# Management Plan #1
# for Woodlot Licence W1832

March 2000

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# Management Plan #1 for Woodlot Licence W1832

## 1 Introduction

This is the first Management Plan for Woodlot Licence W1832, which is located near Winlaw in the Slocan Valley.

The crown land portion of W1832 is an area of 598 hectares located on the height of land at the junction of the Trozzo Creek, Dumont Creek, and Winlaw Creek watersheds. The private land portion is an area of 21 hectares in the middle portion of the Dunn Creek watershed on Perry's Ridge.

W1832 has been offered to a partnership comprised of Tom Bradley, Bernie Clover, and Breakaway Enterprises Ltd. by the Ministry of Forests. The licence will be granted once this first Management Plan for W1832 is submitted by the designated applicants and approved by the Ministry of Forests.

This document has been prepared to meet two requirements:

1. The statutory requirement under the Forest Act that a Management Plan, prepared according to the guidelines set out in Part 4 of the standard Woodlot Licence document, be presented to and approved by the District Manager prior to awarding a woodlot licence.
2. The social requirement that information about the landforms, forests, and ecology of the land within W1832, and about the Licensee's management intentions, goals, and plans, be made available to the community to assist them in being informed about proposed forestry activities in W1832.

Woodlot Licenses are regulated by a substantial set of legislation, policies, and regulations. All plans and operations in W1832 must comply with the Woodlot Licence Forest Management Regulation (WLFMR), the Forest Practices Code, and the Forest Act, as interpreted by the designated Ministry of Forests managers. The commitments contained in this Management Plan are constrained by the legislated requirements, but are not (in our opinion) in conflict with the guiding legislation. Logging operations in W1832 will meet or exceed the legislated requirements.

Once approved, this Management Plan will remain in effect until the District Manager or of the Licensees wish to amend it. This Management Plan will be revised over time, as our knowledge of and understanding of the forest ecosystems on W1832 increases. We will practice adaptive management. All statements and commitments made in this Management Plan will be reviewed and possibly revised in the light of operational experience in the woodlot. We will provide a concordance of changes and revisions with future Management Plans, to assist reviewers.

## 2 Management Objectives

Our management objective for Woodlot Licence W1832 is to manage the timber resources of the woodlot on a sustained yield basis following the principles of ecosystem management, while simultaneously maintaining or enhancing the non-timber uses, functions and products of the forest ecosystems of the woodlot. Our long term goals are the development of diverse forest stands of mixed species and mixed ages, the maintenance of biodiversity, and the management of ecologically important forest structures[1].

Watershed management issues are the key non-timber component of forest and land use in W1832. The crown portion of W1832 occupies much of the remaining unlogged area in the Dumont Creek watershed, which is the source of domestic and agricultural water for many water licensees. The remainder of the crown portion occupies parts of the Trozzo Creek and Winlaw Creek watersheds, much larger hydrologic systems which are also domestic water sources. The private land portion of W1832 is on the lower slopes of Perry's Ridge, in the Dunn Creek watershed, a small creek which is also a domestic water source. Our watershed management objective is to have no detrimental impact on the quantity, quality and/or timing of flow of water supplies to water users.

The Arrow Forest District has advised us that the Provincial, Regional, and District forest management goals are to maintain healthy forest ecosystems while maintaining stable employment opportunities and a flow of economically valuable forest products.

We plan to meet provincial, regional and district goals by:

- protecting biodiversity at the stand level.[2]
- meeting or exceeding the requirements of the Forest Practices Code of B.C.
- maximizing employment generated through harvesting and silviculture by employing ecologically responsible partial cutting techniques.

Additional management goals for W1832 are:

- To improve timber quality and quantity by developing mixed species, multi-layered, multi-aged forest stands.
- To improve ecosystem health and resiliency by controlling forest stocking and managing to improve stand vigor.
- To achieve an ecologically responsible balance between (a) prompt regeneration of logged sites using natural regeneration, (b) retaining the ecologically valuable shrub/herb seral phase on logged sites for moderate lengths of time, and (c) meeting the post harvest regeneration standards set out in B.C. forest policy and legislation.
- To manage the forests of W1832 to achieve a retention or partial retention Visual Quality Objective (VQO).

[1] Large standing green trees, large standing snags, and large fallen logs. Standing snags and fallen logs are often referred to as coarse woody debris.

[2] Biodiversity protection at the landscape level is also important, but is beyond the scope of a Woodlot Licence.

- To maintain and, where necessary, restore biodiversity components such as shrub patches, old growth structures, riparian ecosystems.
- To provide forest recreation opportunities for the community which do not conflict with water management or forest management objectives.
- To provide a accessible demonstration forest of partial cutting options in the Interior Cedar Hemlock biogeoclimatic subzone.

The methods proposed to achieve these goals are outlined in Section 6 below.

## 3 Proposed Annual Harvest Volume - Summary

We propose an annual timber harvest volume of 1,043 $m^3$ for all of W1832. This is distributed between the crown and private land portions of the licence as shown in Table 1.

| Strata | Area (hectares) | Proposed Annual Harvest Rate (cubic meters) |
|---|---|---|
| Schedule A Land Private Land Portion | 21.2 | 10 |
| Schedule B Land Crown Land Portion | 598.2 | 1,033 |
| Total: | 619.3 | 1,043 |

Table 1: Summary of Proposed Annual Harvest Rate for entire W1832.

Much of the private land portion of the woodlot has been recently logged. The timber productivity attributed to the private land portion of the woodlot on a per hectare basis is low because the yield for the area is based on the residual post logging co-dominant stocking on the site, not on post-logging regeneration. Once we have established that a new crop of trees is growing on the site, the yield from the private land portion will rise.

The process used to determine this initial proposed annual harvest volume is discussed in Sections 8 and 9 of this Management Plan. One important issue will be addressed immediately, however.

The economic accessibility of the upper half of the crown portion of W1832 is not known. The location of this area is shown in Figure 1, and is hereinafter referred to as “the upper area”. The upper area can only be reached by a road which crosses extensive areas of steep, very rocky slopes in the center of the woodlot. This road location has been verified in the field, and is feasible from an engineering perspective. A road constructed in this location would be stable, as it would be cut into bedrock, but would also be expensive. It is not known if the value of the timber productivity in the upper area offsets the cost of the access road.

Operable portions of the upper area were included in the potential timber management landbase when deriving the 1,043 $m^3$ per year initial annual harvest volume estimate for all of W1832. However, we believe that it is inappropriate to log at this rate before the issue of access to the upper area is resolved. We have agreed with the Ministry of Forests to constrain the initial harvest rate for W1832 to the volume attributable to the portion of W1832 beneath the upper area. Therefore, the proposed initial harvesting rate for W1832 is 618 $m^3$ per year, as shown in Table 2.

| Strata | Area (hectares) | Proposed Annual Harvest Rate (cubic meters) |
|---|---|---|
| Accessible Lower Slopes | 356.3 | 618 |
| Upper Area with Economically Uncertain Access | 263.1 | 425 |
| Total: | 619.4 | 1,043 |

Table 2: Summary of Proposed Annual Harvest Rate by Accessibility Class.

The licensees will carry out appropriate field surveys, in cooperation with the Arrow Forest District, to generate a reliable cost estimate for the road in question within the first two years of the period covered by this Management Plan. Potential for road cost sharing with the Small Business Forest Enterprise Program, and the impact of allocating the road cost over 10 years development in the woodlot, will also be considered.

If the upper area is deemed economically inaccessible after field based road cost estimates are generated, it will be removed from W1832. A revised Management Plan for W1832 will be prepared which reflects the revised borders of W1832.

If the upper area is deemed economically accessible after field based road cost estimates are generated, a revised Management Plan for W1832 will be prepared which includes the operable portions of the upper area in the accessible timber management landbase. The District Manager may choose to increase the Annual Allowable Cut for the Woodlot based on this information.

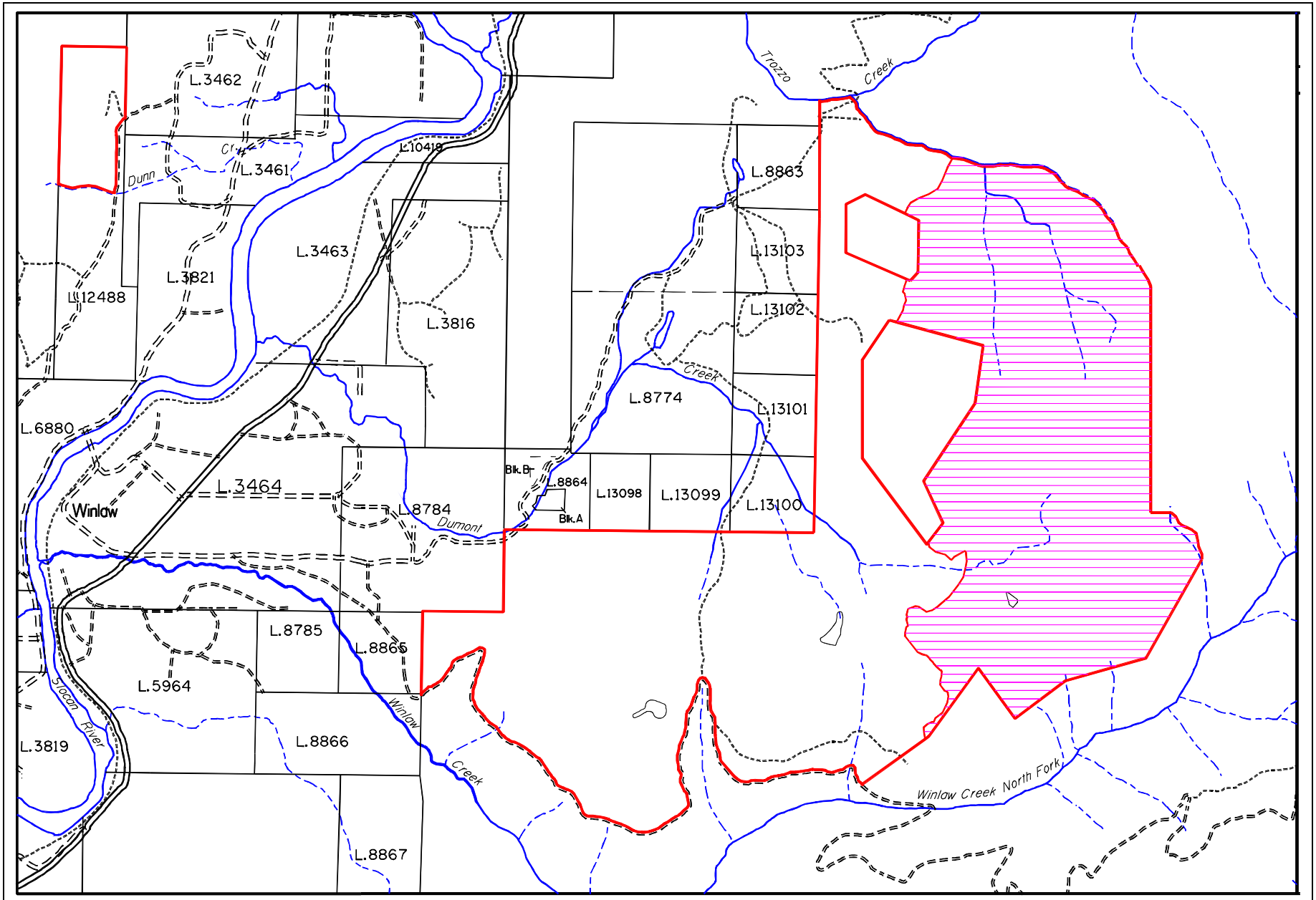


Figure 1: Area of economically uncertain access in upper Crown portion of W1832.

## 4 Accompanying Map Set

This Management Plan is accompanied by a map set composed of 5 maps which show:

Map 1--Management Units

Map 2--Timber Management Landbase

Map 3--Elevation and Topography

Map 4--Watershed Boundaries

Map 5--Field Reconnaissance Traverses

These maps are contained in Appendixes 1 through 5. The maps are referenced throughout the text of this Management Plan.

# 5 Description of Woodlot Area

## *5.1 Location and Area*

The location of W1832 is shown in Figure 2, and in the maps contained in the Appendixes.

**Schedule A Land – Private Land Portion**

Area: 21 hectares NTS Map Reference: 82F063

The legal description of the private land portion is that part of District Lot 12488, Land District 26 (except Plan NEP 20848) which lies west of the access road to the property and north of Dunn Creek. The private land portion of W1832 is the mid portion of the Dunn Creek watershed on Perry's Ridge, 1.1 km due north of the Winlaw Bridge. The parcel is reached via the Slocan River Road and McKean Road. This property is owned by Breakaway Enterprises Ltd.

**Schedule B Land – Crown Land Portion**

Area: 598 hectares NTS Map Reference: 82F063

The crown land portion of W1832 is located on the height of land at the junction of the Trozzo Creek, Dumont Creek, and Winlaw Creek watersheds, immediately above the community of Winlaw. Two substantial excluded areas, totaling 53.2 hectares, lie within the Schedule B portion. These areas were excluded from the woodlot because they contain extensive rock bluffs, talus slopes and steep terrain. The lowest portion of the woodlot is reached at approximately 0.5 km up the Silica Forest Service Road.

## *5.2 Ecological Features*

This section of the management plan describes interesting ecological features and ecosystem dynamics which were observed during field reconnaissance in W1832. Most of these features have management implications, but the emphasis of this section is on identification and description, rather than on management.

### 5.2.1 Bedrock Geology

The bedrock geology within the crown portion of W1832 is typical of the eastern side of the mainstem Slocan Valley. The predominant bedrock type in the area is massive, metamorphosed igneous deposits. The bedrock is strongly and massively layered. Layers are of varying resistance to weathering, and are exposed to the surface in parallel bands which approximately follow the contours of the main valley face[3].

The result of this layering is stepped terrain. The hillside is broken down into a series of low gradient benches, above which rise a steep slope, often a cliff, at the top of which is another bench, then another steep slope, and so forth to the top of the woodlot.

[3] Strike and dip were not assessed.

