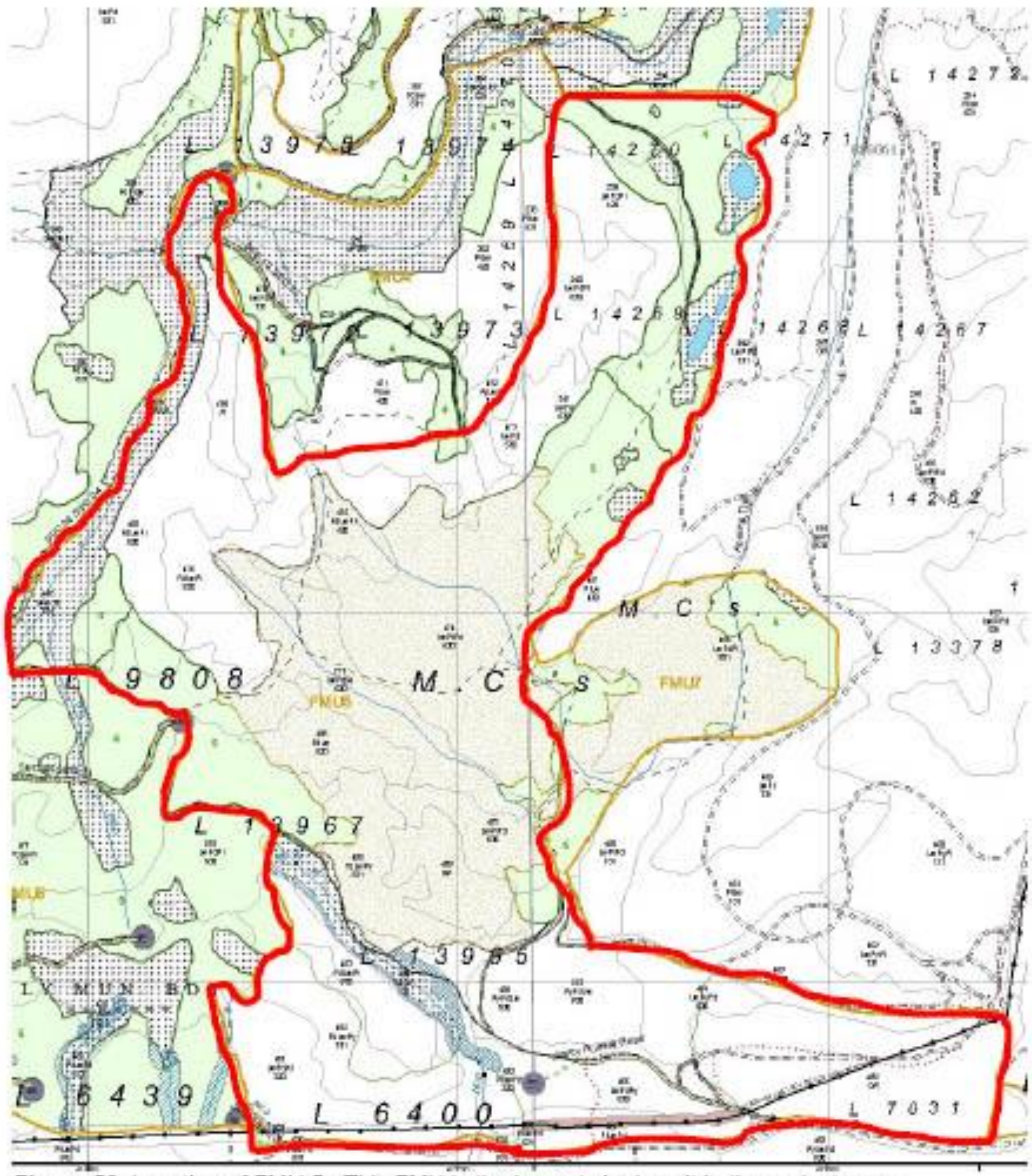

Figure 53. Location of FMU 5. This FMU is the largest single unit in the project area.

Gross Area: 317.9 ha

Fire Management Unit 5 is the largest and most complicated unit in the project area (fig. 53). Within the unit boundary there are dense, multi-layered forests of Douglas-fir and western larch (fig. 54), pure patches of pole-sized lodgepole pine, receding wetlands (fig. 55), dry, open stands of ponderosa pine and bunchgrass (fig. 56), and dense, single storied stands of western larch and ponderosa pine (fig. 57). Topography is less complex here than FMU 3 for example. Most of the unit is comprised of southeast to south aspects including the south slopes of Myrtle Mountain. In the interior of the unit there are a number of short ridges and benches mostly oriented northwest/southeast providing small areas of cool, northeast aspect.

Treatment Options

Current and Near-Future Fuel Conditions

Current and near-future stand structure in FMU 5 can support extreme fire behavior under moderate burning conditions. Under even moderate fire behavior the outcome would be almost complete overstory mortality (fig. 63). Fire effects modeling for current conditions suggests that even most of the overstory larch would be killed (polygon 475 has the lowest modeled larch mortality). This would leave the FMU in a salvage situation. Under salvage situations the highest value trees are removed (i.e., largest diameter, tallest, least fire damage) and the rest are left. The subsequent forest is a plantation planted or naturally regenerated through slash. This condition would likely be unacceptable socially, economically, and environmentally.

Forecasting the surface fuel load from dead lodgepole pine several years into the future yields a significant increase in loading of large material due to bark beetle attack. Should a fire burn under these conditions all overstory trees would be killed and it is likely that there would be soil chemical, biological, and structure impacts. Once again the post-fire management regime would include salvaging any remaining value. Under this scenario there would be even less remaining value than the previous scenario because it is assumed that a wildfire would burn even hotter.

It is not advisable to manage the threat toward the potential for catastrophic loss of the stand, economically-driven salvage, and the re-establishment and management of a single-storied plantation. All current diversity is lost as is esthetic quality, site productivity, and hydrologic integrity.

