Spray Lake Sawmills

Detailed Forest Management Plan 2001 – 2026

Chapter 8 – Timber Supply Analysis

December 15, 2006

Chapter 8 - Timber Supply Analysis and Preferred Forest Management Strategy

8.1 Introduction

Chapter 8 is composed of five main sections. The first section (8.2) is a report by Tesera Systems Inc. that outlines the Timber Supply Analysis (TSA) conducted for the DFMP. The analysis assessed a number of different forest management strategies for review by SLS. An Addendum Report has been added to the original submission of November 2004. The focus of the addendum is on revising the Preferred Forest Management Strategy (PFMS) from the 2004 analysis (Run4), including provisions for enhanced targeting of susceptible Mountain Pine Beetle stands. The analysis (Run 10) with the adjustments made for the MPB and adjustments/corrections in the NLB process still supports the previous PFMS harvest level (Run 4). Spatial Harvest Sequence maps for 25 years are included. As directed by the SRD Decision Document, the results of the other TSA runs have been archived.

The second section (8.3) details an assessment of the TSA results for two of the scenarios conducted jointly by URSUS Ecosystem Management and Tesera Systems. One of the scenarios represents a strong timber focus (Run 2 – Evenflow with no adjacency constraints). The other scenario represents the management option favored by SLS (Run 4 – Surge harvest to evenflow with 20 year adjacency constraint) subject to the vegetation/wildlife habitat assessment. As directed by the SRD Decision Document, the habitat suitability maps have been archived.

The third section (8.4) assesses the selected forest management strategy (Run 4) using the ECA model. A separate ECA analysis of Run 10 was not conducted based on the interpretation of Run 4 provided by Dr. Uldis Silins and given Run 10's link to Run 4 and the fact that less area is scheduled for harvest over time.

The next section (8.5) assesses the selected forest management strategy against applicable objectives from Chapter 5. This section has been updated to reflect the enhancement relative to the targeting of Mountain Pine Beetle susceptible stands.

The last section (8.6) shows Table 12 (Tesera report) indicating the "net" coniferous AAC (sustainable harvest level from Run 4 less 10.57% for cull/other resources/data improvements) of the preferred forest management strategy. The Quota area (B9) AAC has been separated from the FMA AAC.

8.2 Timber Supply Analysis (please refer to the attached Tesera Reports; the original TSA Report and the TSA Addendum Report).

8.3 Projecting the Effects of Timber Harvest Scenarios on Vegetation and Wildlife Habitat (please refer to attached URSUS Report).

Erratum note: The base year on the graphs in the report should be 2001.
Explanatory note: In the SRD review of the November 2004 DFMP, there was questions about the successional assumptions. Specifically, questions were raised about the

differing assumptions in the Timber Supply Analysis and the Wildlife Habitat Analysis. The following rationale is provided.

In the TSA, succession was based on yield strata for the purpose of projecting future and sustainable timber yields. In the URSUS report, different successional assumptions were used, tailored specifically to project future wildlife habitat units used to determine wildlife habitat suitability.

8.4 Equivalent Clearcut Area Modeling

The Equivalent Clearcut Area (ECA) model is used to predict the potential change in water yield following forest harvesting and the associated rate of hydrologic recovery over time.

Increased water yield due to harvesting is most strongly associated with greater snow accumulation and accelerated spring melting. The greatest impact is associated with harvesting at high elevations. The importance of an increased rate of melting from harvesting at mid elevation is less certain as it is subject to seasonal variations.

As forests grow the rates of accumulation and melting are reduced. This reduction is identified as hydrologic recovery. Snow accumulation recovery is dependant on the amount of forest growth as vegetation intercepts snow and promotes evaporation.

The relationship between tree height and crown closure can be used to estimate percent recovery for fully stocked stands. Fully stocked stands that reach a crown closure of 50 - 70% can expect a recovery of 90% once the trees are more than 9 meters tall. Our current yield curves indicate that the average age of stands meeting this criteria within the FMA is approximately 50 years. Following is an interpretation of the results for the FMA.

8.4.1 **Hydrologic interpretation of Equivalent Clear-cut Area projections provided conducted by Spray Lakes Sawmills (SLS) for their Detailed Forest Management Plan**

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Background

As part of their DFMP process, SLS used the “ECA-Alberta” hydrologic model written by Dr. Uldis Silins to evaluate the potential effect of harvest operations on water production from SLS forest management areas. Equivalent clear-cut area is an area based representation of the “hydrologically effective disturbance” area that either new or older-recovering disturbances represent on the landscape (% total area or absolute area in ha). Equivalent clearcut areas were projected over a 200 yr planning horizon. Lodgepole pine was projected as the dominant regenerating species on medium site quality sites was used in the ECA projections. Basal area growth was used as the variable to simulate hydrologic recovery of disturbed stands and stands were assumed to be at full hydrologic utilization at 50 years with an additional assumed regeneration lag for harvested stands of 5 years resulting in an overall stand age at full hydrologic utilization of 55 yrs.