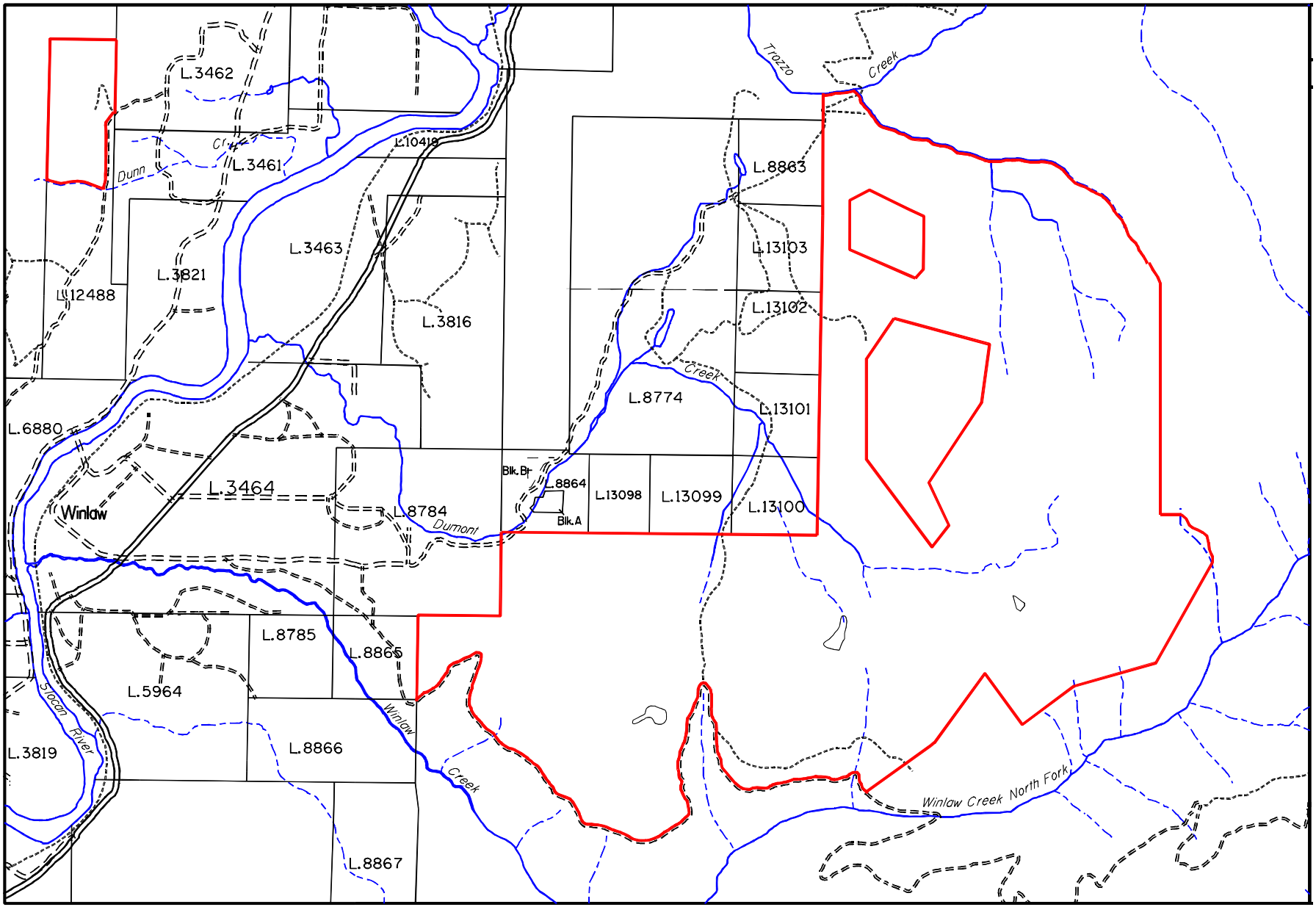


Figure 2: Location of Woodlot Licence 1832

The stepped terrain is strongly dominated by linear features which extend parallel to the contours, north/south along the main valley face. The steps form small, linear drainage basins, which extend from the center of W1832 north to Trozzo Creek and south to Winlaw Creek. The thickest and hardest layers of rock are expressed as belts of steep exposed cliffs with extensive talus aprons which occur in concentric bands along the valley face.

The lower elevations of the crown land portion in the long western arm of W1832 encompass two elevated benches and the long, uniform hillslopes of two pronounced hills. The microterrain in this area is more uniform than the upper slopes, and the bedrock in the area is not strongly striated.

The private land portion of W1832 is typical of the east slope of Perry's Ridge. This area is dominated by the exposed edges of layered gneisic rock, which were deeply fractured during the uplift of the ridge. The rock layers dip towards the north west. As a result of the heavy, fine grained layering within the metamorphosed rock, and the deep fracturing, the bedrock weathers easily. Much of the lower slopes of Perry's Ridge, and the area within W1832, is mantled by a deep layer of coarse colluvium.

### 5.2.2 Impacts of Glaciation

The crown portion of W1832 is situated just north, or upstream, of the former confluence of the Slocan Mainstem and Winlaw Creek glaciers of the last ice age. Most of the woodlot area is dominated by Slocan Mainstem glaciation, but a belt of confused glaciofluvial and morainal deposits occurs along the likely junction between the two glaciers.

#### 5.2.2.1 Striated Bedrock

The Slocan Mainstem glacier moved north to south, parallel to the edges of the exposed bedrock layers in the crown portion of W1832. Because the rock layers have differing resistance to erosion, the overall impact was similar to using a wire brush on a piece of wood:

- Softer rock layers were extensively scraped and eroded, resulting in flatter, lower elevation benches.
- Hard, resistant rock layers were further exposed by the erosion of the softer rocks, resulting in steeper, higher cliffs.
- Soil was scraped away from many hill crests and convex slopes.
- Soil was deposited in long valleys running parallel to the glacier's course.

The coincident pattern of bedrock layering and glacial movement resulted in increasing the degree of north-south linearity of features in the crown portion of W1832.

#### 5.2.2.2 Complex Surficial Geology

Surficial geology refers to the study of the overburden, or soil, which covers bedrock deposits. Overburden can come from a variety of sources, including water deposition, wind deposition, glacial deposition, and weathering in situ.

Surficial geology in the crown portion of W1832 is dominated by glacial deposits. Glaciers scrape away soil material in some locations, but also may deposit accumulated

soil materials beneath the ice sheet as they move, and at the edge of the ice sheet as they melt.

Basal till is material deposited beneath moving ice sheets. Basal till is formed from a combination of preglacial soil materials and eroded rock which has been fragmented by frost weathering and crushed by the vast pressures within the moving ice. As a result, basal till is composed of an unsorted mix of boulders, cobbles, gavel, sand, silt, and clay. Basal till is often compacted and impermeable to water at moderate depth, due to the immense weight of the glacier which moved over top of it. However, the presence of fine particles results in soils with high potential water holding capacity and high potential nutrient exchange capacity. As these soils tend to occur in depressions and valleys which are moisture receiving sites in W1832, the soils derived from basal till are some of the best growing sites in W1832.

Glacial action also scraped away most or all soil from elevated rock hills and convex slopes in W1832. What soil currently exists in these locations is the result of weathering bedrock in situ in the approximately 10,000 years since the ice departed. The resulting colluvial soils are thin and dominated by coarse angular fragments of weathered rock, with 5 to 25% of the soil volume composed of sand and silt in the spaces between the rocks. Such soils may be reasonably fertile, but their moisture holding capacity is very limited, and tree and plant growth is usually limited by summer drought. Such soils tend to occur on elevated, moisture shedding crests and convex slopes, which exacerbate moisture shortages. Some growing sites in W1832 with colluvial soils are moderately productive and suitable for timber management; others are too dry, too sensitive, and/or too low in productivity to be included in the timber management landbase.

The confluence of two large valley glaciers in the neighborhood of W1832 produced some interesting features. A fascinating area of complex terrain is found on the upper boundary of W1832, in the east central region of the woodlot. This area is composed of a jumble of small, non-linear depressions, benches and ridges, with considerable vertical relief between features. It appears that the ice sheets did not move over and scour this area, but rather came together at this site and were relatively stagnant. The bedrock in the area was seems to have been altered by ice plucking and by frost weathering, resulting in the unusual hummocky terrain. During deglaciation, sporadic lateral moraine and glaciofluvial deposits were added to the area, increasing complexity and adding deep soil in some depressions.

Glaciofluvial deposition refers to the deposition of soil materials by water flowing or ponding beside melting glaciers. Valley glaciers are generally highest in the middle of the valley, and slope downwards towards the sides. Thus, as glaciers melt, flowing water runs off the glacier to the sides, carrying a bedload of gravel, sand, and silt released from the melting ice. These watercourses often form lakes between the melting ice and the valley walls. When the flowing water slows down on entering the temporary “ice dammed” lake, the suspended bedload of soil material is deposited in a characteristic, sorted deposit. Where basal till is a jumble of all particle sizes, glaciofluvial deposits are composed of uniformly sized particles, often layered into sands, silts, and gravels. A line of small glaciofluvial deposits was left at the junction between the Slocan and Winlaw Creek glaciers during deglaciation. Some of these deposits are likely quite deep, but they do not appear to extend over large areas.

Deep, coarse textured glaciofluvial deposits can be relatively poor growing sites. Many glaciofluvial deposits are coarse textured, and dominated by infertile sand. As well, the uncompacted, uniform deposits are very permeable to water, which tends to flow along bedrock or silt layers deep in the soil profile, out of reach of tree roots. Precipitation inputs may percolate down to lower soil horizons rapidly, resulting in moisture shortages in the growing season.

A massive glaciofluvial terrace is found at the far southwestern corner of the crown portion of W1832. This terrace is about 800 meters long by 200 meters wide. The surface of the terrace is hummocky and kettled, the result of large pieces of ice becoming embedded in the soil during the formation of the terrace, and then slowly melting away later.

Surficial geology in the private land portion of W1832 is dominated by colluvial processes. As mentioned above, the bedrock on the east slope of Perry's ridge weathers very easily into angular pieces from 1 to 4 inches in size. These rock fragments have accumulated in deep drifts over much of the area, with 10 to 25% by volume of finer soil particles in the spaces between the rocks. Water holding capacity of this soil type is limited, but it is extremely stable and provides an excellent, deep rooted growing medium.

### 5.2.3 Drainage Patterns

5.2.3.1 General Pattern

The crown land portion of W1832 has unusual drainage patterns.

In general, one expects water (precipitation inputs) to run downhill from the top of a slope to the bottom, generally following a path similar to the fall line–the straightest path down hill. This common soil water movement pattern is responsible for many of the richest forest growing sites, as lower slope positions tend to receive water inputs both from precipitation and from soil water inputs from the slope above.

This pattern occurs in the private land portion of W1832 and the lower elevation of the crown portion, but does not hold true in the upper crown portion.

The linear nature of the bedrock and surficial geology, and the resulting stepped terrain, has been highlighted above. Instead of moving through the soil from the top of W1832 to the bottom, following a roughly east-west path, soil water is soon intercepted by one of the many long, narrow north-south valleys which cross the woodlot, and diverted to the north or south. Thus, instead of seeing gradually increasing site moisture and fertility while moving downslope, one sees a repeating pattern of:

- dry, moisture shedding sites, both steeply sloped and relatively flat,
- short stretches of moist lower slopes, and
- moist to wet, narrow valley bottoms

Thus, much of the lower slopes of W1832 are not particularly moister and more fertile than the upper slope areas, and areas of moist sites and/or open water can be found at all elevations in the woodlot. Drainage patterns in much of the woodlot are oriented strongly north-south, across the macro scale hillside, by micro terrain features.

The western arm of the crown portion of W1832 and the private land portion have more uniform slopes, and soil water moves downslope in a more uniform pattern, resulting in

typical lower slope receiving sites which are moister and more productive than the upper slopes.

5.2.3.2 High Elevation Water Sources

The many small drainages in the upper portion of the crown portion of W1832 have a further interesting feature. There are at least five small, year round ponds, wetlands or springs high on the hillside, in otherwise dry ecosystems.

Figure 3: Typical upper slope wetland in W1832.

Instead of moving uniformly downhill to lower slopes by soil percolation, precipitation inputs are captured and channeled by the striated terrain. Where this channeled water encounters impermeable subsurface layers, it comes to the surface. Where the catchment basins are large enough, a year round water supply results. (We believe these water source are year round resources as we have visited them in the dry part of the fall in two successive years, and have found ample water on both occasions.)

The existence of likely year round water sources greatly enhances the value of the open pine forests and dry, south facing shrub fields for wildlife. Rather than having to travel to the bottom of the neighboring North Fork valley on a daily basis for water, animals can remain high on the hillside with easy access to a variety of forage resources.

### 5.2.4 Extensive Areas of Shallow Soils

The moving glaciers scoured the soil from many areas in the crown portion of woodlot, but most extensively on hillcrests and convex slopes. Ecotypes MU 2, MU 3, and MU 5 on the management units map are areas with shallow soils. A portion of the shallow soil area is excluded from the woodlot by the two central gaps in W1832.

The area above the central rock band contains many sites with shallow to moderately shallow colluvial soils over gently domed bedrock. The terrain shape results in rapid runoff of precipitation, and increases site dryness. These sites have low biological productivity, and are dominated by ecologically sensitive areas. Road and trail construction is difficult in this terrain, and will be constrained to intervening valleys with deeper soil deposits wherever possible.

The upper areas of the two hills in the western arm of the crown portion also have shallow soils, with similar limitations.

### 5.2.5 Dry, South Aspect Slopes

The southern edge of the crown portion of W1832 runs along, and includes part of, a series of dry, south aspect slopes which drop steeply into Winlaw Creek. This ecotype is dominated by open grassland, interspersed with shrub fields of ceanothus, willow, aspen and ocean spray, and thickets of Douglas-fir and ponderosa pine trees. This ecotype is identified as MU 1 on the management units map.

The steep, south facing slopes are recognized as important winter/late spring ungulate range, and are habitat for many other species of birds, small mammals, and reptiles.

Figure 4: Grassland on step south facing slopes, showing encroachment of coniferous trees.

Management of the open grasslands is a difficult issue. The grasslands and the ungulate browse species can best be managed by periodic, appropriate burning. This renews the forage and browse species, and prevents the encroachment of forest trees into the open areas. Appropriate management was likely carried out by the Sini'xt prior to 1890, and has been carried out by local the wildlife club in recent history. However, controlled burning has been delayed for many years at this time, resulting in a decline of habitat value and the buildup of high levels of dry, fine fuel. When the slope is eventually ignited (by planned ignition, natural event or accident), it will likely burn with a hotter fire and a more aggressive fire than desirable. As the steep, grassy slopes lead directly up to the forested areas of W1832, and thus to the Winlaw and Dumont Creek consumptive use watersheds, this is a relatively high risk situation. Fire is required in this ecosystem, and will occur eventually. Human objectives of sound watershed management, of sound wildlife habitat management, and of moderating the risk of uncontrolled wildfire, can likely best be met by a carefully planned program of prescribed burning in this ecotype.

### 5.2.6 Rock Bluff / Talus Slope Complexes

.A central belt of cliffs, steep slopes and rock outcrops extends across the middle of the crown portion of W1832 from north to south. These cliffs are the predominant ecological and visual feature of the central woodlot. A substantial portion of the central cliffs is excluded from the woodlot by the two central gaps in W1832.

The cliffs are discontinuous, and are separated by areas of steep, rocky slopes and by talus slopes. The cliffs range from approximately 3 to 20 meters in height and from 10 to 100

meters in length. The larger cliffs have extensive talus aprons extending for 20 to 100 meters downhill. Some cliffs and/or talus slopes are sparsely vegetated with Douglas-fir forests and shrub communities, while others are bare rock.

Long, flat benches are found at the lower edge of many of the cliffs and associated talus slopes. Several of these benches contain ponds or wetlands with year round water supplies. Others support dense deciduous shrub communities.

Figure 5: Talus slope and associated ecologically sensitive forests.

The lower potions of many talus slopes have accumulations of organic material which support unusual plant communities on these exposed sites, which are subject to temperature extremes and frequent drought. The cliff/talus complex thus contains a range of unique habitats not found in other, more forested, portions of the woodlot. These ecological resources are very sensitive to disturbance from human trampling and misuse, but are also likely of great recreational interest to persons interested in plants and ecology.