Treatment Strategies

The preferred treatment strategies for FMU 5 include: (a) a commercial thin where economically feasible, followed by species-specific slashing, clean-up of surface fuels resulting from the thinning, and the clean-up of all the pre-existing fuels that cannot be gathered by the thinning equipment; (b) where appropriate, the spatial isolation of areas of moderate to high fuel hazards, and, (c) extensive manual fuel treatments in areas deemed uneconomical or environmentally sensitive to mechanical treatment. The proposed thinning prescriptions for commercial thinning areas in FMU 5 include both “managed” forest targets and “open” forest targets under the KBLUP plan standards. These areas would both see 100-200 stems/ha residual density of Douglas-fir, western larch, and ponderosa pine, and would target lodgepole pine removal with other conifers favored for retention. An unfortunate consequence of the “managed” forest designation is its requirement to re-stock the area to 1200 stems/ha.

A significant proportion of FMU 5 (approximately 20%) is not scheduled for commercial thinning; primarily due to environmentally sensitive slopes and poor wood quality (large “white” area to the southwest of Myrtle Mountain on the FMU map). Actively treating this area through manual tactics would be expensive and treatment options complex. Due to the size of the area and where it is located it is recommended that at this time it be left in its current state and not actively treated. At a landscape-scale the threats posed by this stand can be mitigated by treating all adjacent areas to the north, east, and south and "isolating" this area. Future treatments will be outlined for stands to the west (this area falls outside the realm of this current plan).

An even larger proportion of FMU 5 falls into the category of manual treatment. This designation includes areas not scheduled for commercial thinning due to environmentally sensitive slopes and poor wood quality ("white" area along the east flank of Myrtle Mountain), and areas of critical habitat to the Williamson sapsucker. Due to the fuel hazards identified in these areas and their proximity to values at risk they will be treated. The treatment goal is to meet the Fire Management Plan objectives of reduced fire behavior and increased wildfire resilience. As part of the analysis trade-offs will be considered as they affect treatment economics, efficiency of treatment, measures of risk, and habitat suitability.

The following section will outline the range of potential fuel treatment strategies that can be applied to this FMU. Estimated costs for the treatments and a recommended schedule are detailed in section 4.0.

Following commercial thinning the managed forest type would exhibit crown characteristics similar to figure 64. A significant quantity of "bulk" has been removed from the mid-canopy but at the lower canopy there is still enough canopy mass to support a crown fire. This mass is comprised of unmerchantable diameter trees (<12 cm DBH) that are assumed to be untouched by Tembec. The upper canopy of very low CBD is comprised of well-spaced western larch and Douglas-fir. For modeling purposes the thinning targeted lodgepole pine and Douglas-fir ahead of western larch. Reality on the ground, due to a uniform spacing of residual trees, will see lodgepole pine still targeted foremost but may see a greater balance of Douglas-fir and western larch removed.

Following commercial thinning the open forest type would exhibit crown characteristics similar to figure 65 which are also very similar to the post-thinning managed forest type. A significant quantity of "bulk" has been removed from the mid-canopy but at the lower canopy there is still enough canopy mass to support a crown fire. This mass once again is comprised of unmerchantable diameter trees (<12 cm DBH) that are assumed to be untouched by Tembec. The upper canopy of very low CBD is comprised of well-spaced western larch and Douglas-fir.

The "isolated" fuel hazard is modeled under current conditions plus the near future condition of increased fuel load due to beetle killed lodgepole pine (fig. 66). Combined with the existing crown fuel hazard posed by small-diameter Douglas-fir and a steep, west aspect, this area currently is a significant hazard that will only get worse over time. It is recommended that the rate of fuel input be monitored and future decisions of hazard mitigation be based on how quickly this condition changes relative to how quickly the adjacent hazards are mitigated.

The extensive area that falls outside commercial thinning feasibility requires extensive treatment. Based on reconnaissance plots established by Tembec over the winter, a significant proportion of stand density must be treated. In polygon 241, current density includes 2,800 stems/ha Douglas-fir and 1,600 stems/ha western larch for a total density of 4,400 stems/ha. In polygon 717, 3,000 are Douglas-fir and only 200 are western larch. In polygon 485 2,500 stems/ha are Douglas-fir and only 28 stems/ha are lodgepole pine. In polygon 241, this density is not widely distributed by DBH class or species. Almost 92% of the Douglas-fir density occurs in trees <18 cm DBH, while 93% of all western larch are <12.5 cm DBH. In polygon 717, 92% of the Douglas-fir are once again <18 cm DBH, while only 35% of larch are. In polygon 485 Douglas-fir <18 cm DBH make up 93% of the Douglas-fir density. Canopy characteristics for these areas (fig.'s 59-61) consistently indicate the greatest “bulk” of canopy fuels in the lower-canopy which correlates well with the smallest diameter class trees. Reducing the crown fire hazard and increasing wildfire resilience in these portions of FMU 5 means that the treatment must focus on removing a substantial portion of the smaller diameter Douglas-fir, and all diameters of lodgepole pine.

The follow up treatments behind the Tembec commercial thinning should include slashing all unmerchantable, small stems (spacing) plus surface fuel clean-up. This treatment would yield canopy characteristics similar to figures 68 and 68 and surface fuel characteristics similar to figure 20. The actual quantity of traditionally submerchantable stems left post-thinning is unknown ahead of time because Tembec often employs a “post and rail” operation along with their traditional thinning operations. A significant quantity of the <12.5 cm DBH lodgepole pine could be removed under this type of scenario. All remaining sub-merchantable-sized trees will need to be felled and either skidded or dragged to roadside for chipping or hand piled and eventually burned.