The cliff complex presents a major engineering challenge for forestry activities within the crown portion of W1832. Approximately 42% of W1832 lies above the cliff belt, and can only be accessed by a road which rises through the cliffs. The engineering and economic feasibility of constructing such a road is a major consideration in planning forestry activities in W1832.

The cliff complex is also the prominent visual feature of the woodlot from the populated areas of the Slocan Valley. The viewer's eye is immediately drawn to the gray openings in the otherwise uniform forested landscape.

### 5.2.7 Complex Vegetation Patterns

#### 5.2.7.1 Vegetation Types Found

As is suggested by the above discussion of the complexity and variability of soil depth, site moisture, and terrain, and as is shown on the management unit map, W1832 contains a wide range of ecotypes and complex vegetation patterns. The average management unit polygon area is only 3.5 ha in area, and the magnitude of the ecological change between neighboring polygons is often significant.

Common vegetation types include:

- Small diameter larch, pine and Douglas-fir forests on dry, rocky sites.
- Medium to large diameter, open Douglas-fir forests on steep[4] hillsides, often with colluvial soils, often on ecologically sensitive sites.
- Large diameter, closed canopy Douglas-fir, cedar and larch forests in moist valley bottoms and riparian ecosystems.
- Large diameter Douglas-fir forests on good growing sites at the bottom of long, uniform slopes.
- Large diameter, open pine stands on medium quality, upper elevation growing sites.
- Very small diameter pine stands on poor growing sites.
- Open, south aspect grasslands with dry site shrub communities.
- Aspen forests.
- Wetlands and fens.
- Unusual, drought resistant perennial herb communities on talus slopes.

Figure 6: Uniform lodgepole pine forest on good pine growing site.

5.2.7.2 Biogeoclimatic Classification

The B.C. Biogeoclimatic Ecosystem Classification System (BEC) is a method for identifying and describing ecosystems and vegetation patterns based on climate, vegetation, and site characteristics. It is a hierarchical system, with nested classifications ranging from the very specific (site series phase) to the very broad (biogeoclimatic zone).

The BEC system is an important tool for communication among land and forest managers. It facilitates exchange of information by allowing practitioners to ensure that they are referring to the same or similar ecosystems in a discussion.

W1832 lies within two BEC subzones, the Dry Warm Interior Cedar Hemlock Subzone (ICH dw) and the Columbia Shuswap Moist Warm Interior Cedar Hemlock Subzone Variant (ICH mw2). The mapped boundary between these two subzones closely follows the boundary of the area of economically uncertain access

Figure 7: Variable density mixed pine/larch/Douglas-fir forest

[4] 40 to 70% slope gradient.

shown in Figure 1. The ICH dw is lower slope; the ICH mw2 is upper slope. The following information on these BEC classes is drawn from Braumandl and Curran (1992).[5] This following descriptions highlight the average features of each subzone; hotter, colder, wetter and dryer areas are of course found in each subzone, and are identified at the site series level of classification.

**ICH dw**

The private land portion and the lower elevation crown portion of W1832 lie within the ICH dw subzone, as does the populated area of the Slocan Valley. This subzone has very hot, moist summers and very mild winters with light snowfall, by British Columbia interior ecosystem standards. Soils generally dry out for periods in the late summer. Snowpacks are shallow and of short duration, which, combined with the mild climate, result in no significant soil freezing.

Natural climax forests within the ICH dw are composed of cedar and hemlock, but, as a result of extensive forest fires around 1900 and extensive logging, very few climax forests exist. Fire origin stands of Douglas-fir and larch are very common.

The ICH dw is the most diverse subzone in B.C. in terms of tree species. It contains 14 commercial tree species, and some plant species which are rare within the province.

The major role of fire in the ICH dw has resulted in the creation of scattered, remnant old growth stands. Maintenance of these old growth habitats is key to wildlife protection.

**ICH mw2**

The ICH mw2 is similar to the ICH dw, but has some significant ecological differences, as would be expected moving upslope. The ICH mw2 covers the upper crown portion of W1832, roughly the same area shown as "economically uncertain access" in Figure 1.

The ICH mw2 has hot, moist summers and very mild winters with light snowfall, by British Columbia interior ecosystem standards. Soils may dry out for periods in the late summer. Snowpacks are of moderate depth and duration, which, combined with the mild climate, prevents soil from freezing to any significant depth.

Natural climax forests within the ICH mw2 are composed of hemlock and cedar, but, fire origin stands of Douglas-fir, larch, spruce, hemlock and cedar are much more common.

The main vegetation differences between the ICH mw2 and the ICH dw are that "hot climate" tree species such as grand fir and ponderosa pine are rare of absent from the ICH mw2, and that the understory in the ICH mw2 tends to be dominated by moss and herbs, rather than shrubs.

5.2.7.3 Fire and Disturbance History

The majority of the Winlaw Creek watershed, including the crown portion of W1832, was disturbed by forest fire in the early part of the twentieth century. Local history indicates that the fire started at the old Winlaw sawmill in 1912. Based on local history and the

[5] Braumandl, T.F. and M.P. Curran. 1992. A field guide for site identification and interpretation for the Nelson Forest Region. Ministry of Forests Research Branch.

uniform age profile of the current forests, we believe that the 1912 fire was a hot, stand replacement fire which killed the great majority of trees in the forest. Little logging activity has taken place on the crown portion of W1832 to date. Very few stumps have been observed, and what disturbance has taken place seems to be limited to mining activity and possibly some cedar salvage.

The private land portion of W1832 has a similar fire disturbance history. In addition, the private land portion has also been extensively logged in the last 20 years, and may have been partially cut prior to that.

As mentioned above, the open grasslands within and along the southern crown portion have likely had a frequent fire return interval under human management for many years. The last time this area was burned was in the 1970's by the local Fish and Wildlife Association.

Figure 8: Lower forest canopy on a moist bench site.

### 5.2.8 Old Growth Forests

No substantial, contiguous areas of old growth forest occur within W1832.

Many old growth structures (large live trees, large standing dead trees, and large fallen trees) exist within younger forests in the crown portion of the woodlot. These include:

- Concentrations (5 to 10 trees) and individual cedar veterans[6] in moist draws and along watercourses. These trees are 1 meter or more in diameter and generally have hollow trunks, large branches, and damaged bark. They are extremely high value wildlife habitat.
- Occasional Larch or Douglas-fir veterans on dryer slopes. These trees range in size in relation to site quality. Average stems are 60 to 80 cm in diameter, and likely 35 meters tall. The largest stems on the best sites are 120 cm or larger in diameter, and likely more than 40 meters tall. Measured age on a hollow larch veteran was 320 years. These impressive structures provide cavity nesting and denning sites, nesting trees, perching locations, and many other ecological values.
- Scattered very large Ponderosa pine veterans along the southern edge of W1832. These appear to be the only large stems in a large area, and provide unique perching locations overlooking Winlaw Creek Valley.

[6] A veteran is a tree which survived the last major stand replacement forest fire. Veterans are generally well over 100 years old.

- Snags[7]. All of the live old growth classes listed above are accompanied by, and outnumbered by, large standing snags. Some of the snags were likely killed in the 1912 fire and have been standing ever since, while others lived on for many years after the fire and have died more recently. Some of the snags are robust and will remain upright for many years, but others have severely decayed lower trunks and roots and will fall in the near future.
- Logs. The moister portions of the woodlot (valley draws and lower slopes) have a substantial supply of large fallen logs from old growth forests, in varying stages of decay. Both the varying decay rates of the different species of logs and the gradual input of logs over time as trees and snags fall has resulted in a diverse coarse woody debris profile in these sites. The forests on dry upper benches and dry steep slopes contain few to no large fallen logs.

Figure 9: Isolated ponderosa pine veteran.

As mentioned, the 1912 stand replacement fire burned completely through the crown portion of W1832. However, what is not known is whether this fire burned through an extant old growth stand, or whether it burned through a younger forest which contained old growth structures, some of which remain today. The current density of old growth structures suggests the later. Few forest fires completely incinerate 1 meter trees, and such large structures take more than 90 years to rot away after falling to the ground. If an old growth forest had burned in 1912, one would expect to see many more old growth structures in W1832 than are currently found there.

The private land portion of W1832 has a similar fire history. However, the private land portion has also been extensively logged in the last 20 years, and was likely partially cut prior to that. Almost all old growth stems which may have survived the last major fine in the early part of the twentieth century have since been logged, with the exception of a small pocket of twisted Douglas-fir on a rocky outcrop in the center of the area.

[7] Large snags (dead standing trees) and large logs (dead fallen trees) are often described with the technical term *coarse woody debris.*

# 6 Licensee Commitments

## *6.1 Introduction*

The management goals for W1832 were listed in Section 2 above. This section of the Management Plan describes the means by which we propose to accomplish these goals.

## *6.2 Deferring Cut on Potentially Inaccessible Area*

Sustainable timber cutting rates must accurately reflect the area of the timber management landbase and the timber productivity on that landbase.

The economic accessibility of the upper half of the crown portion of W1832 is not known. This area is shown in Figure 1, and is hereinafter referred to as "the upper area". The upper area can only be reached by a road which crosses extensive areas of steep, very rocky slopes in the center of the woodlot. This road location has been verified in the field, and is feasible from an engineering perspective. A road constructed in this location would be stable, as it would be cut into bedrock, but also expensive. It is not known if the value of the timber productivity in the upper area offsets the cost of the access road.

Operable portions of the upper area were included in the potential timber management landbase when deriving the 1,043 $m^3$ per year initial annual harvest volume estimate for all of W1832. However, we believe that it is inappropriate to log at this rate before the issue of access to the upper area is resolved. We have agreed with the Ministry of Forests to constrain the initial harvest rate for W1832 to the volume attributable to the portion of W1832 beneath the upper area. Therefore, the proposed initial harvesting rate for W1832 is 618 $m^3$ per year.

The licensees will carry out appropriate field surveys, in cooperation with the Arrow Forest District, to generate a reliable cost estimate for the road in question within the first two years of the period covered by this Management Plan. Potential for road cost sharing with the Small Business Forest Enterprise Program, and the impact of allocating the road cost over 10 years development in the woodlot, will also be considered.

If the upper area is deemed economically inaccessible after field based road cost estimates are generated, it will be removed from W1832. A revised Management Plan for W1832 will be prepared which reflects the revised borders of W1832.

If the upper area is deemed economically accessible after field based road cost estimates are generated, a revised Management Plan for W1832 will be prepared which includes the operable portions of the upper area in the accessible timber management landbase. The District Manager may choose to increase the Annual Allowable Cut for the Woodlot based on this information.

## *6.3 Watershed Management*

Our watershed management objective is to have no detrimental impact on the quantity, quality and/or timing of flow of water supplies in Dumont, Trozzo, Winlaw or Dunn Creeks.

The requirements to meet this objective cannot be set out in a few sentences. In fact, most of the commitments listed in the rest of Section 6 have a direct bearing on water quality, quantity, and timing of flow. The keystones of our water management approach are to:

1. maintain functioning forest ecosystems,
2. maintain forest cover,
3. minimize site and soil disturbance, and
4. set a sustainable, area based timber harvest rate.

The commitments listed in this Management Plan should constrain disturbance from logging such that it does not detrimentally alter water quality, quantity or timing of flow.

### *6.4 Logging Systems*

Logging operations in W1832 will meet or exceed the restrictions on site disturbance in WLFMR. Specific licensee commitments are to:

1. Use suitable logging equipment to minimize site disturbance. The predominant logging equipment will be a small crawler tractor or, where required due to slope gradient or other factors, a small skyline yarder.
2. Minimize soil disturbance through careful design of all parts of the transportation system, including skid trails. Skid trail design will stress contoured skid trails to minimize water diversion and disruption of natural flow patterns. Skid trails will be located on natural slope breaks wherever possible.
3. Carry out field assessments to identify ecologically sensitive terrain, and remove ecologically sensitive areas from the timber harvesting landbase. Examples of ecologically sensitive areas include sites with:
    - Very shallow soil
    - Very coarse textured soils
    - Very fine textured soils
    - Very dry (xeric) sites
    - Very wet (hygric) sites
    - Very steep slopes (>60% slope gradient, see Point 5 below)

    An area will be deemed ecologically sensitive if a conservative interpretation of soil depth, soil texture, slope gradient, and site moisture regime indicates that timber harvesting will likely result in unacceptable levels of risk of soil mass movement, of sediment delivery into surface water, or of reduction in site productivity
4. Log in appropriate season and terrain combinations:
    - No logging or log hauling will be carried out on saturated soils in spring or at other times of the year.
    - Ground based harvesting during snowfree periods will be restricted to sites with moderate to low (<40%) average slope gradients.
    - Ground based harvesting on steep slopes (41 to 60% average slope gradient) will only be carried out on trails constructed using snow and logging slash. Snow trails have a minimal side cut which is within standards controlling site disturbance from ground based harvesting systems.

- Skyline yarding systems will be used on steep slopes which can not be logged with ground based systems in appropriate snow conditions.

5. Reserve the option of partial cutting using skyline yarding systems on forested sites with very steep slopes (> 60% average slope gradient) if a field assessment by a qualified soils and terrain expert indicates that the site is stable and that cable logging will not result in negative impacts on soil or water.
6. Respond to changes in site moisture due to weather events which change soil compaction potential by stopping operations or changing harvest location.
7. Limit timber cutting operations in riparian ecosystems, and bar ground skidding traffic from riparian ecosystems. Riparian ecosystems will be identified in the field, and will include the areas of increased moisture adjacent to creeks, ponds, and wetlands. We will harvest no more than 20% of the net timber yield of riparian ecosystems over time, using only single tree selection methods. The remaining 80% of timber yield within riparian ecosystems will contribute to old growth habitat and coarse woody debris.

   There is a significant difference between the above goals, based on field identified riparian ecosystems, and the riparian management stipulations in WLFMR. WLFMR calls for no Riparian Reserve Zone and a 20 meter Riparian Management Zone around the Class S6 sized streams found in W1832, and for no Riparian Reserve Zone and a 30 meter Riparian Management Zone around the Class W4 sized wetlands found in W1832. WLFMR specifies significant restrictions on logging activity in Riparian Reserve Zones which protect riparian ecosystems from disturbance, but no special restrictions are specified for Riparian Management Zones.

   We believe that protection of riparian ecosystems is required, but we are not confident that 20 meter fully protected buffers on both sides of water features and 30 meter fully protected buffers around wetlands are appropriate in W1832, given the small size of the ephemeral creeks and wetlands which we have mapped. However, we are required by regulation to use buffers of these widths, although the management approach within the buffers is not stipulated.

   We will therefore translate the above combination of stated goals and regulated buffer widths to the following: We will harvest no more than 50% of the net timber yield of Riparian Management Zones over time. The remaining 50% of timber yield within Riparian Management Zones will contribute to creation and maintenance of old growth habitat and coarse woody debris. Leave trees, old growth structures, and coarse woody debris will be concentrated in the riparian ecosystem within the Riparian Management Zone.

   There is a direct conflict between this goal and Goal 6.6-2 below. The road location to the upper portion of the woodlot crosses several riparian ecosystems, and runs beside two small elevated ponds on upper benches. The road will disturb riparian vegetation in these locations.
8. Manage exposed soil areas which are potential sediment sources through prompt seeding with erosion control mix after disturbance.
9. Bar the use of chemical pesticides.

10. Require that petroleum waste and other waste be properly handled and removed from the site for disposal or recycling.