Most surface fuels will also need to be chipped or piled.
Mitigating the fuel hazard conditions in the unthinned portion of FMU 5 will require the removal of large quantities of below-merchantability trees, these are typically trees less than 12.5 cm DBH. Unfortunately, due to access and other constraints, the minimum diameter class that will need to be treated to reduce fuel hazards in these areas of FMU 5 is 18 cm. From starting densities of 2,500 to 4,400 trees/ha this means “gaming” the fuel and stand structure conditions in the model until the best case for meeting the two fire management objectives are met. In polygon 241, overall density must be reduced by 95% to favorably impact crown fire hazard and wildfire resilience (Table 7). Utilizing a diameter limit cut of 18 cm DBH for both Douglas-fir and western larch, Douglas-fir is reduced from 2,805 stems/ha to 235 (92% reduction) and western larch is reduced from 1,580 stems/ha to 110 (93% reduction). The effect on canopy characteristics is illustrated in figure 69. At a residual density of 298 trees/ha, a 93% reduction in density, there is a significant reduction in fire behavior. With this structure it is not impossible to initiate or propagate a crown fire (Table 7), but it would take extraordinary circumstances.

In polygon 485, overall density must be reduced by 94% to favorably impact crown fire hazard and wildfire resilience (Table 7). In this area the majority of small-diameter Douglas-fir contributing to the hazard are <10 cm DBH while the lodgepole pine that will likely constitute a future hazard element are larger diameter trees. It is recommended that Douglas-fir be reduced from 2,675 stems/ha to 175 (93% reduction) while all lodgepole pine or most lodgepole pine (retain some large diameter pine for biodiversity) be removed. The effect on canopy characteristics is illustrated in figure 70. At a residual density of 175 trees/ha, an overall 94% reduction in density, there is a significant reduction in fire behavior. With this structure crown fire is unattainable (Table 7).

In polygon 717, the minimum diameter limit for removal increases to 18 cm for both Douglas-fir and western larch. Douglas-fir density will need to be reduced from 3,020 stems/ha to 228 (92% reduction) while western larch needs to be reduced from 198 stems/ha to 128 (35% reduction). This retains a residual density of 356 stems/ha of a wide variety of diameter classes. This should translate into high vertical structural diversity in the core WISA area. This level of treatment has a positive effect on fire behavior (fig. 71, Table 7).

Table 7. Fuels and fire behavior summary for FMU 5.

Variable	Current Condition (Polygon 241)	Current Condition (Polygon 485)	Current Condition (Polygon 717)	Polygon 241 (Managed Forest/no addl.)	Polygon 241 (Managed Forest/addl. treat.)	Polygon 241 (Manual Treatment)	Polygon 485 (Open Forest/no addl.)	Polygon 485 (Open Forest/addl. treat.)	Polygon 485 (Manual Treatment)	Polygon 717 (Manual Treatment)
Fuel loading (kg/m^2):										
<7.5 cm	1.02	1.02	1.02	2.92	1.12	0.55	1.57	0.55	0.55	0.55
>7.5 cm	1.00	1.00	1.00	2.00	0.51	0.20	2.00	0.51	0.20	0.20
Total	2.02	2.02	2.02	4.92	1.63	0.75	3.57	1.06	0.75	0.75
Fuelbed bulk depth (m)	0.4	0.4	0.4	0.4	0.06	0.2	0.2	0.2	0.2	0.2
Canopy bulk density (kg/m^3)	0.06	0.05	0.05	0.06	0.005	0.02	0.05	0.01	0.02	0.02
Canopy base height (m)	0.3	0.3	0.3	0.3	14.6	14.0	0.3	13.7	13.1	12.8
Canopy fuel load (kg/m^2)	0.41	0.30	0.35	0.19	0.06	0.24	0.24	0.13	0.19	0.20
Fire behavior:										
Rate of spread (m/min)	11.7	8.7	6.4	3.2	0.6	6.3	1.3	4.7	2.6	3.5
Flame Length (m)	2.3	2.0	1.7	2.0	0.3	1.3	1.0	1.1	0.9	1.0
Fireline intensity (kW/m/sec)	1,603	1,197	882	1,155	28	466	259	347	189	256
Min. windspeed crown fire init. (km/h)	8.0	8.0	8.0	8.0	Not attainable	104	8.0	102	Not attainable	97.6
Min. windspeed crown fire prop. (km/h)	57.6	68.8	64.0	57.6	Not attainable	112	68.8	Not attainable	Not attainable	136
Crowning index	Moderate	Moderate	Moderate	Moderate	Low	Low	Moderate	Low	Low	Low
Mortality	extreme	extreme	extreme	extreme	low	low	moderate	low	low	low

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A summary of fuel conditions and potential fire behavior are provided in Table 7. The commercial thin areas are broken down into three distinct states: initial condition, conditions following a commercial thin only treatment, and the desired condition following the commercial thinning ***plus*** additional fuel mitigation. The manual treatment areas are broken down into two states: the initial condition, and the desired condition following treatment. It is anticipated that there will be a significant quantity of dead downed material and density of sapling stems post-commercial thinning that could contribute to a fuel hazard (more open stands post-thin exacerbating the situation by drying fuels sooner, producing more and taller grass, and affording higher average below-canopy windspeeds). These are structures that Tembec would not be able to address without a subsidy. Getting to the desired condition and maintaining that condition is discussed in the section on Budgets and Scheduling.

The thin only treatment in the commercial thinning areas shows no appreciable improvement in crown fire hazard or wildfire resilience. The pre-existing surface fuel coupled with thinning-generated fuel, and the retention of a high density cohort of small diameter trees, does not result in an improved fuel hazard condition. Fire environment conditions have also somewhat deteriorated with the reduced canopy from the thinning. Surface fuels now dry sooner in the year and stay dryer longer while wind friction has been reduced. Depending on the residual density and the ecosystem, the herbaceous response, taller grass could further exacerbate the situation.

There are few strategic fire management options related to the non-commercial thin areas of FMU 5. The area is too large, contains too much fuel, and is in too close a proximity to values at risk to simply isolate and manage as a persistent hazard. On the other hand, the inaccessibility and fuel characteristics make it a very labor intensive and potentially expensive area to treat. Model gaming produced what should be considered to be a good compromise of substantially reduced crown fire hazard, moderate improvement in wildfire resilience, and moderate project cost (see section 4.0). Reducing density overall, specifically from Douglas-fir and within the smaller diameter classes, has a significant effect on fire behavior and fire effects. A note of caution with the figures in Table 7 associated with the manual thinning areas: the surface fuel characteristics used in the model are for post-prescribed fire conditions. It is recommended that for this FMU in particular, a series of understory burns take place following slashing, piling and pile burning. The model was run with higher surface fuel loads post-treatment (non-prescribed fire scenario) as well that produced passive crown fire at 50 km/h and active crown fire at 112 km/h. The former in this case is more of a likelihood than the latter. This has significant impacts for firefighter safety and wildfire suppression tactics. In the case of the manual treatment area, it is recommended that understory burning be a part of the treatment regime.