### *6.5 Silvicultural Systems*

References to silvicultural choices and systems occur throughout this Management Plan, in sections devoted to wildlife habitat, coarse woody debris management, stand improvement, regeneration, and visual quality management. Rather than repeat all of the specific goals and commitments related to silviculture in this location, only a few basic commitments will be made. This section should be regarded as including the various other statements made about silviculture in the rest of this Management Plan.

Silvicultural commitments include:

1. Forest cover will be maintained at all times on the timber management landbase outside Management Units 13 and 15 through the use of uniform partial cutting. Group selection using small openings may also be used to regenerate shade intolerant species, such as western larch.
2. Management Units 13 and 15 contain dense, even aged pine forests with few wind firm, healthy stems suitable for leave trees. Small clearcuts which retain any healthy, windfirm trees available on the site may be used in these two specific Management Units.
3. Broadcast slash burning will be avoided. However, small broadcast burns will likely be required for wildlife habitat maintenance[8], and for natural regeneration of fire dependent tree species such as western larch.
4. Approximately 15% of net site productivity will be directed towards full cycle trees[9].
5. Reestablishment of conifers after logging will be by natural regeneration from leave trees on the site, within the constraints imposed by the WLFMR and by available seed sources.

### *6.6 Road Construction and Maintenance*

Road design, construction and maintenance are critical factors in managing the impact of logging on water quality, quantity, and timing of flow. Road standards and drainage structure standards are extensively regulated by WLFMR, and reproducing the 14 pages of relevant standards from WLFMR in this document is not appropriate. The commitments contained in this section are constrained by the legal requirements of WLFMR, but are not (in our opinion) in conflict with the guiding legislation.

We make commitments to:

1. Ensure that road system design meets total chance planning standards. In brief, this means that the timber management landbase should be accessed with as few roads as possible, and that the eventual need for access to all parts of the landbase should be considered when designing road systems.

[8] See Section 6.7.2.

[9] See Appendix 6

2. Where possible, locate roads using natural terrain features to minimize site disturbance, ecological impacts, and impacts on water resources. This commitment cannot be absolute because the need will arise to cross short stretches of ecologically sensitive terrain to reach favorable road building terrain beyond.
3. Minimize road running surface width to the lower limit which will be permitted by the MoF and reasonable safety considerations. Our objective is to construct to a Road Class 6 standard (4 to 4.5 meter wide running surface), or narrower. Turnouts will be provided by landing locations required for future harvesting.
4. Minimize road clearing width to lower limit which will be permitted by the MoF and reasonable safety considerations (approximately 10 to 15 meters in width). The objective is to minimize the hydrologic and visual impacts from the linear clearcut which results from road construction.
5. Manage exposed soil areas which are potential sediment sources through prompt seeding with erosion control mix after disturbance.
6. Design and maintain drainage structures to ensure that water flow is not impeded, and to ensure that natural drainage patterns are maintained.
7. Develop and follow a seasonal road inspection and maintenance procedure to ensure that roads, ditches and drainage structures will perform as designed in spring thaw and rain events.

A potential concern with regard to our ability meet our road construction commitments is the possibility that the MoF Small Business Forests Enterprise Program (SBFEP) will utilize our main woodlot access road for logging activity in the upper part of the Trozzo Creek watershed. We understand that the SBFEP is willing to consider operating on minimum safe road widths to respect our Woodlot management goals.

## *6.7 Wildlife Habitat - Biodiversity*

### 6.7.1 Distributed Habitat Resources

Ecologically responsible forest management can lead to increased habitat for some wildlife species. The following types of wildlife habitat resources will be managed for in W1832:

1. Early successional shrub patches. These areas will provide forage for mammals, and nesting and foraging habitat for songbirds
2. Large old trees and snags. Management of old growth ecological resources is a complex matter. Decision making must consider worker safety, the ecological value of these structures, and timber management goals. The following general guidelines will be applied:
    - Current old growth patches will be protected by reserve zones as required for ecosystem protection and for worker safety.
    - Individual old growth stems and snags inside logging blocks will be retained or will be felled to produce CWD based on the specific situation. If the stem is assessed to be stable or relatively stable, it will be retained, or retained with a worker safety buffer if WCB regulations require. If the stem is assessed as unstable and ready to fall naturally, it will be cut and left on site to create CWD.

- We will avoid felling unstable old growth stems during the breeding season for birds and mammals. Stems which are observed to contain active nests or dens will not be felled.
- Stand management practices will designate full cycle trees to remain on site in perpetuity. The management goal is to create a distributed population of large, old trees for wildlife habitat, and eventual creation of coarse woody debris. These structures will benefit cavity nesting birds, bats, small mammals and large perching birds.

3. Forest cover. As we plan to maintain partial forest cover at all times, many animal species will be able to use the woodlot area for some or all of their habitat needs.
4. Dense forest cover. Patches of dense, naturally forest cover will occur on forested ecologically sensitive areas and in riparian zones, and in any areas which we choose to designate as habitat reserves following further inventories and planning.
5. Riparian connecting corridors. The special management approach around all creeks, waterbodies and wetlands will form connecting corridors of dense forest cover extending throughout the woodlot.
6. Management practices will provide habitat for soil organisms by:
   - Maintaining forest and vegetation cover.
   - Minimizing soil disturbance and maintaining the natural soil profile.
   - Barring pesticides.
   - Avoiding slashburning
   - Maintaining current stocks of coarse woody debris through careful logging, and planning to replenish existing stocks over time.

### 6.7.2 Ungulate Winter Range

The south west portion of the woodlot will be managed for ungulate range. This area is shown on Map 2 in Appendix 2. We will work with the local community and wildlife biologists to develop and implement a habitat improvement plan for this area. This site contains extensive deciduous brush fields, which are now overmature and do not provide the quality and quantity of browse which they could. Many stems are severely hedged, and others are now too tall to be accessible. Browse rehabilitation through mechanical treatment or prescribed burning appears to be required. Prescribed burning to manage habitat resources is discussed in Appendix 8. We are not able to commit to directly perform habitat improvement work, but we do commit to try and facilitate required work. Timber harvesting in the forest types identified as a component of the ungulate management area will be carried out as part of a program to improve habitat values, not to maintain timber productivity.

## *6.8 Forest Stand Improvement*

Our management goals for W1832 include improving both timber quality and quantity and improving ecosystem health and resiliency. These goals are not incompatible in a partial cutting timber management regime, and will be achieved by managing stocking to optimize timber production, and by working with natural successional processes to create distributed large, old forest structures and coarse woody debris. The overall level of timber

production will be impacted by diverting a proportion of site productivity into the production of ecologically important structures, but this will be partially offset by careful stand management to maximize growing space use and productivity.

Extensive commercial thinning will be carried out in W1832. Thinning increases the radial growth rates of residual crop stems, resulting in the more rapid production of more valuable products. This can result in an increase in yield of utilizable timber from the site, and a reduction in the proportion of site productivity diverted to small non merchantable timber, which is also of low value as ecological structures. Commercial thinning can also be an important tool for reducing the risk of mountain pine beetle infestations in lodgepole pine stands.

Specific stand improvement approaches which we plan to implement in W1832 are:

1. Developing uneven aged stands where possible.
2. Developing a mix of forest age classes and (as much as possible) species composition across the landscape.
3. Managing stand stocking through precommercial and commercial thinning to grow high quality, large diameter sawlogs, rather than many small trees in overstocked stands.
4. Protecting existing veteran trees, large snags and large fallen trees. In the case of snags, this may mean leaving groups of large living trees in order to avoid safety hazards to workers, per WCB regulations.
5. Allowing a well distributed population of full cycle trees to grow old, die and fall on the site. These stems will replace the current population of veterans, snags and fallen logs over time.

### *6.9 Forest Health Issues*

Jane Taylor, a USDA Forest Pest Management plant pathologist, made the following comments about forest health issues in 1995:

> *The USDA Forest Service has committed to implementing an ecosystem approach to land management. This approach involves the incorporation of forest management practices within a sound ecological framework that puts an emphasis on sustainability and places the production of values in an ecosystem context. The ecological approach considers the associations between ecosystems at various scales and focuses on the vital ecosystem elements of composition, structure, and function.*
>
> *One of the important concepts in ecosystem management is that systems are dynamic and that all components and functions occur within natural ranges of variability at both the temporal and spatial scales. Components such as insects, pathogens, and fire have common or average ranges with occasional outbreak periods which, although are outside of the common range, are still within the natural range of variability. When components of forest ecosystems become imbalanced the health, integrity, and sustainability of the system may be threatened.*
>
> *Dr. Sue Hagle (1992), Plant Pathologist, USDA Forest Service, defines forest health in an ecosystem management context: "Forest health is a condition typified by disturbance factors occurring within the natural range of amplitudes and*

> *periodicities. These functions provide for a natural rate of nutrient and energy flows within forest ecosystems. A healthy forest is a condition in which insects, pathogens, fire, and other agents function within limits set by the variability of natural ecosystems."*[10]

We agree with this definition, and will develop management approaches to forest health issues within W1832 within this context.

Our preferred forest health management approach is to take minimal direct control action, while working to restore forest diversity and to reduce, where appropriate, the habitat suitability for organisms which kill or damage trees suited for timber. Our management approach will adapt to reflect forest health and forest ecology research, and to reflect real world forest conditions. If the specific approaches discussed below lead to systemically increasing populations of destructive organisms, other approaches will be developed and implemented.

The following subsections discuss our current understanding of the types of insects and diseases which threaten coniferous crop trees in W1832 and of the population state of the organisms in question. Our planned forest health management approach to these disturbance agents is also discussed.

### 6.9.1 Mountain Pine Beetle

W1832 contains lodgepole pine stands which are becoming suitable habitat for high populations of mountain pine beetle. Large populations of pine beetle will kill substantial numbers of lodgepole pine and ponderosa pine trees, resulting in significant temporary changes in ecosystem dynamics and possible loss of commercial logging opportunities. Table 3 list the area and a brief description of pine forests within W1832.

| MU # | Area (ha) | Species | CC | Tree Size | Comments | Site Index (age 50) |
|---|---|---|---|---|---|---|
| 12 | 77.3 | Pl50Lw30Fd20 | 50% | 20 cm + dbh | Colluvial Soils, with Es terrain on rock humps. | 17.4 |
| 13 | 28.7 | Pl80Lw10Fd10 | 70% | Moderate | Mixed Pl forest on dryer sites, colluvium | 17.0 |
| 15 | 24.9 | Pl100 | 80% | Moderate | Pure Pl, good wood | 19.5 |
| 16 | 31.9 | Pl100 | 70% | Large Diameter | Large diameter open pine stand, generally in moister hollows between Es terrain. | 24.0 |
| 18 | 16.1 | Pl100 | 80% | Small Diameter | Overstocked Pl and/or Fd on dryer sites, colluvial soils | 12.0 |
| Total: | 179.0 | | | | | |

Table 3: Area and Description of Lodgepole Pine Management Units.

[10] Jane E. Taylor. 1995. Western larch dwarf mistletoe and ecosystem management. In: Ecology and management of Larix forests: A look ahead. USDA Forest Service. Intermountain Research Station GTR-INT-319

As discussed in Appendix 7, pine beetles require medium to large diameter pine stems for population expansion, and require still air in the lower forest canopy to facilitate pheromone communication and mass attack on larger trees.

Our initial reconnaissance work in W1832 indicates that much of the pine forest in the licence are not high quality beetle habitat.

Management Units 12 and 16 contain large pine stems which would help the local beetle population convert from an endemic level to an epidemic level, but these forests are open stands or exist in small clumps between natural openings, with the result that pheremone communication would be difficult on most summer days.

Management Unit 18 has a closed canopy to trap still air near the ground on summer days, but contains small diameter pine (10 to 17 cm) which are not suitable for beetle breeding success and population increase.

Management Units 13 and 15 present a higher risk of beetle population growth, as they combine moderately large diameter pine stems with moderately closed canopies.

We looked for pine beetle signs during field work, but did not perform a beetle survey per se. Beetle activity was noted only if pitch tubes or red attack trees were visible. There are many gray dead pine trees in W1832, and we did not attempt to identify the cause of death of older snags. Gray trees are not involved in current beetle population dynamics, but may be able to provide insight into past beetle activity in the area.

The current beetle population in W1832 is light. Five small groups of 3 to 5 red attack trees noted in September 1999. No green attack trees were found.

Our management approach to pine beetle will be to place a high priority on commercial thinning of stands containing lodgepole pine. This program will have the objectives of:

- Removing the usable pine component from mixed species stands, where it is generally in poor health and a priority for cutting regardless of insect populations.
- Improving regeneration environment for other tree species to increase stand diversity over the long run.
- Reducing crown closure in pure pine stands to reduce habitat suitability for pine beetles by:
    - Increasing vertical air movement through the forest to disrupt pheromone communication between breeding beetles.
    - Increase individual tree vigor to increase the likelihood of a successful individual stem defense against attacking beetles.

This cutting priority will be constrained by access difficulties and water management considerations—the most beetle susceptible forests are in the upper area with economically uncertain access. Due to the importance of water management in W1832, we do not favor increasing cutting rates to salvage or preemptively cut pine forests as a beetle management approach.

### 6.9.2 White Pine Blister Rust

Western white pine is an extremely productive, valuable, and ecologically important species which is afflicted with a non-native pathogen, the white pine blister rust. Blister

rust was imported from Asia, and native white pines have little natural resistance to it. The result has been a substantial decline in the species, both from mortality and because foresters have tended not to plant it following logging due to the widespread disease.

White pines are scattered through the higher site index growing sites on W1832, and blister rust is common. Our management approach to white pine blister rust will be to work to retain white pine in appropriate ecotypes. Methods used will be:

1. Reserving healthy or lightly infected white pine trees from cutting.
2. Planting rust resistant white pine stock beneath open even canopies or in small patch cuts on suitable sites. We will use rust resistant strains have been developed from naturally resistant individuals in the native white pine population by conventional plant breeding approaches, without resort to genetic manipulation through biotechnology.
3. Possible experimentation with aggressive brushing and pruning practices which are employed in the US Pacific Northwest to control blister rust infestations while growing white pine in relatively pure stands on relatively short rotations (60 to 70 years). This experiment will not be possible in the first five years of operations.

### 6.9.3 Larch Mistletoe

Taylor (1995)[11] made the following comments about dwarf mistletoe in western larch forests:

> *Dwarf mistletoes are parasitic plants that extract water and nutrients from living host trees causing decreased height and diameter growth, reduction in cone and seed crops, and direct mortality or predisposition to other pathogens and insects (Filip and Schmitt 1990).*
>
> *Larch dwarf mistletoe is a native component of western larch forest systems, having co-evolved with its hosts for millions of years (Hawksworth and Wiens 1972). Because larch dwarf mistletoe only grows and reproduces on living trees, ecological forces that have patterned the development of western larch have also played important roles in influencing the ecology and biology of the dwarf mistletoe.*
>
> *How do we approach dwarf mistletoe management in a manner consistent with the concepts of ecosystem management? Traditionally we have emphasized dwarf mistletoe impacts on timber growth and yield and viewed the parasitic plant as a pest that must be suppressed. Dwarf mistletoe management should no longer focus only on timber resource objectives and commodity production, but should also recognize the value of dwarf mistletoes as functional components of forest ecosystems in which they occur…..*

The entire article is reproduced in Appendix 9.