Riparian Systems

Embedded within FMU 5 are a number of riparian features, wet meadows, intermittent ponds, intermittent streams and draws, and swamps (fig. 72). The series of wet meadows known as Duck Pond are one example while the aspen/cottonwood swamp along Jimmy Russell Road is another. Most of these features have likely changed structurally and functionally as a result of fire exclusion. In the current state some are receding in area and are being encroached upon by upland conifer forest, others are being inundated by high fuel loads. A wildfire, it could be argued, would have a net benefit to these ecosystems, however, the greater landscape goal is to minimize the effects of wildfire, not encourage its occurrence. The goal behind active management, therefore, is to mimic most but not all positive effects of fire. Examples of positive effects of fire would be the killing of encroaching conifers or the consumption of excess fuels. A negative example involves the retention of mature aspen and cottonwood. These trees are not highly fire-resistant (both are highly fire adapted) and would likely be killed by fire. If the goal is to retain the current cohort of mature, large diameter deciduous trees fire should not be used as a management tool, instead, a fire surrogate should be used. In this scenario selective, manual thinning of attributes not wanted by managers would be a more appropriate tool. If, in the future, understory burning is to be utilized, control measures can be implemented around some riparian features to minimize the negative impacts of fire.

Healthy, diverse, multi-layered riparian systems would be highly beneficial in this FMU from a fire behavior perspective. If for example, the three riparian draws/intermittent streams draining from the northwest to the southeast through FMU 5 were healthier, i.e., wider, contained more deciduous layers, and exhibited compacted fuels with higher moisture content, they could significantly affect wildfire behavior as it spread across the landscape. These systems would not be intended to stop a wildfire, but to certainly slow its progress and reduce its intensity or vary its intensity.

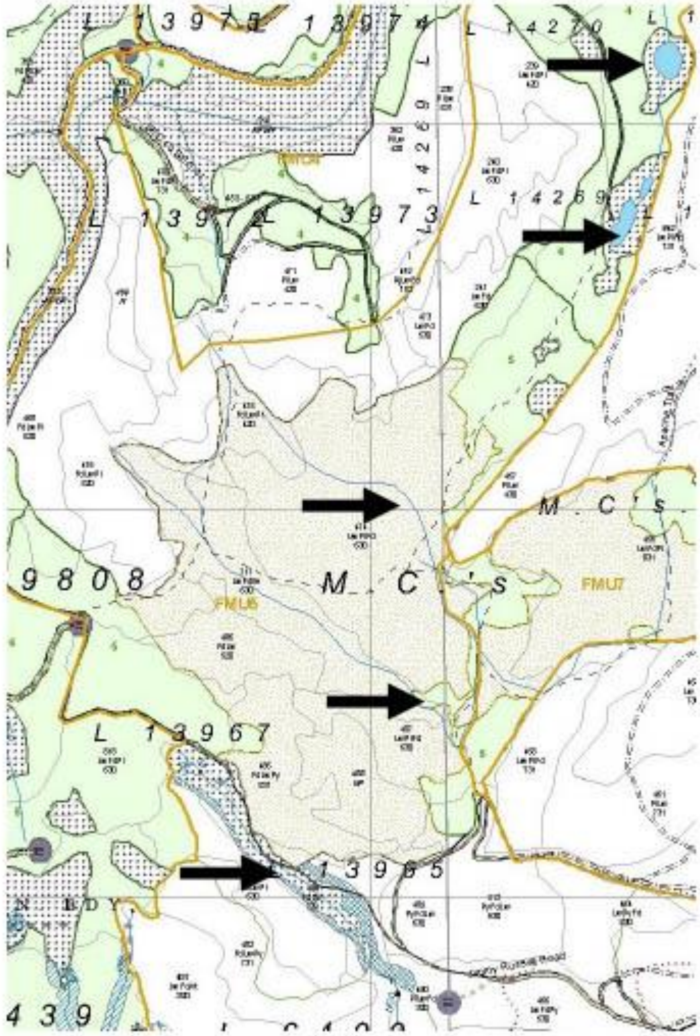

Figure 72. Riparian systems in need of ecological restoration (arrows). These systems, if restored to historic condition, could have a mitigating impact on fire behavior and fire effects throughout the immediate landscape.

Williamson Sapsucker Habitat

Discussions with Ministry of Environment biologists (T. Antifeau), plus a review of the literature, yielded the following Williamson sapsucker (WISA) habitat requirements:

• mixed western larch (most preferred), Douglas-fir, ponderosa pine forests for nesting,
• mature to old trees preferred for nesting,
• cavity trees likely to exhibit heart rot (causes variable),
• forests with 40 - 70% crown closure,
• multiple canopy layers,
• medium sized (20 – 50 cm DBH) Douglas-fir for sap wells,
• large mature trees or snags containing ant colonies.

Meeting the dual objectives of mitigating fire behavior while improving wildfire resilience can be achieved while at the same time maintain a significant proportion of the WISA habitat attributes. Two significant issues, as they relate to some key habitat attributes, are scale of occurrence, and location on the landscape. All of the attributes listed above could be located on a single hectare of land and not be at odds with the primary fire management objectives. Scattered combinations of these attributes could also be complimentary with the recommended structure for the FMU. Populating the entire WISA polygon within FMU's 5 and 7 with all or most of these attributes combined would be at odds with the stated management objectives.

If the recommended treatments were fully implemented in FMU 5 several attributes would be degraded or non-existent, while others would be in good supply. These include the higher end of the crown closure scale, secondary canopy layers, large, old stumps and logs, and recruitment Douglas-fir sap well trees. Attributes that will be in good supply include mature and old western larch, ponderosa pine and Douglas-fir, contemporary sap well-sized Douglas-fir, and large snags and downed logs. The primary targets for fuel hazard reduction are the small-diameter Douglas-fir and western larch, and all lodgepole pine. This would reduce most stands to a single canopy layer or possibly two if there is an old cohort and a mature cohort. Canopy closure in most cases would be reduced to the 30 – 40% level. Future sap well trees would have to come from the remaining density of Douglas-fir which, in most cases are suggested to be trees >18 cm DBH. If a series, or even a single prescribed burn is applied to the area the older decomposing CWD is likely to be severely reduced in quantity.

With minor spatial and quantity adjustments to the general treatment recommendations, a compromise can be reached that would see these particular attributes maintained. Scattered individual and small clumps of small-diameter Douglas-fir can be targeted for retention on specific parts of the landscape to function as sap well recruitment trees. These attributes will need to be located where they are not likely to be lost as a result of a prescribed burn or a wildfire. This means they will need to be located on flat topography, base of slopes, or on reverse slopes (cool aspects adjacent to warm aspects). Patches of multi-layered trees where larch is the understory layer beneath larch, Douglas-fir, and/or ponderosa pine are acceptable from a fire perspective provided they are not large areas (<20 ha) and there is a crown separation between the cohorts (see earlier pre-treatment canopy profiles showing two distinct canopy layers). Western larch is one of the least crown fire-prone conifers in North America so it is an acceptable risk to maintain some dense patches of sapling or pole-sized larch. Maintaining snags and CWD through prescribed burning is very difficult and costly; but it can be done. Areas of high CWD density can be segregated from burn units as another strategy. Burning will also result in new snags.

These treatment changes will require more extensive and expensive planning and layout in this unit. The more complicated the design the more expensive the planning and layout. Specific attributes will need to be located, recorded, and mapped using GPS and GIS technology (i.e., sap well trees, nest trees, snags, downed logs, etc.), and in some cases marked (i.e., clumps of sapling or pole-sized trees). This applies to any future treatment. Layout for manual treatments such as slashing and piling will be costly. So too will layout costs and eventual prescribed burning operational costs.

Access

Vehicle access for fuel mitigation work and wildfire suppression is fair to poor in this FMU. The main access road is the Jimmy Russell Road which traverses the southern end of the unit. Emergency access for a small engine plus possibly fuel work could be sought from Teck-Cominco to come through Forest Crowne. This road however has a steep section just east of the crown boundary that larger engines and water tenders cannot negotiate. Some short-term thinning access, comprising skid trails could be maintained for ATV and gator access for fuel mitigation work. Several trails that are in fact old roads could also be improved to the point of allowing ATV or gator access. These systems could then be degraded to prevent unwanted use once initial fuel treatments are completed.

3.6. Fire Management Unit 6

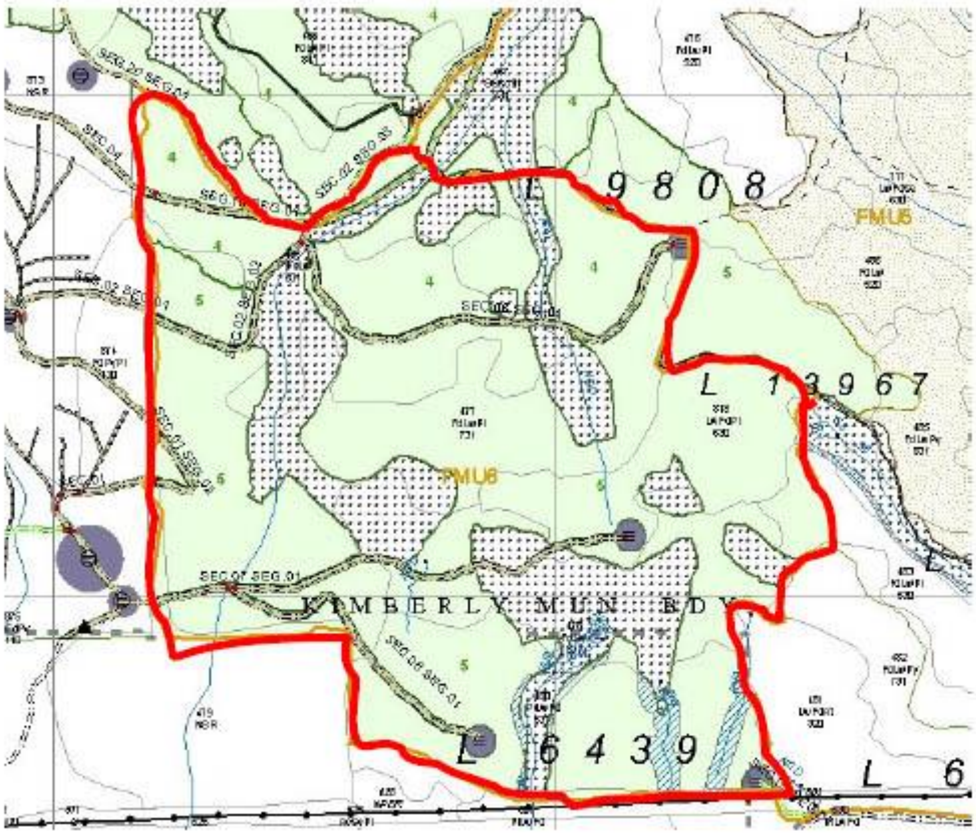

Figure 73. Location of FMU 6.

Gross Area: **131.8 ha**

Fire Management Unit 6 (fig. 73) comprises a large area of gentle terrain in the southwest corner of the project area. The aspect is primarily south with a few broad benches internal to the unit. Forest types range from dry western larch/Douglasfir/ lodgepole pine mixes (fig. 74) to moist areas of western redcedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), and Engelmann spruce. The HNFR for the unit is

Fire Regime II with some pockets of moist fire refugium. The Fire Regime Condition Class is primarily 3 on dry upland sites and 2 on refugium sites.