Control of, rather than eradication of, mistletoe is our objective. The western larch component in some stands on W1832 has a moderate mistletoe infection level. As we hope to achieve larch regeneration from seed trees in some areas, and do not plan to create large openings, widescale eradication of mistletoe sources will not be possible. A high

[11] Ibid.

cutting priority will be placed on young (80 to 100 year old) infected trees during initial logging in a area. Larch veterans are also infected, but these giant old trees are critically important ecological resources, and will not be cut to reduce mistletoe infection sources.

### 6.9.4 Root Diseases

Root diseases are endemic in second growth western coniferous forests. Most coniferous tree species have associated pathogenic fungi which can attack their root systems. The effects of root diseases range from slower growth (due to root loss and diversion of resources to combat the infections) to tree death. Root diseases are persistent in the soil, and often spread from tree root to tree root through the soil.

As explained by Schowalter et al[12], root diseases are a natural ecological component which become more effective at killing tress when ecological dynamics are disturbed. Accepting some losses to root disease while working to modify ecological conditions to be less favorable to root diseases is the only viable long term control mechanism.

We looked for evidence of root disease infestation during field work, but did not perform a root disease survey per se. Root diseases were noted in locations with blown down trees which exposed rotten roots, with pockets of progressive mortality, with many broke stubs, and/or with snag concentrations. The species of diseases present were not identified.

The main root disease pockets we identified are on dry, south facing slopes along the southern border of the woodlot. These open, diverse stands are components of the ungulate range area. Root disease in this context is an important disturbance agent which maintains forest openings, stand diversity and browse resources in the ungulate range, not an ecosystem health problem.

In the remainder of the woodlot, observed root disease infections were scattered and discontinuous. At the noted infection level, root diseases are valuable creator of forest diversity and snags, not a forest management issue. At this time, we do not plan to make root disease areas a high cutting priority.

We will address root disease issues with the following steps:

1. Stand management to increase rhizosphere health and diversity, especially the creation of coarse woody debris.
2. Increasing birch stocking in severely affected areas. Birch trees are immune to most root diseases of conifers, have commercial value, and radically alter soil conditions by producing rich deciduous litter and by hosting free living nitrogen fixing bacteria. As a resistant species, birch supplies no food for existing root disease colonies. The combination of soil modification and starvation is believed to have significant treatment properties.[13]

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[12] Integrating the Ecological Roles of Phytophagous Insects, Plant Pathogens, and Mycorrhizae in Managed Forests. Tim Schowalter, Everett Hansen, Randy Molina and Yanli Zhang. In: Creating a Forestry for the 21st Century. Island Press. 1997.

[13] Simard, Suzanne and Alan Vyse. 1994. Paper birch: Weed or crop tree in the interior cedar-hemlock forests of south British Columbia. In: Interior Cedar-Hemlock-White Pine Forests: Ecology and Management. David Baumgartner, Ed. Washington State University.

3. Favoring resistant conifer species for leave trees. Most root diseases are associated with host conifer species which they readily attack, while other species are somewhat resistant, and some species are apparently immune. Due to high genotypic variability among fungi and host trees, and the long time frames involved, predicting resistance can be difficult. However, coniferous tree species which are believed to be resistant to an identified the root disease on site will be favored near known infection centers.
4. Utilizing available biological innoculants against root disease fungi on a trial basis to control the ecological impacts of man made disease vectors (cut stumps).
5. Where suitable in the context of other management priorities, planting disease resistant tree species in identified infection centers.

### *6.10 Regeneration*

The following discussion of regeneration approaches is constrained by the requirements of B.C. legislation and forest policy, which state that harvested areas shall be restocked within 7 years of logging, and shall contain free to grow trees within 15 years of logging. These constraints will affect our silvicultural and regeneration choices, but not our general goals.

Reestablishment of conifers after logging will be by natural regeneration from leave trees on the site as much as possible, within the constraints imposed by available seed sources and by regeneration environment. Natural regeneration:

- Ensures trees from a genotype suited to the site remain on the site
- Avoids root deformity problems associated with both container and bare root stock
- Allows natural selection of best growing stock
- Interacts naturally with deciduous shrub layer on site

The main control of regeneration delay is management of the regeneration environment, which in turn is controlled by regulating harvesting intensity/leave tree density. Our experiences in partial cutting in the Slocan Valley indicate that retaining a fairly high canopy closure in residual stands suppresses deciduous shrub growth. However, maintaining too high a canopy closure also suppresses coniferous regeneration. We will manage canopy closure throughout the woodlot to try and create optimum conditions which allow for a balance between brush and regeneration growth.

The optimum canopy closure to achieve this end varies with site quality, site moisture, slope and aspect. We will conduct trials of various leave tree spacing/canopy removal levels on small areas, and will monitor results. This is a continuation of work we have been doing for many years.

While our management goal is to ensure prompt regeneration of conifers through control of the regeneration environment, we wish to maintain a partial deciduous shrub canopy in most cases. In the 1980's, ecologists realized that the deciduous shrub phase was one of the few forest successional phases which actually added nutrients to the forest soil, as well as improving soil structure and chemistry. This has significant implications for long term site productivity. In addition, diverse shrub communities provide habitat for a wide range of bird, animal and insect species, and also have important and only partially understood

roles in rhizosphere maintenance. Once conifers overtop the early seral deciduous canopy, they grow quickly in the rich forest soil produced by deciduous shrub litter.

In situations where the regeneration delay becomes unacceptably long and/or where coniferous establishment is unacceptably low per regulations, planting will be used to achieve regeneration. Manual brush reduction will be carried out as required to achieve free to grow status as required.

Western larch is a significant component of the current and historical forest types on W1832 and similar ecosystems. Larch is shade intolerant, and seedling establishment and juvenile growth are best on a burned or disturbed substrate.[14] We wish to retain larch forests in W1832. The silvicultural needs of the species will likely require the creation of small openings, seed tree cuts, site preparation and/or small scale burning to prepare a suitable regeneration environment. Planting larch stock in prepared areas will be considered, as an option to trying to coordinate harvest and post harvest treatments with unpredictable natural seed crops.

### *6.11 Visual Quality Management*

Maintaining the visual quality of the lower slopes of the Slocan Valley is a high priority for many residents. We will use a variety of partial cutting approaches which will maintain sufficient forest cover to meet either Retention or Partial Retention visual quality objectives.

Figure 10: W1832 from Slocan River Road, south of Winlaw.
The approximate extent of the woodlot is outlines in white.

[14] Silvics of the Forest Trees of the United States. USDA Forest Service. Agriculture Handbook No. 271. 1965.

Figure 11: The central Slocan Valley from the upper Crown portion of W1832.
All parts of the valley shown here have an unobstructed view of the upper part W1832.

Because the partial cutting techniques we use favor leaving large, healthy trees, the usual visual impact of a logged area is a slight "thinning" of the forest crown. This is usually difficult to see immediately after logging, and becomes even less visible over time.

We will also carry out visual analyses and planning exercises, per the Visual Landscape Design Training Manual published by the Ministry of Forests. We will also incorporate the recent principles of landscape design, as discussed by Diaz and Bell.[15]

We will use the following general visual management principles:

1. Block boundaries will be planned to reflect natural landscape patterns and visual flows.
2. Block boundaries will be feathered and irregular in shape to minimize prominent edge.
3. Natural slope features will be used to minimize exposed visual edges.
4. Partial cutting will minimize the visual contrast between logged areas and forest matrix.

### *6.12 Recreation*

We have noted that partially cut areas in the Slocan Valley receive a moderate amount of recreation use, and we expect this will also occur in the crown portion of W1832. Once access is established, the woodlot will be a relatively short distance from the rapidly growing community of Winlaw. We expect to receive a significant level of recreational use, from hikers, mountain bikers, equestrians, and motorized vehicles.

There are several scenic points within the woodlot, with expansive views over the Slocan Valley. A variety of ecologically significant features (old growth forests, deer habitat,

[15] Landscape Analysis and Design. Nancy Diaz and Simon Bell. In: Creating a Forestry for the 21st Century. Island Press. 1997.

wetlands) also exist. These features could become the focus of a network of trails and or recreation sites. Community involvement will be the key to developing this potential.

Forest recreation can have a high educational component, especially given the types of alternative silviculture which we plan to use. We will erect information signs describing various harvesting a silvicultural operations, and publish an information pamphlet to facilitate a self guided tour in the first five years of operations, once examples of partial cutting exist within the woodlot.

Recreation is a complex issue. People have a right to use crown forests for quiet personal enjoyment, but they do not have a right to adversely impact the interests of other community members or the forest ecosystem while doing so. Recreational use may require management in this domestic watershed area. All parties agree that having humans and domestic animals excreting in domestic water sources is unhealthy and undesirable. Increased recreational use also increases the risk of accidental fires. Potential noise pollution from dirt bikes and all terrain vehicles is a serious concern. Free lance and domestic firewood cutting is often in direct conflict with maintenance of biodiversity and old growth structures. We hope to be able to manage such potential conflicts through a combination of education, signage, and community pressure. If this is not successful, access management through gating may be required.

### *6.13 Community Involvement*

Any direct commitment in a Management Plan to public involvement carries an inherent level of risk. While we are genuinely interested in and committed to communicating with our community, we are also aware that other parties could make a conscious decision to overwhelm our abilities to meet open ended commitments to public outreach, thus placing us in default on our Management Plan commitments. We are therefor guarded in our commitments to public outreach and involvement programs.

We will participate in local land use planning processes and in the preparation and presentation of plans, as required of Woodlot Licence holders. We will endeavor to continue to maintain a positive relationship with community members. All sectors of the community are interested in alternatives to clearcutting, and implementing ecologically and economically sound alternatives to clearcutting is a main management goal for W1832.

We will endeavor to work with the concerned water users during planning and operations in the woodlot. Our goals will be to communicate our intentions, to hear water users concerns and knowledge, and to find reasonable solutions to reasonable concerns. We accept that water management concerns will reduce the timber management landbase within W1832. If possible, we would like to include water users in the planning process so that we can more effectively and proactively address watershed concerns.

The management of the ungulate range portion of the woodlot will be very much a community project. We lack the expertise and manpower resources to carry out necessary habitat improvement and maintenance activities. We would hope to involve local hunters and recreationists in a range improvement planning and operations program.

Developing the recreation potential of the woodlot would also be a community project. Designing, creating and maintain biking, horse or hiking trails in conjunction with the

timber transportation network will require community involvement. Managing recreational use will also require community involvement.

We will conduct on site tours of the Woodlot area for concerned citizens, schools, or other groups to discuss our work in alternatives to clearcutting. Public outreach programs will commence after some initial harvesting has been completed. If the demand exists, we will conduct up to one group tour per month in the accessible summer months.

We will develop a self guided walking tour of harvesting operations and ecologically significant features within the woodlot, once sufficient harvesting has taken place to have a meaningful display. The objective will be to highlight issues of forest ecology and watershed management, and to demonstrate alternative harvesting practices. The infrastructure for this will include a descriptive pamphlet, explanatory signs, and marked trails. We will make reasonable efforts to maintain this infrastructure if vandalism occurs, but we are unable to commit to maintenance regardless of the level of vandalism.

We will also maintain an internet presence to facilitate public access to management plans, operational plans, and other public documents regarding W1832, and to distribute information about the forest management activities underway in the woodlot. We will make reasonable efforts to maintain this internet presence if subject to sabotage or excessive service demands, but we are unable to commit to maintenance regardless of possible developments.

## 7 Resource Inventories

We will conduct the following types of resource inventories in the woodlot area:

1. Access Economics Feasibility Study. The economic accessibility of the upper half of the crown portion of W1832 is not known. The area can only be reached by a road which crosses extensive areas of steep, very rocky slopes in the center of the woodlot. Road constructed in this location would be expensive. It is not known if the value of the timber productivity in area accessed offsets the cost of the required road.

   We will carry out appropriate field surveys, in cooperation with the Arrow Forest District, to generate a reliable road cost estimate for portion of the proposed access road shown on Map 5, Appendix 5, which passes through rocky areas within the first two years of the period covered by this Management Plan.
2. Terrain and Soil Inventory. Collect data about landform, slope gradient, soil type, soil texture, soil depth, soil drainage, soil moisture and any past soil movement patterns. This information will be used to assess terrain stability in the woodlot, to identify ecologically sensitive areas, and to decide if logging is a suitable land use for areas. A substantial portion of this inventory work has been carried out during preparation of this Management Plan.
3. Streamcourse and Gully Mapping. W1832 is within domestic use watersheds. Water courses (permanent and ephemeral) will be followed and mapped to ensure that we have accurate knowledge of water flow patters before operational planning begins to ensure that water resources are protected. A substantial portion of this inventory work has been carried out during preparation of this Management Plan.
4. General Wildlife Inventory. We will collect data regarding the populations and habitats of birds, fish, and mammals that are present within the woodlot area, and/or adjacent to or dependent upon the woodlot. This information will be used to protect, and where possible, improve, habitat.
5. Ungulate Habitat Mapping. The south west corner of the W1832 contains valuable and intensively used ungulate range, which includes open meadows, brushfields and adjacent forested areas. This area should be mapped in detail and habitat use patterns determined. An inventory of this area should lead to a habitat management plan for the ungulate range. We will seek help from local wildlife groups, from Selkirk College, from graduate students in Wildlife Biology, and/or from FRBC funding to carry out this work.
6. Timber Type and Volume Inventory. We plan to collect standard cruise data to measure timber volumes for planning purposes, as well as specific information about the crown height, crown width and health of each tree assessed. This information will be used to develop standard timber volume estimates, and to develop stand profiles which will be used to prepare and explain silvicultural prescriptions. The sampling intensity of the timber inventory will vary over time, starting with reconnaissance level surveys and increasing in resolution and reliability as more information is gathered.
7. Snags and Coarse Woody Debris Survey. Current levels will be assessed , and the information used to develop management plans to define and meet future target levels.
8. Biodiversity Mapping. We are currently aware of several unique habitat types within W1832. These include wetlands, old growth forests in moist depressions, open meadows, and steep talus slopes. These must be delineated and removed from the

timber landbase. In addition, a overall management scheme should be developed to provide necessary linkages and buffers to ensure these areas remain ecologically functional. A substantial portion of this inventory work has been carried out during preparation of this Management Plan

9. Cultural Sites and Cultural Resources. The Ministry of Forests has conducted an Archeological Overview Assessment and an Archeological Impact Assessment which include the W1832 area. We are informed that no archeological sites were found in W1832, and we have no plans to perform further archeological investigations at this time. However, we recognize that additional investigation by third parties and/or local knowledge may result in differing findings. Any archeological or historical use sites found in W1832 in the future will be surveyed in more detail, and protected.

We will not fully inventory the entire woodlot area immediately. Further work on Inventories 2, 3, 4, 6, 7 and 8 will proceed as an adjunct to timber management planning. Work on Inventory 5 will be carried out as funding and/or volunteer expertise is identified. Inventory 9 will proceed as archeological or cultural sites are identified by detailed surveys or by interested parties.

Data collected and compiled during resource inventories will be used to refine the AAC for the woodlot, and to guide operational plans.