Treatment Options

Current and Near-Future Fuel Conditions

Current and near-future stand structure in FMU 6 can support extreme fire behavior under moderate burning conditions. Under even moderate fire behavior the outcome would be almost complete overstory mortality (fig. 77). Fire effects modeling for current conditions suggests that even most of the overstory larch would be killed (polygon 477 has the lowest modeled larch mortality). This would leave the FMU in a salvage situation. Under salvage situations the highest value trees are removed (i.e., largest diameter, tallest, least fire damage) and the rest are left. The subsequent forest is a plantation planted or naturally regenerated through slash. This condition would likely be unacceptable socially, economically, and environmentally.

Forecasting the surface fuel load from dead lodgepole pine several years into the future yields a significant increase in loading of large material due to bark beetle attack. Should a fire burn under these conditions all overstory trees would be killed and it is likely that there would be soil chemical, biological, and structure impacts. Once again the post-fire management regime would include salvaging any remaining value. Under this scenario there would be even less remaining value than the previous scenario because it is assumed that a wildfire would burn even hotter. It is not advisable to manage the threat toward the potential for catastrophic loss of the stand, economically-driven salvage, and the re-establishment and management of a single-storied plantation. All current diversity is lost as is esthetic quality, site productivity, and hydrologic integrity.

Treatment Strategies

The preferred treatment strategies for FMU 6 include: (a) a commercial thin where economically feasible, followed by species-specific slashing, clean-up of surface fuels resulting from the thinning, and the clean-up of all the pre-existing fuels that cannot be gathered by the thinning equipment; and, (b) where appropriate, the spatial isolation of areas of moderate to high fuel hazards. The proposed thinning prescriptions for commercial thinning areas in FMU 6 include both “managed” forest targets and “open” forest targets under the KBLUP plan standards. These areas would both see 100-200 stems/ha residual density of Douglas-fir, western larch, and ponderosa pine, and would target lodgepole pine removal with other conifers favored for retention. An unfortunate consequence of the “managed” forest designation is its requirement to re-stock the area to 1200 stems/ha.

A small proportion of FMU 6 (approximately 10%) is not scheduled for commercial thinning; primarily due to environmentally sensitive slopes, sensitive ecosystems, and cultural/recreational values. Due to the size of the area and where it is located it is recommended that at this time it be left in its current state and not actively treated. At a landscape-scale the threats posed by these stands can be mitigated by treating all adjacent areas around them and “isolating” the area.

The following section will outline the range of potential fuel treatment strategies that can be applied to this FMU. Estimated costs for the treatments and a recommended schedule are detailed in section 4.0.

Following commercial thinning the managed and open forest types would exhibit crown characteristics similar to figure 78. A significant quantity of “bulk” has been removed from the mid-canopy but at the lower canopy there is still enough canopy mass to support a crown fire. This mass is comprised of unmerchantable diameter trees (<12 cm DBH) that are assumed to be untouched by Tembec. The upper canopy of very low CBD is comprised of well-spaced western larch and Douglas-fir. For modeling purposes the thinning targeted lodgepole pine and Douglas-fir ahead of western larch. Reality on the ground, due to a uniform spacing of residual trees, will see lodgepole pine still targeted foremost but may see a greater balance of Douglas-fir and western larch removed.

It was not considered necessary to model the “isolated” fuel hazard due to the size of the patches and the fact that much of the area surrounding these small patches was being treated. It is recommended, however, that the rate of fuel input be monitored and future decisions of hazard mitigation be based on how quickly this condition changes relative to how quickly the adjacent hazards are mitigated.

The follow up treatments behind the Tembec commercial thinning should include slashing all unmerchantable, small stems (spacing) plus surface fuel clean-up. This treatment would yield canopy characteristics similar to figure 79 and surface fuel characteristics similar to figure 20. The actual quantity of traditionally sub-merchantable stems left post-thinning is unknown ahead of time because Tembec often employs a “post and rail” operation along with their traditional thinning operations. A significant quantity of the <12.5 cm DBH lodgepole pine could be removed under this type of scenario. All remaining sub-merchantable-sized trees will need to be felled and either skidded or dragged to roadside for chipping or hand piled and eventually burned. Most surface fuels will also need to be chipped or piled.

Effective fuel mitigation in FMU 6 includes both the initial commercial thinning plus follow-up slashing and surface fuel clean-up. Commercial thinning alone minimally improves fire behavior (rate of spread and fireline intensity) but doesn’t improve the risk of crown fire initiation or propagation. The addition of slashing and fuel clean-up (removal) positively alters the surface fuel load and depth, the aerial fuel characteristics (CBH, CBD, and crown fuel load), which subsequently impact fire behavior and wildfire resilience (Table 8).

Access

Vehicle access for fuel mitigation work and wildfire suppression is very good in the short term in this FMU. The main project area access road runs through the FMU while a number of other haul roads will be available for use. These roads would all be of a standard that large engines and water tenders could traverse them. Some short-term thinning access, comprising skid trails could be maintained for ATV and gator access for fuel mitigation work. Several trails that are in fact old roads could also be improved to the point of allowing ATV or gator access. These systems could then be degraded to prevent unwanted use once initial fuel treatments are completed. Road access improvements for commercial thinning should be maintained through the fuel mitigation process as well.