# 8 Methods Used in Preparation of Management Plan

## *8.1 Field Work*

Map 1 shows the field reconnaissance traverses carried out in W1832 to provide information for this Management Plan. The purpose of the traverses was to gain a reconnaissance level understanding of the following factors within W1832:

- bedrock geology
- surficial geology
- drainage patterns and watershed divides
- identification of wetland areas
- ecological sensitivity of the terrain
- ecological limits to development activity.

Traverse locations were selected based on air photo interpretation prior to field work. Each traverse location was selected to combine:

- dispersed geographic coverage of the woodlot area
- an air photo identifiable tie point
- assessment of major forest ecosystem and terrain types in the woodlot.

Each traverse was carried out by a two person crew using hand compass and a 75 meter nylon chain. Traverses were tied to air photo identifiable features in at least one location, more often if possible.[16] Traverses are oriented across contours (i.e. up and down the hill) in order to ensure thorough sampling of ecosystem variability.

A strip map showing the following information was maintained on each traverse:

- ground slope
- rock outcrops
- areas of shallow soil over bedrock
- gullies
- watercourses
- wetlands
- riparian ecosystems
- ecologically sensitive areas
- moderate and high usage wildlife habitat
- forest type boundaries
- forest type composition
- forest ecosystem health issues
- unusual ecosystems and/or important ecological resources

[16] Traverse Line 3 is tied to a legal survey pin. Only this one pin has been found to date along the boundary of W1832.

Site index[17] was measured in representative ecotypes in potentially operable forest areas, per Ministry of Forests specifications (Thrower et al 1994)[18]. Site index measurement locations were selected to show average growing conditions in common forest ecotypes, in order to produce representative estimates of timber growth rates within W1832. Most of the tree sample cores were saved and available for use in growth rate analyses in the future.

Information gathered from the field reconnaissance was used to delineate management units (ecosystem types), to delineate the approximate operable timber management landbase, and to estimate the timber productivity on the timber management landbase.

Considerable field time was also invested in an initial haul road location to explore potential access to the upper portion of W1832. A feasible road location (in engineering terms) was identified which links the upper third of W1832 to the existing Silica Forest Service road, and other potential routes through the central belt of rock bluffs in W1832 were ruled out. The economic feasibility of this road is a separate issue, as discussed in Section 3.

## *8.2 Mapping*

### 8.2.1 Map 1: Management Units

The land within W1832 was stratified into 24 management units , or ecosystem types. Each management unit shows the location(s) of an often discontinuous type of forest which is sufficiently similar in vegetation cover, terrain, soil, and growing site potential to be managed in a similar way. These initial management units are based on reconnaissance level field surveys and air photo interpretation, and will be revised over time as further field assessment and operational planning are carried out in W1832.

The management unit mapping covered the two exclusions in the crown portion of W1832. This was done to assist in the photo to map transfer process, and to identify the types of ecosystems within these defacto protected areas within W1832.

The management units were delineated on 1:18,000 black and white air photos take in July 1965. These older air photos proved to be ideal for the task. They are of extremely high image quality, and were taken when the forests in W1832 were approximately 55 years old. Our field work showed that W1832 contains many areas with shallow soils over bedrock and bedrock outcrops, which impose ecological limits on human activity, and which are unsuitable for timber management. Many of these ecologically sensitive rocky site are impossible to see on more recent air photographs, as the crowns of the scattered Douglas-fir trees in the area have grown large enough to conceal the rock beneath the trees. On the 1965 air photos, the younger trees have not yet obscured the majority of the rocky sites, which can therefore be identified and removed from the timber management landbase. The boundaries of open, grassy areas, and of many forest type changes, also are more clear on the older photos than on newer air photos.

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[17] A quantification of the timber growing potential of a forest site based on a measurement of tree height and tree age.

[18] Thrower, J.S., Nussbaum, A.F., and DiLucca, C.M. 1994. Site index curves and tables for British Columbia: interior species. 2nd Edition. B.C. Ministry of Forests Research Branch.

Polygon showing distinct ecosystem types ranging from 0.1 ha to 18.5 ha were drawn on the air photos using stereoscopic photo interpretation and information from the field reconnaissance. Each polygon boundary indicates a change in one or more of vegetation type, terrain type, and/or soil type. Each of the typed air photos was examined several times to ensure that the standards used to delineate type changes were uniformly applied, and that the polygon linework was accurate and reflected on the ground observations where these were available.

Standards used to identify type changes were:

- Vegetation Type
  - presence/absence of forest vegetation
  - shifts in 20% crown closure or greater.
  - significant changes in stand density
  - significant changes in stand height
  - presence of and density of large snags and fire veteran trees
  - species composition
- Terrain Type
  - slope gradient. The boundaries of slope classes of 0 to 30%, 30 to 60 %, and greater than 60% slope gradient form terrain type boundaries.
  - slope shape (convex, concave, smooth)
  - site moisture and drainage patterns
- Soil Type
  - soil depth to bedrock
  - organic soil and wetland areas
  - soil parent material and means of deposition (morainal, colluvial. glacio-fluvial)

Many of the ecosystem type lines delineated in W1832 reflect a well defined natural boundary between significantly different ecosystems. In such cases, the line on the map is a good reflection of natural conditions—the ecosystem really does change significantly at the mapped boundary. In other instances, the delineated line is the interpreted midpoint of a gradual transition between differing ecotypes. In such a case, the line on the map is a poor reflection of natural conditions—no change is visible at the mapped boundary; but change becomes apparent walking some tens of meters away from the line in either direction.

The resulting map of ecosystem types is a reasonable approximation of landbase conditions, based on air photo interpretation and a moderate level of field verification of the air photo interpretation. Revision of polygon boundaries and reclassification of polygons is expected as surveys and planning continue on W1832. Eventual harvest plans for W1832 will be based on site specific field information, and may include some areas classified as ecologically sensitive in this initial Management Plan. Likewise, some areas currently classified as suitable for timber management may be reclassified as ecologically sensitive as planning proceeds.

For the crown portion of W1832, the ecosystem type linework was transferred from the air photos to a digital map file by scanning and rubber sheeting. The steps followed were:

1. A digital basemap of the W1832 area was prepared from the following sources:
   - MoF NAD 83 TRIM base forest cover mapping
   - Digital file of W1832 boundary from MoF
   - Digital file of Terrain Stability Inventory Level B mapping by Klohn-Crippen Ltd.
2. A set of tie points which can be located on the air photo and on the digital base mapping of W1832 were identified. These included air photo centers and conjugal principle points, roads, and streams. These tie points were marked on the air photos, in addition to ecosystem type linework.
3. The portion of the air photos containing ecosystem type linework and tie points was scanned using a flatbed scanned to produce a color raster image of the typed photo.
4. The red typelines and tie points were isolated from the scanned image file using graphics filters.
5. The typelines and tie points were converted from raster to vector images, and exported to a DXF file format.
6. The DXF file was imported into the GIS. A scaling factor and X,Y correction were used to place the imported image in as accurate a position as possible on the base map, using the marked tie points to asses positional accuracy.
7. Where required, rubber sheeting functions were used to improve the fit of the imported DXF file to the tie points on the base map.
8. The resultant fitted linework was edited by hand to clean up inaccuracies resulting from the digital manipulations.

This approach is sufficiently accurate for the development of a management plan for W1832. The inaccuracy from a scanning and rectification approach to capturing linework from an airphoto will affect the absolute location of some polygon boundaries, which may be offset by 20 to 30 meters from true georeferenced position. However, the absolute area and relative area of polygons is not greatly affected by these errors. Thus, the estimates of timber management landbase and productivity based on this map will be suitable for an initial management plan for W1832.

The management units in the private portion of W1832 were drawn by hand onto the map of the study area, based on air photo interpretation and field traverses in the area.

The map was color themed by management unit. Table 4 contains the area of and a brief description of each management unit.

### 8.2.2 Map 2: Timber Management Landbase

This map is a summary of the information from Map 1, with the addition of two new overlay polygons showing ungulate range and area of uncertain access.

All non-forested and ecologically sensitive management unit were themed as for Map 1, with the exception of riparian ecosystems.

Riparian buffers to map the Riparian Management Zones required by WLFMR were generated around all mapped streams and wetlands using GIS. Buffers widths used were

20 meters (both sides) on ephemeral and permanent creeks, and 30 meters on wetlands. The area within riparian buffers was themed.

Remaining forested management units were then consolidated and themed using leading tree species.

Two ungulate range polygons were delineated. These were drawn using air photo interpretation to estimate the extent of the features which were identified as ungulate range in the field. These areas are shown as a crosshatched overlay on top of the above themes.

A polygon was added to delineate the area of uncertain economic access, based on air photo interpretation. The method used was to identify all areas which were within a long ground skid of lower access road locations. A dividing line was then drawn to mark the upper edge of the area known to be accessible without building the expensive road across the central rocky area. This area is shown as a crosshatched overlay on top of the above themes.

### 8.2.3 Map 3: Elevation and Topography

Contours were interpreted for the mapped area using Pamap 5.2 and a standard digital elevation model.

The themed elevation map was prepared using digital contour information. Index contours at 200 meter elevation intervals were used to produce a polygon layer which was themed to suggest elevation.

### 8.2.4 Map 4: Watershed Boundaries

The crown portion of W1832 contains unusual drainage patterns. Due to deeply striated bedrock and stepped terrain, precipitation inputs tend to be diverted to flow north or south over much of the woodlot, in small channels incised across the main east-west slope.

The watershed divides between Dumont, Trozzo and Winlaw Creeks were delineated based on a combination of field reconnaissance and air photo interpretation. The watershed divide between Trozzo and Dumont Creeks was identified in the field. Much of the divide between Winlaw and Dumont Creeks is easily determined from air photos, but subtle divides in areas of low relief were checked in the field.

An extremely unusual area was identified on the divide between Dumont and Trozzo Creeks. A small stream splits in two on a moist flat right at the watershed divide, and one branch flows west to Dumont Creek and the other branch flows north to Trozzo Creek. Instead of two streams coming together to form one stream, one stream splits into two, which flow to separate watersheds. The hydrology of the flat is extraordinarily subtle—a single uprooted tree could alter the current division of the water significantly. It is notable that the incised channel to Dumont Creek appears too large for the current volume of flow, and the sides of the channel are extensively revegetated and show accumulations of organic material. This suggests that in relatively recent time (<100 years) there was greater flow towards Dumont Creek than in the current diversion pattern, in spring freshet at least.

The boundaries of the watersheds were drawn onto the air photos, and transferred to the digital map file based on their relationship to the management unit polygons.

### 8.2.5 Map 5: 1998-99 Field Work

The field reconnaissance traverses were added to the map based on the air photo tie points identified on each traverse, and the traverse noted of direction and distance traveled. In situations where the recorded tie points were not in the alignment reported by the traverse notes, the traverse was adjusted to fit the tie points.

The preliminary road location to access the upper crown portion of W1832 was also plotted on this map from field notes.

# 9 Proposed Annual Harvest Volume - Rationale

## *9.1 Introduction*

We estimate that a timber volume of 1,043 $m^3$ per year can be sustainably harvested from W1832 in accordance with stated management goals and practices.

Per the directive of the Arrow Forest District, we have used the WOODLOT for Windows Ver 1.7 software package to calculate a proposed annual harvest volume for W1832. This section of the Management Plan explains the derivation of and rationale for the factors and information input into WOODLOT.

As with most user-friendly, semi-automated software packages, WOODLOT is convenient to use but places a very significant barrier between the user and the data set. After extensive research time invested in trying to persuade WOODLOT to output data files containing important information on area and productivity by landbase strata, we admitted defeat and turned to the Silva Timber Yield Model (STYM) and the MoF Variable Density Yield Prediction (VDYP) batch software for this functionality. Therefore, the proposed annual harvest volume for W1832 is determined using WOODLOT, but the information on area and timber productivity per landbase strata below is derived from STYM and VDYP. STYM and VDYP produced an estimate of total potentially available timber productivity of 1,097 $m^3$/year for the sites within W1832, or 54 $m^3$/year more than WOODLOT suggested annual harvest volume. We have chosen to ignore the 54 $m^3$/year discrepancy, rather than eradicate it through a prorated correction.

## *9.2 Landbase and Inventory Data Inputs*

WOODLOT requires the following information for each forest type polygon which is of natural origin[19] and is to be managed using partial cutting techniques:

- Landbase and Administrative Information
  - Polygon number
  - Net Area (operable area which will grow commercial tree species)
  - Forest Inventory Zone
  - Public Sustained Yield Unit number
  - Ownership status
  - Managed or natural forest stand
- Forest Inventory Data
  - Species composition
  - Current stand age
  - Site Index
  - Approximate crown closure at harvest
  - Expected stocking class at harvest

[19] Regrew from natural regeneration after a disturbance, was not planted.

### 9.2.1 Landbase and Administrative Information

Polygon number was drawn from the GIS data file.

Net area was determined for each polygon based on suitability for timber management. This is discussed in Section 9.4 below.

W1832 is located in Forest Inventory Zone (FIZ) E, Public Sustained Yield Unit (PSYU) 129 - Slocan.

Ownership status was drawn from the GIS files.

All stands on W1832 are natural stands, not planted stands managed with juvenile stocking control.

### 9.2.2 Forest Inventory Data

This information was developed for all forested areas in W1832 using the methods described in Sections 8.1 and 8.2 above.

The forest inventory information was gathered at the management unit level. Each management unit is a grouping of discontinuous forest types which are sufficiently similar in species composition, terrain, soil, and growing site potential to be managed in a similar way. These initial management units are based on reconnaissance level field surveys and air photo interpretation, and will be revised over time as further field assessment and operational planning are carried out in W1832.

The forest inventory characteristics of each management unit are shown in Table 4. Note that the areas shown in Table 4 are gross areas, not net operable areas. The derivation of net operable area is discussed in Section 9.4.

WOODLOT requires an estimate of expected stand crown closure and stocking class at harvest. We have made the conservative assumption that current stand crown closure will be maintained under a partial cutting regime; it may well increase in some instances. Stocking class is assumed to remain unchanged.