3.7. Fire Management Unit 7

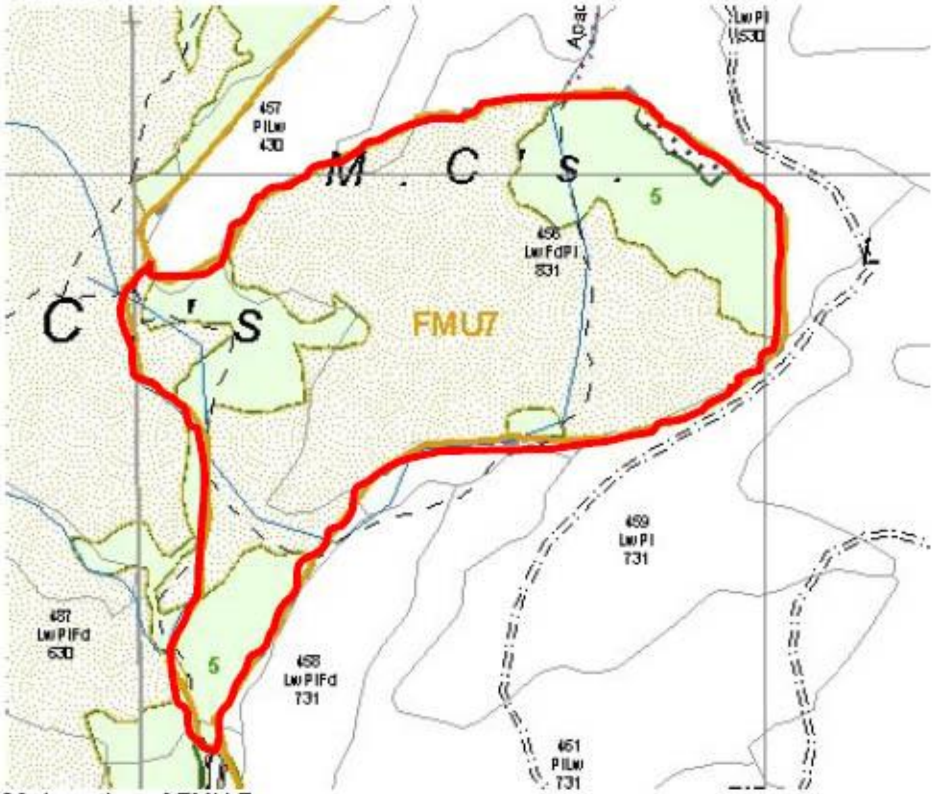

Figure 80. Location of FMU 7.

Gross Area: **34.2 ha**

Fire Management Unit 7 is the furthest east area covered under the plan (fig. 80). It consists of a significant “bulge” of land almost completely surrounded by private land (Forest Crowne). This FMU contains some of the most unique topography and forested communities in the entire project area. The west and east flanks of the unit contain dense, pole-sized lodgepole pine, most of which is targeted for removal, while the central portion contains: (a) a moist depression inhabited by an old patch of mixedconifer species, (b) an intact deciduous marsh, and, (c) a significant rock cliff band and gully.

Treatment Strategies

A significant portion of the lodgepole pine hazard will be addressed by Tembec under their Cutting Permit (fig. 80). Provided additional post-thinning fuel clean-up takes place as it is outlined in previous sections of this plan, approximately half the area of the FMU will have been treated. The previously mentioned significant ecosystems, with the exception of the dry ponderosa pine type, are not in need of active treatment. The ponderosa pine type and the remaining areas of live and dead lodgepole pine do however need active fuels work. This amounts to approximately 10 ha out of the FMU total of 35 ha. In the ponderosa pine area this involves slashing, piling and burning ingrowth Douglas-fir, while in the lodgepole pine type it involves felling, piling or chipping pine, and burning the piles. Areas that are contiguous to proposed commercial thinning areas should be managed similarly if possible. The WISA habitat designation of this area should not be affected if similar treatment practices to FMU 5 are followed. Prescribed understory burning is not recommended for this FMU due to its size, topography, and proximity to private land.

Access

Vehicle access for fuel mitigation work and wildfire suppression is poor in this FMU. There are no main access roads within close proximity of this unit. Emergency access for a small engine plus possibly fuel work could be sought from Teck-Cominco to come through Forest Crowne. These roads however have not been kept in good running order so some work would need to go into getting them into good condition. Some short-term thinning access, comprising skid trails could be maintained for ATV and gator access for fuel mitigation work. Several trails that are in fact old roads could also be improved to the point of allowing ATV or gator access. These systems could then be degraded to prevent unwanted use once initial fuel treatments are completed.

3.8. Fire Management Unit 8

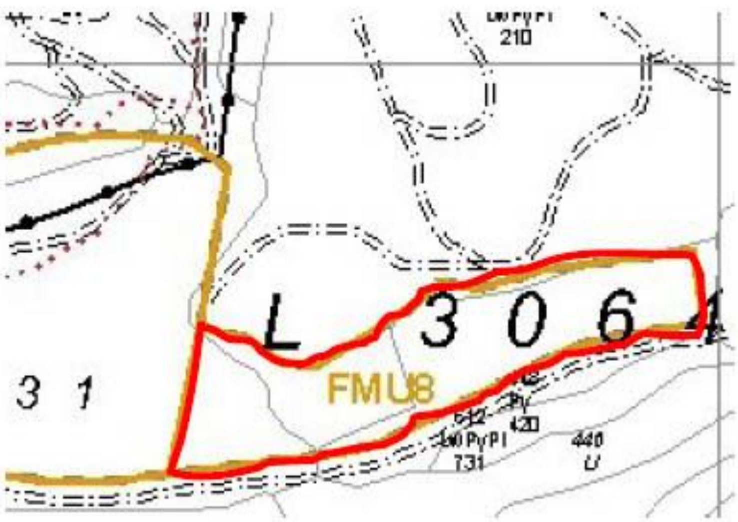

Figure 84. Location of FMU 8. This unit lies directly downslope and upwind of Forest Crowne property (private land) and an expanding subdivision complex.

Gross Area: **5.7 ha**

Fire Management Unit 8 (fig. 84) is a small, narrow band of a dry bunchgrass/ponderosa pine ecosystem at the extreme southeast edge of the project area. To the north and east of the unit is private land (Forest Crowne), while the south boundary is bordered by the St. Mary's Lake Road. Forest structure includes scattered dense clumps of encroaching ponderosa pine and Douglas-fir, mature overstory ponderosa pine, open bunchgrass grasslands, and scattered aspen clones (fig. 85).