### 9.2.3 Data Manipulations

Forest inventory characteristics for each management unit were copied from Table 4 to the management unit data layer to generate a simple forest cover map data layer. The management unit map layer also contains ecological sensitivity information per Section 8.2.1 above. The management unit/forest cover data set was overlain with map layers of ownership, riparian management zones, ungulate range, watershed boundaries, and area of uncertain access to generate a data file which contained mapped information for the landbase netdowns discussed in Section 9.4. The data file was moved from GIS to dBase, from dBase to a CSV file, and from the CSV file to WOODLOT.

| MU # | Area (ha) | Species Composition | Age Class | Stocking Class at Harvest | Crown Closure at Harvest | Site Index (age 50) | Tree Size | Terrain | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 27.6 | *Grass/Shrub* | | | | n/a | Non-Forested | Steep | Open, dry, south facing meadows |
| 2 | 5.4 | *Pl100* | 5 | 0 | 30% | 10.0 | Small Diameter | Ecologically Sensitive - Shallow Soil | Pl on shallow soil, ridges |
| 3 | 23.8 | *Fd90Pl10* | 5 | 0 | 40% | 10.0 | Variable | Ecologically Sensitive - Shallow Soil | Fd on shallow soil, ridges |
| 4 | 3.9 | *Fd80At20* | 5 | 0 | 30% | 20.0 | Variable | South Slopes | Brush/Fir/Decid - root rot centers. |
| 5 | 62.0 | *Fd50Pl50* | 5 | 0 | 10% | 10.0 | Variable | Ecologically Sensitive - Shallow Soil | Rock/open (with some forest) |
| 6 | 2.6 | *Talus* | | | | n/a | Non-Forested | | |
| 7 | 1.8 | *Wetland* | | | | n/a | Non-Forested | | |
| 8 | 51.2 | *Fd60Lw20Cw20* | 5 | 0 | 60% | 22.8 | Large Diameter | Flat, Moist, Benches | Large diam. stand on moist flats, often with scattered OG vets, ephemeral creeks. |
| 9 | 62.4 | *Fd100* | 5 | 0 | 60% | 28.1 | Large Diameter | Benches, Moderate lower slopes. | Lower elev Fd Forests, Mb and fGt soils. |
| 10 | 26.1 | *Fd100* | 5 | 0 | 60% | 20.0 | 30 cm + dbh | 20 to 55% slopes | Moderately dry Fd stands, 80% + Fd stocking, colluvial soil. |
| 11 | 40.0 | *Fd50Lw30Cw10Hw10* | 5 | | 70% | 25.0 | 30 cm + dbh | Benches, Moderate lower slopes. | Lower elev Fd Forests, Mb and fGt soils. Slightly moister than MU 9. |
| 12 | 77.3 | *Pl50Lw30Fd20* | 5 | 0 | 50% | 17.4 | 20 cm + dbh | Dry, rolling to stepped terrain | Colluvial Soils, with outcrops of ES 5 terrain on rock humps. |
| 13 | 28.7 | *Pl80Lw10Fd10* | 5 | 0 | 70% | 17.0 | Moderate | Flat to rolling terrain | Mixed Pl forest on dryer sites, colluvium |
| 14 | 50.3 | *Fd80Pl20* | 4 | 0 | 70% | 18.5 | 30 cm + dbh | Moderate to steep terrain | Denser stands, smaller dbh than MU 9 & 11. |
| 15 | 24.9 | *Pl100* | 5 | 0 | 80% | 19.5 | Mod Size | Flat to rolling terrain | Pure Pl, moderate diameter |
| 16 | 31.9 | *Pl100* | 5 | 0 | 70% | 24.0 | Large Diameter | Complex, stepped terrain. | Large diam. open pine stand, generally in moister hollows between ES 5 terrain. |
| 17 | 22.4 | *Fd30Cw30Lw20Hw20* | 5 | 0 | 70% | 22.0 | 40 cm + dbh | Rolling bench | Low elevation forest along SW boundary |
| 18 | 16.1 | *Pl100* | 5 | 4 | 80% | 12.0 | Small Diameter | Flat to rolling terrain | Overstocked Pl and/or Fd on dryer sites, colluvial soils |
| 19 | 7.4 | *Fd40Lw30Pl30* | 5 | 0 | 50% | 20.0 | | | Unidentified timber types. |
| 20 | 5.5 | *Fd80Cw20* | 5 | 0 | 20% | 18.0 | | Moderate Slopes | Sparse overstory, dense choked cedar understory on North aspects. |
| 21 | 19.0 | *Fd60At40* | 3 | 0 | 50% | 27.2 | Variable | Flat to steep terrain | Mixed stand on south to west aspects, along Winlaw Creek valley. |
| 22 | 10.1 | *At100* | 2 | 0 | 90% | 18.0 | Small Diameter | Moderate Slopes | Pure Aspen stand |
| 23 | 8.1 | *Fd50Cw50* | 1 | 0 | 10% | 20.0 | Regen | 30 to 50% Slopes | Recent Clearcut with regen and advanced regen |
| 24 | 10.8 | *Fd100* | 5 | R | 30% | 18.5 | 40 cm + dbh | 50 to 60% Slopes | Partial Cut - Codominant leave trees |

Table 4: Forest Inventory Characteristics of Management Units in W1832.

## *9.3 Management and Silviculture Assumptions*

### 9.3.1 Silviculture Regime: Partial Cutting

We assume that all timber cutting on W1832 will be partial cutting, not clearcutting. WOODLOT uses a simple approximation technique to model future yields under partial cutting. This technique is approved by the MoF, therefore we used it.

WOODLOT requires a simple description of the partial cutting parameters, which is a challenge in forests as variable as those in W1832. We used the following parameters:

- For forests other than small diameter lodgepole pine forests:
  - 30% of stand of volume to be removed per logging pass
  - Minimum re-entry period: 20 years
- For operable smaller diameter lodgepole pine forests (MU 13 and 15)
  - 50% of stand of volume to be removed per logging pass
  - Minimum re-entry period: 45 years

Note that these are just the parameters used in initial runs of a basic timber supply model for W1832. We have chosen the values to reasonably approximate the management approach we expect to implement in the stands in question, after ecologically sensitive forested sites, riparian ecosystems, and full cycle trees have been removed from the landbase. The parameter values are not intended as a Management Plan commitment to this exact intensity and/or frequency of cutting. Actual logging prescriptions will be based on forest and site conditions, and on the principles and management goals set out in Section 6 of this Management Plan.

The generic 30%/20 years parameters are intended to model a partial cutting timber management regime within the Douglas-fir, larch and pine stands. The more aggressive 50%/45 years parameters are intended to model small patch group selection harvesting within the operable small diameter pine stands in the upper portion of W1832. We would prefer to commercially thin the pine stands to reduce pine beetle hazard, but are concerned that this may not be feasible due to limited windfirmness and vigor. We chose the model parameters to reflect what we currently view as the most likely silvicultural approach.

WOODLOT also requires a minimum harvest age for each polygon. The program defaults to using the culmination age calculated for each polygon by the VDYP Ver 6.4a which is packaged with WOODLOT. This method of estimating minimum harvest age is not a good model of a partial cutting regime, as there is generally commercial thinning volume available in stands well in advance of culmination age.

Additional flaws in the default approach were found in early WOODLOT runs for W1832. Using the defaults, WOODLOT suggested the AAC for the lower crown portion of W1832 was 136 $m^3$/year, a figure far below the approximate timber productivity of the area generated by STYM. Investigation showed that WOODLOT had determined that any cutting rate greater than 136 $m^3$/year resulted in a situation where no stands were "old enough" to cut in the lower portion of the woodlot in the period from 2002 to 2007, as all uncut stands were slightly younger than the VDYP culmination age over this period. As a result, the model selected a 136 $m^3$/year cutting rate to "stretch" a small group of stands

over this 5 year period, while waiting for a large group of 85 to 90 year old high quality Douglas-fir stands to "mature" so they could be commercially thinned. The 136 $m^3$/year rate was then maintained in perpetuity by WOODLOT. The harvest flow model produced by this set of default assumptions was not realistic.

To improve the model to better reflect real silvicultural options, we reset the minimum harvest ages used by WOODLOT to the ages shown in Table 5.

| Site Index (BHA 50) | Designated Minimum Harvesting Age |
|---|---|
| >= 24 | 80 |
| 20 - 23 | 90 |
| <= 19 | 110 |

Table 5: Minimum Harvest Ages used in WOODLOT runs.

The 80 year minimum harvest age does no indicate that stands will be liquidated at 80 years, or that managed stands will contain no stems older than 80 to 110 years. It is a realistic assessment of the age at which most stands contain significant available volumes of timber suited for commercial thinning.

WOODLOT defaults to a 20% netdown in timber productivity to allow for the impact of partial cutting. This seems pessimistic, as our actual hopes are to meet or exceed natural stand commercial timber production rates[20], but again, this is the approved figure and was therefore utilized.

Additional work on the stand growth rates and patterns under partial cutting regimes is needed. We will investigate this matter in the term of this Management Plan, and may propose a revised cutting rate if an improved approximation of stand productivity under partial cutting regimes can be identified, supported, and agreed upon with the MoF.

### 9.3.2 Reforestation and Regeneration Delay

As discussed in Section 6.10, coniferous regeneration will be by natural regeneration from leave trees on the site as much as possible, within the constraints imposed by the Forest Practices Code, by available seed sources, and by regeneration environment.

While our management goal is to ensure prompt regeneration of conifers through control of the regeneration environment, we are willing to accept a significant regeneration delay to allow for natural regeneration through a deciduous shrub canopy in some cases.

WOODLOT contains a setting for regeneration delay, but the Woodlot Licence Management Plan Handbook expressly states that regeneration delay is used for clearcut stands only. We have therefore modeled without a regeneration delay allowance.

### 9.3.3 Utilization Levels

Timber utilization levels with be the standard levels for the Nelson Region. Minimum utilization standards area:

- 30 cm stump height,
- 10 cm minimum top diameter,
- 12.5 cm diameter at breast height (dbh) for lodgepole pine, and
- 17.5 cm dbh for all other species.

[20] See Section 6.8.

Deciduous trees will be utilized if possible, for specialty markets or firewood.

### *9.4 Determination of Net Operable Landbase*

The total area of W1832 is 619 hectares. However, much of this area is unsuited for timber management, and other portions are encumbered by significant constraints required to respect other forest uses.

We used two approaches when passing map information from the GIS to WOODLOT. We used landbase netdowns to model the impact of removing entire polygons from the timber management landbase, and used a reduction in stand yield to model partial netdowns. The netdowns in stand yield are applied in addition to the default 20% netdown for partial cutting discussed in Section 9.3.1.

Thus:

- An ecologically sensitive area to be removed completely from the landbase was netted out before the data is sent to WOODLOT.
- A riparian management zone polygon with an 50% netdown was sent to woodlot "as is". WOODLOT then deducted a 20% netdown to allow for the alleged impact of partial cutting, and then reduced the remainder by a further 50% to model our desired level of retention within riparian management zones.
- A forested polygon with no applicable netdowns was sent to WOODLOT "as is". WOODLOT deducted a 20% netdown to allow for the alleged impact of partial cutting, deducted a 7% netdown to allow for areas occupied by roads, trails and landings, and then reduced the remainder by a further 15% to model the full cycle tree netdown.

A key concept is that when modeling an annual harvest rate using WOODLOT, equal volume and area netdowns have equal impacts on predicted harvest rate. Plainly the two concepts are different if considered literally, but here we are using them interchangeably to control a timber yield model. No management approach is signified by the decision to model some netdowns as area based netdowns and others as volume based netdowns.

The specific netdowns used to determine the timber management landbase are discussed, in the order in which they were applied, below. Table 6 on the following page shows the area and approximate timber productivity of the areas netted out of the landbase.

It is important to note that management unit map[21] used as a source for the landbase netdowns discussed below is based on air photo interpretation and a moderate level of field verification of the air photo interpretation. Revision of polygon boundaries and reclassification of polygons is expected as surveys and planning continue on W1832. Eventual harvest plans for W1832 will be based on site specific field information, and may include some areas classified as ecologically sensitive in this initial Management Plan. Likewise, some areas currently classified as suitable for timber management may be reclassified as ecologically sensitive as planning proceeds.

[21] The methods used to create the management unit or ecosystem type map area discussed in Section 8.2.1.

| | Lower Portion and Private Land Portion | | | Area with Uncertain Access | | | Total Woodlot Are | |
|---|---|---|---|---|---|---|---|---|
| | Area (hectares) | Timber Productivity (m3/year) | % of Total Area | Area (hectares) | Timber Productivity (m3/year) | % of Total Area | Area (hectares) | Timber Productivity (m3/year) |
| **Total Area** | 356.3 | 952 | 100% | 263.1 | 682 | 100% | 619.4 | 1634 |
| ***Less:*** | | | | | | | | |
| **Areas Not Suited for Timber Management** | | | | | | | | |
| **100% Netdowns** | | | | | | | | |
| Non Forested Ecotypes | 19.4 | 0 | 5% | 10.8 | 0 | 4% | 30.2 | 0 |
| Wetlands | 1.6 | 0 | 0% | 0.2 | 0 | 0% | 1.8 | 0 |
| Shallow Soil and/or Steep Slopes | 39.6 | 30 | 11% | 52.3 | 35 | 20% | 91.9 | 65 |
| Small Diameter Pine Stands | 9.7 | 10 | 3% | 6.5 | 7 | 2% | 16.2 | 17 |
| **Partial Netdowns (Remainder in Timber Management Landbase)** | | | | | | | | |
| Ecologically Sensitive Areas within Timber Management Landbase | 2.1 | 4 | 1% | 10.5 | 24 | 4% | 12.6 | 28 |
| Protected Portion of Riparian Management Zones | 8.2 | 24 | 2% | 9.3 | 27 | 4% | 17.5 | 51 |
| Protected Portion of Ungulate Range Management Area | 20.6 | 49 | 6% | 0.0 | 0 | 0% | 20.6 | 49 |
| Allowance for Permanent Roads, Trails, Landings | 17.9 | 49 | 5% | 12.1 | 34 | 5% | 30.0 | 83 |
| **Productivity Directed to Full Cycle Trees** | | 191 | | | 136 | | | 327 |
| *Subtotal:* | 119.1 | 356 | 33% | 101.7 | 264 | 39% | 220.8 | 620 |
| ***Equals:*** | | | | | | | | |
| **Timber Management Landbase** | 237.3 | 644 | 67% | 161.3 | 453 | 61% | 398.6 | 1097 |

Table 6: Area and Timber Productivity by Landbase Stratification.

### 9.4.1 Small Resultant Polygons

The forest data passed to WOODLOT was generated by overlaying a set of digital maps inside PAMAP GIS. We did not utilize sliver controls because the project data set was small, on a GIS scale, and sliver control was unnecessary overhead. A total of 398 resultant polygons were generated by the overlay process, some with areas as small as 0.01 hectare, or one pixel. Although meaninglessly minute in a forest planning process, these sliver polygons do add up to a small area over the project extent.

We discovered late in the process of preparing this Management Plan that WOODLOT does not handler polygons less than 0.05 ha in size, and defaults to 0 area for such small polygons. We therefore removed 35 sliver polygons with a total area of 0.91 ha from the landbase prior to sending the map data for WOODLOT. Of this area, 0.57 ha were part of the potential timber management landbase, and 0.44 ha were part of ecologically sensitive areas.

### 9.4.2 Non Forested Areas

Management Units 1, 6 and 7 were netted out of the landbase before sending the data file to WOODLOT.. These non-forested areas are grassy slopes, talus, and wetlands respectively. Total area of this class is 32.0 hectares.

### 9.4.3 Upland Ecologically Sensitive Terrain: Shallow Soil and/or Steep Slopes

Management Units 2, 3 and 5 were netted out of the landbase. These are ecologically sensitive dry sites with shallow soils on varying slope gradients. These units contain very poor growing sites which will not produce timber crops in a reasonable time frame after logging, and which would likely suffer significant site degradation from logging operations. We therefore removed them from the landbase before sending the data file to WOODLOT. Total area of this class is 91.9 hectares.

### 9.4.4 Very Small Diameter Pine Stands

Management Unit 18 is occupied by very small diameter lodgepole pine forests, with some areas of small diameter Douglas-fir. The stands are 80 years old, are seriously overstocked, and contain few trees >15 cm dbh or >20 m tall. Most of the management unit is perched on moisture shedding sites, and growing site quality is poor, regardless of stocking level.

These stagnant stands are unmerchantable in their current form, are contributing no merchantable volume to W1832, and are not growing. We have removed them from the timber management landbase until the area has been successfully silviculturally treated.

Total area of this strata is 16.2 hectares.

Figure 12: Overstocked pine stand in MU 18. Trees are 10 to 15 cm in diameter, and less than 20 m tall

### 9.4.5 Ecologically Sensitive Inclusions in Timber Management Landbase

During the photo interpretation to delineate management units, some areas were identified which contained a mixture of stable terrain and ecologically sensitive terrain (shallow soils and/or steep slopes) which could not be differentiated at the scale of analysis. An estimated netdown factor was assigned to these areas. An area of 50.3 ha was assigned a 20% netdown for included sensitive terrain, and an area of 4.6 ha was assigned a 50% netdown. These polygons were sent to WOODLOT for inclusion in the analysis, with the appropriate netdown indicated by a Volume Adjustment Factor (VAF). A VAF is a netdown control code which WOODLOT and VDYP accept.

The netdown for ecologically sensitive inclusions in the timber management landbase has the equivalent impact of removing 12.6 ha from the landbase.

### 9.4.6 Riparian Ecosystems

The approach used to model riparian ecosystems is described in Section 6.4. We reduced the predicted timber yield in Riparian Management Zones by 50% to model the impact of our riparian management commitments.

These polygons were sent to WOODLOT for inclusion in the analysis, with a 50% netdown indicated by a VAF.

### 9.4.7 Ungulate Range

The ungulate range management area is described in Section 6.7.2.

The forested, non-riparian polygons overlain by the ungulate management polygon were sent to WOODLOT with an 80% netdown indicated by a VAF to allow for our ungulate range management commitments.

The netdown for the ungulate range management restrictions has the equivalent impact of removing 20.6 hectares from the timber management landbase.

### 9.4.8 Allowance for Permanent Roads, Trails, Landings

Operable area was reduced by 7% to allow for the construction of access roads, permanent skid trails, and landings. This netdown was implemented using the global Area Netdown constraint in WOODLOT. The road and trail netdown removed 30.0 hectares from the timber management landbase.

In Table 6, the road and trail netdown results in removing 5% of the total landbase, not 7%. This is because nonforested and ecologically sensitive areas are removed from the landbase prior to calculating the area and proportion of the road and trail netdown in the table.

The 7% figure is an initial estimate, drawn from the data package for the Arrow Timber Supply Review. We plan to build narrow haul roads and use small roadside landings, which will tend to reduce the area occupied access structures, but this will be offset by the construction and maintenance of permanent skid trails for repeated partial cutting entries. At this time, we do not have a quantitative assessment of the impact of these transportation network choices on the total area occupied by access structures. Therefore, we used the District average in this initial analysis.

Future Management Plan revisions will used improved estimates, as they become available from work in W1832 or in other locations.

### 9.4.9 Creation of Full Cycle Trees

We will divert 15% of net timber management site productivity to create and maintain full cycle trees[22]. The impact on timber management of protecting existing old growth structures on the timber management landbase is included in this estimate.

A 15% yield netdown was applied to forested stands within the remaining timber management landbase using a VAF factor passed to WOODLOT. As these individual stems and clumps of trees will be scattered throughout the timber management landbase, and we did not calculate an equivalent area netdown for the creation of full cycle trees.

## *9.5 Management Issues with No Effect on Landbase*

The following management issues with potential impacts on the timber management landbase were not considered in the WOODLOT runs to estimate initial harvest volume for W1832 for the reasons given.

[22] See Appendix 6.

### 9.5.1 Higher Level Plans

Operations in W1832 are covered by the Kootenay Boundary Land Use Plan. Winlaw Creek is a subunit considered in the implementation strategy of that plan. Objectives for the Winlaw Creek Unit are:

1. to maintain the regional connectivity corridor from the West Arm of Kootenay Lake though Lemon Creek, and
2. to maintain ungulate habitat through the application of biodiversity emphasis under the Forest Practices Code.

Activities in W1832 have no impact on the first goal. Management commitments and netdowns previously described should meet the requirements of the second goal. Additional netdowns are not needed.

### 9.5.2 Archeological Features

No archeological features are currently known in W1832. Appropriate netdowns will be used in future Management Plan revisions if archeological features are found.

### 9.5.3 Recreation Management

No set asides for recreation are planned in W1832.

### 9.5.4 Biodiversity and Wildlife Management

Management commitments and netdown previously described to maintain old growth structures, to maintain ungulate habitat, to protect riparian ecosystems, and to manage for full cycle trees should reflect reductions in timber harvest needed to maintain biodiversity and wildlife values. Additional netdowns are not needed.

### 9.5.5 Water Management

Management commitments and netdown previously described to maintain forest cover through the use of partial cutting, to create coarse woody debris, to maintain old growth structures, and to protect riparian ecosystems should reflect reductions in timber harvest needed to maintain water quality, quantity, and timing of flow. Additional netdowns are not required.

### 9.5.6 Root Disease Areas

The currently identified areas of significant root disease infestation[23] are all contained within the ungulate range polygons described above. Therefor, no additional netdown was made for stands with high rates of root disease infection.

## *9.6 Cutting Order*

Cutting order, or the order in which stands are harvested, is not a timber supply issue in W1832, although it may be a forest health management issue. Most stands are currently

[23] See Section 6.9.4.

old enough to harvest, and harvest rates do not need to be constrained to ensure that young stands are mature enough to be logged after current older timber supplies are cut.

Access to the lower elevations of W1832 is good. The lower crown land is reached by the Silica Forest Service Road, and access arrangements may be negotiated with neighboring landowners along the north west boundary of the crown portion. The private land portion is completely roaded, but contributes little to the near term harvest.

However, access to the upper crown portion of W1832 is uncertain. It would be inappropriate to calculate a suggested near term harvest rate which was dependant on access to the upper area 1) while only being certain of access to the lower areas, and 2) in a situation where, logically, lower elevation timber stands will be accessed before upper area stands even if the upper area proves to be economically accessible. We therefore constrained the harvest order so that all polygons on the lower part of the crown land portion were cut before the polygons in the upper area.

This reordering had no impact on the short or long term cut. If the upper area is in fact economically accessible, it is not imperative that it be accessed immediately to maintain an even flow of timber. However, as discussed in Section 6.9.1, it is a priority to access the pine stands in the upper portion of the woodlot to carry out thinning operations.

## *9.7 Results*

The WOODLOT runs using the parameters discussed above suggested an annual timber harvest volume of 1,043 $m^3$ for W1832. This is distributed between the crown and private land portions of the licence as shown in Table 7.

| Strata | Area (hectares) | Proposed Annual Harvest Rate (cubic meters) |
|---|---|---|
| Schedule A Land Private Land Portion | 21.2 | 10 |
| Schedule B Land Crown Land Portion | 598.2 | 1,033 |
| Total: | 619.3 | 1,043 |

Table 7: Proposed Annual Harvest Rate on Private and Crown Land Portions.

The disbursement between crown and private was determined by performing a WOODLOT run for all of W1832, then performing a WOODLOT run with the private land portion removed, and calculating the difference.

The timber productivity attributed to the private land portion of the woodlot on a per hectare basis is low because the yield for the area is based on the residual post logging co-dominant stocking on the site, not on post-logging regeneration. Once we have established that a new crop of trees is growing on the site, the yield from the private land portion will rise.

The initial annual harvest volume estimate for W1832 shown in Table 7 includes the upper crown portion of W1832 with economically uncertain access. As discussed in 6.2, we will defer the potential annual harvest on the upper area until the issue of access economics is

settled. WOODLOT runs were performed on just the lower, accessible portion, and on just the upper, uncertain access portion of W1832. The results of these runs are shown in Table 8.

| Strata | Area (hectares) | Proposed Annual Harvest Rate (cubic meters) |
|---|---|---|
| Accessible Lower Slopes | 356.3 | 618 |
| Upper Area with Economically Uncertain Access | 263.1 | 425 |
| Total: | 619.4 | 1,043 |

Table 8: Proposed Annual Harvest Rate on Accessible and Uncertain Access Areas

Therefore, initial suggested annual harvest volume on W1832 is 618 $m^3$/year.

WOODLOT conveniently generates graphs of predicted standing timber volume over time, shown in Figure 13 and Figure 14. The dark green area represents the proportion of timber volume which has reached minimum harvest age (per Table 5) and the light green portion represents timber volume beneath minimum harvest age. Note that this graph reflects the age class distribution within the managed forest portion of the timber management landbase only. The graph does not include stands on the many portions of W1832 outside the timber management landbase which will develop old forests, or the approximately 15% of the potential timber management landbase which will contain old growth structures.

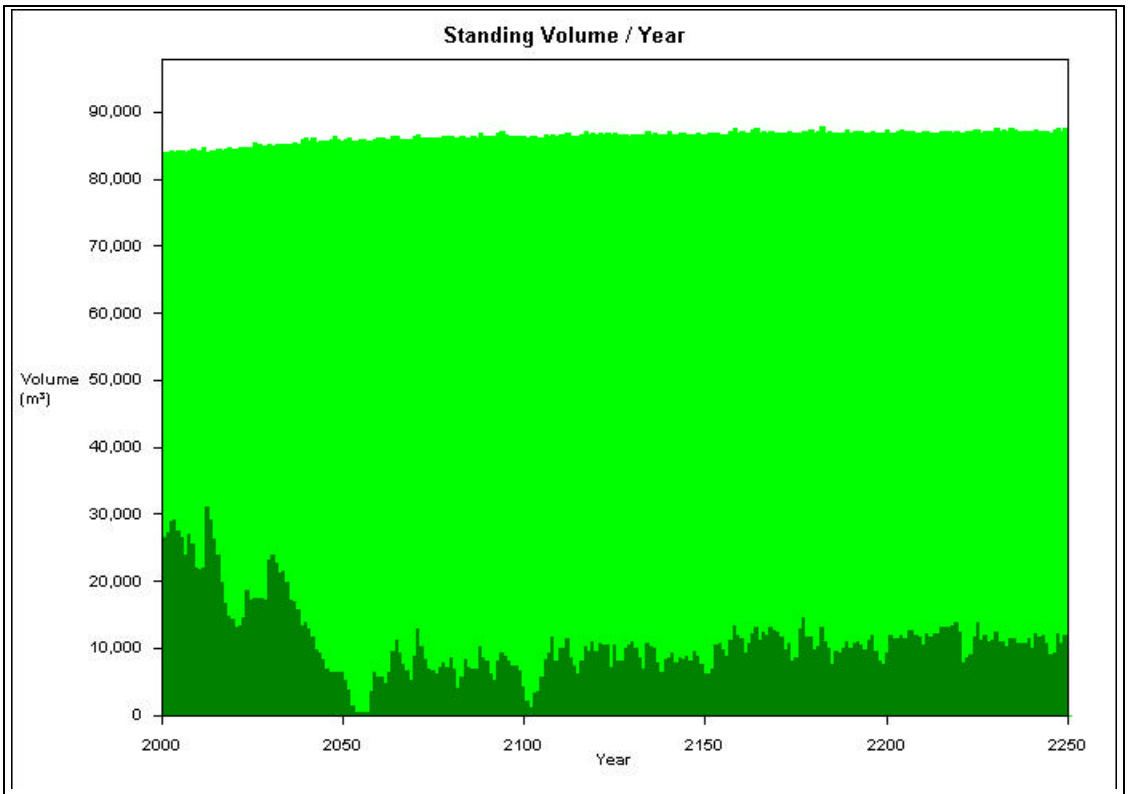


Figure 13: WOODLOT Timber Management Volume by Age over Time Graph, all of W1832.

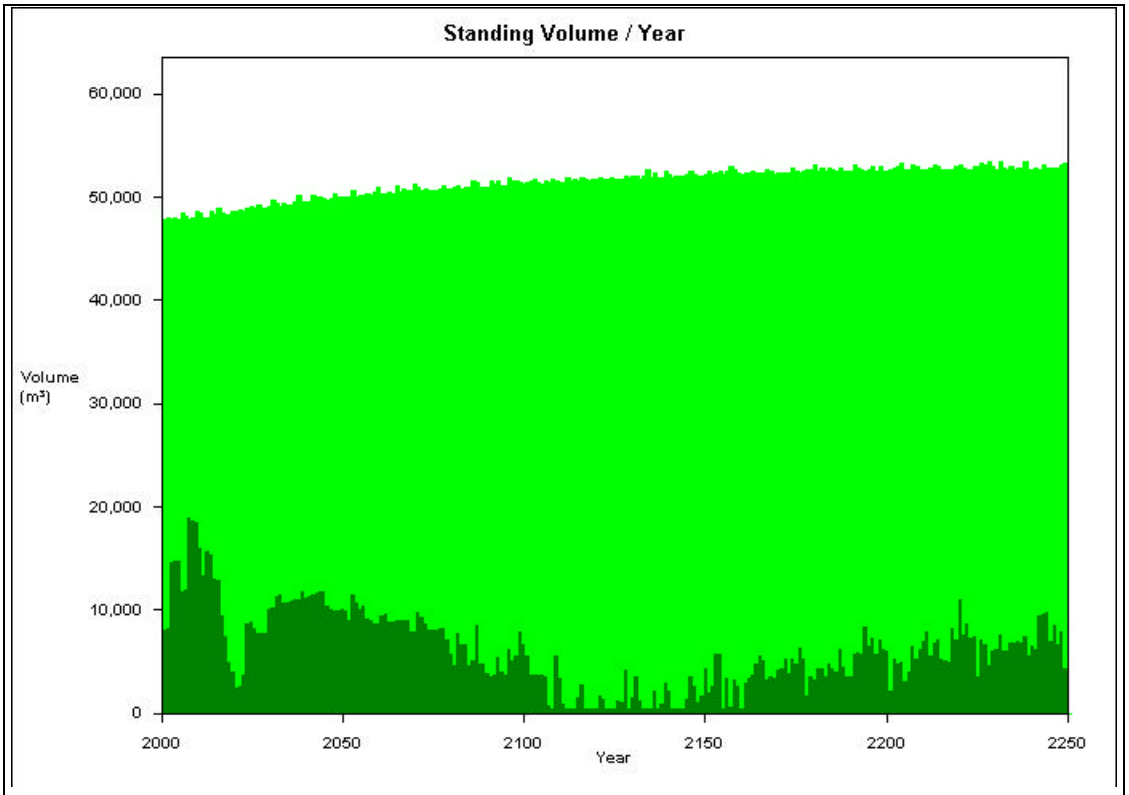


Figure 14: WOODLOT Timber Management Volume by Age over Time Graph, lower accessible portion of W1832.

## *9.8 Data and Files*

MoF instructions for preparation of Woodlot Licence Management Plans request that standard printed reports from WOODLOT should be contained in an Appendix to the Management Plan. While this is feasible, it has not proved practical in this case. WOODLOT and the Management Plan guidelines appear to assume that most woodlots will have a relatively small data set, which can be analyzed and checked by hand. While small be GIS standards, the current data set for W1832, and the WOODLOT reports, exceed reasonable hand analysis. We have therefore included a CD with the following data in Appendix 10:

- PAMAP GIS files of W1832 maps.
- HP650 plot files for W1832 map set.
- Applicable dBase themeing and analysis programs.
- WOODLOT *.LOT file used in analysis.
- Management Plan text.