Historic Natural Fire Regime for this unit is Fire Regime I, frequent low-severity fire. The Fire Regime Condition Class for this unit is 3, despite the area having burned in the late

1970's. The encroachment of young ponderosa pine and Douglas-fir post-wildfire constitutes structures that historically were thinned by subsequent fire. The current 100-year old cohort of mature pine also follows this pattern. The killing of these trees in a wildfire would restore the overstory structure to pre-settlement conditions but would input much higher surface fuel loads than would be there historically. Increased burn severity on this site would be beneficial to invasive weeds (knapweed, cheatgrass) already known to exist in the area.

Surface fuels consist primarily of cured herbaceous material and some timber litter. Under the dense mature stand there are some accumulations of larger dead pine due to the wildfire thirty years ago. Fuel loading is typically < 1.0 kg/m² while depth ranges from 0.3 m to 0.75 m. Aerial fuels are discontinuous.

This area has a written and approved plan in place for addressing the encroaching conifers. Long-term fuel management should focus on conifer encroachment and cheatgrass management. High cover values of cheatgrass in grasslands have greatly altered fire regimes over large areas of the US Great Basin. In many areas cheatgrass conversion has resulted in extended fire seasons, greater fire occurrence, and significantly simplified ecosystems. Despite a lack of provincial recognition of cheatgrass as an aggressive invader it should be the target of control.

4.0 Schedule of Activities and Estimated Budget

The following schedule of activities (Table 9) and budget (Table 10) are simply estimates. Scheduling of fuel mitigation work is contingent on the schedule of the commercial thinning and access development/decommissioning, and project funding. From a prioritization perspective FMU's 1, 2, 3, 5, and 7 are most critical followed by FMU's 8, 4, and 6 in that order. Due to the juxtaposition of commercial thinned area and manual thinning area all FMU's should be treated within a very timely manner.

Developing a reasonable budget estimate for this project area is very difficult, forest and fuel conditions are highly variable as is terrain and access. Also complicating this task is the general lack of accurate fuel treatment cost and productivity information from B.C. A great deal of information has been published recently in the western US but due to differences in labor pool, cost of living, tax structure, etc., these numbers are of little benefit to us here in B.C. Cost and productivity estimates related to local projects such as Teck-Cominco's continuing work in Lois Creek, the city's work in Levirs Avenue and Riverside Campground and the City of Cranbrook's work in McLeary Park were considered as were Ministry of Forests Ecosystem Restoration program estimates. Estimates are for operational costs only; they do not include planning and monitoring. **None of the fuel treatments (manual treatment or post commercial thinning treatments) include a potential revenue stream from the utilization of small diameter trees**.

To simplify calculations the following categories of costs were used:
- steep hillslopes without commercial thinning are assessed at $7,000/ha (slashing, hand piling, pile burning),
- steep hillslopes with commercial thinning are assessed at $1,500/ha (slashing, chipping, hauling),

• moderate slopes with commercial thinning are assessed at $1,000/ha (slashing, chipping, hauling),
• broadcast prescribed burning is assessed at $3,000/ha.

There are areas of manual thinning that could be treated with slashing, chipping, and hauling but it was assumed that this cost would be similar to slashing/piling/pile burning treatment. A cost estimate of $7,000/ha for example is based on the following logic:
• 2,500 trees/ha <12.5 cm DBH to be removed; 10 trees <12.5 cm DBH = 1 hand pile (maximum dimensions 1.5 m tall X 1.5 m diameter, large material on top, fines on bottom); 1 person can slash, buck and construct 3 piles/day at $160/day, and 60 trees/day (42 person-days/ha) for a total cost of $6,700 plus $300/ha for equipment, etc.
• It is assumed that following commercial thinning there would be less material to slash or drag for chipping. Access should be better on commercial thin areas as well bringing the per hectare cost down. If large amounts of <12.5 cm material is untouched by the thinning the cost/ha would climb to close to the $7,000/ha rate.
• Prescribed burning costs are estimated to be high due to objectives (maintaining high overstory survival), access limitations, surface fuels, fuelbreak construction, water limitations, and proximity to values at risk.

A quick summary of Table 10 yields the following statistics:
• Of a gross area of 873 ha, approximately 435 are scheduled for commercial thinning while another 183 are identified for manual thinning. A further 255 ha, or 30% of the project area, are strategically treated by “isolating” fuel hazards.
• The overall estimated cost of the initial phase of the project (maintenance of this area has not been addressed in this plan in any detail) is $2,641,000, or $3,025/ha. This would roughly equate to almost 17,000 person days of employment.

Table 10. Budget estimate by activity and FMU.

FMU	Gross Area (ha)	Commercial Thin (Approx. ha)	Post-Commercial Thin (flat) ($)	Post-Commercial Thin (steep) ($)	Manual Thin ($)	Prescribed Burn ($)	Total ($)
1	150	140	115,000	37,500			152,500
2	72	35		52,500	252,000		304,500
3	97	35	35,000		329,000		364,000
4	64	20		30,000			30,000
5	318	95	140,000		630,000	840,000	1,610,000
6	132	100	100,000				100,000
7	34	10	10,000		70,000		80,000
8	6	0					0
Total	873						2,641,000

Table 9. Schedule of activities from 2006 to 2010.

FMU	2006	2007	2008	2009	2010
1	• thinning • chipping				• regeneration and noxious weed assessment
2	• thinning	• spacing • piling	• spacing • piling • pile burning	• broadcast underburn	• spacing • piling • pile burning
3	• thinning	• spacing • chipping • piling • pile burning	• spacing • chipping • piling • pile burning	• spacing • chipping • piling • pile burning	• regeneration and noxious weed assessment
4	• thinning	• piling • pile burning			• regeneration and noxious weed assessment
5	• thinning	• spacing • piling • pile burning	• spacing • piling • pile burning	• broadcast underburn	• spacing • piling • pile burning
6	• thinning	• spacing • piling • pile burning	• spacing • piling • pile burning	• spacing • piling • pile burning	• spacing • piling • pile burning
7	• thinning • spacing				• regeneration and noxious weed assessment
8	• spacing • pile burning				• regeneration and noxious weed assessment