Ten planning units spanning forested regions north and south of the Bow River were simulated. Over the 200 yr planning horizon, maximum Equivalent clearcut areas ranged from 18.4-29.5 % across the 10 planning units. Over the first 25 yrs of the planning horizon, maximum ECA % are projected to be considerably lower ranging from 8.20-19.24 %. The purpose of this document is to provide a hydrologic interpretation of the likely impact of these projected ECA's on annual water production or streamflow in this region. This interpretation is focused solely on the likely effects of disturbance and subsequent hydrologic recovery on annual streamflow generation (annual yield). As streamflow will vary strongly due to annual variability in precipitation, hydrologic projections (streamflow & deviation from average streamflow) are based on long term average climatic conditions in these regions. Thus, the streamflow projections outlined in this interpretation reflect only the cumulative effect of the forest disturbance and subsequent hydrologic recovery of multiple disturbances (each at varied stages of recovery) on streamflow over and above the effects that variability in climate would produce. Put another way, this allows disentangling the variability in streamflow generation due to climate from that produced solely by the disturbance and recovery over time.

Methods

Representative hydrometric data was abstracted from Water Survey of Canada & Alberta Environment gauging stations (Figure 1). A subset stations established on smaller rivers or creeks that would represent long-term average water yield in areas of similar hydro-climatic settings as the landscape units to be simulated were used. This excludes the majority of regional stations on larger river river systems, basins with high yielding headwater source areas well inside the front range Rocky Mountains, or stations with shorter record length. Similarly, representative annual precipitation data was assembled using a combination of regional Meteorological Service of Canada climate stations and from the Alberta Sustainable Resource Development Sacramento precipitation gauge network.

Within the region near to the SLS FMA boundaries 10 hydrometric stations and 12 climate stations were found to be suitably representative. Though moderately strong west-east variance is evident, within the regions near to the FMA boundary, the strongest hydro-climatic variance is evident between regions north and south of the Bow River valley (Table 1). Long term average regional precipitation and water yields were calculated for these regions separately. Mean annual precipitation and streamflow is generally lower north of the Bow River (574 & 194 mm/yr respectively) compared to the region south of the Bow River (642 & 385 mm/yr respectively).

Table 1 – Regional hydro-climatic summaries

North of Bow River

Hydrometric station	Mean annual water yield (mm/yr)	Climate station	Mean annual precipitaiton (mm/yr)		
North Ram	208	Clearwater	641	Streamflow and ET as % of average precipititation	
Prairie Creek	194	Blue Hill LO	645	Q	ET
James River	163	RedDeer RS	513	33.88%	66.12%
Fallen Timber	154	Harold Ck.	578		
Waiparous R. at Meadow Ck	241	Mockingbirk LO	537		
Ghost R. above Waiparours	206	Ghost RS	528		
Average	194.3		573.7		

South of Bow River

Hydrometric station	Mean annual water yield (mm/yr)	Climate station	Mean annual precipitaiton (mm/yr)		
Jumping pound near Jumping pound	347	Kananaskis	638	Streamflow and ET as % of average precipititation	
Elbow R. at Bragg Ck.	407	Elbow RS	645	Q	ET
Trapp ck near longview	394	Highwood RS	501	59.93%	40.07%
Cataract	391	Trapp Ck	723		
		Pekisko	683		
		Pekisko Sacramento	662		
Average	384.8		642.0		

Streamflow projections were performed for the 10 watershed planning units using the same input parameters as produced by the SLS planning team. Long-term regional mean annual precipitation and streamflow for the two regions above were used to project the annual water yield increases (both % increase over baseline averages and absolute increases in mm/yr). Again, the entire 200 yr planning horizons were projected.

Results & Interpretation

Water yield projections generally reflected differences in ECA % among the 10 planning units, though projected water yield increases on a unit area basis are higher in the northern planning units. In the northern units, maximum water yield increases ranged from 8.2-12.2 % above baseline water yields over the 200 yr horizon, however within the 1st 25 yrs these increases ranged from 4.7-11.3 %. In contrast, the projected water yield increases were considerably lower in southern planning units over the 200 yr horizon (3.1-4.1%) and within the next 25 yrs are projected to range between 1.6-2.7 % increases over baseline streamflow.

It should be noted that larger % yield increases in northern planning units reflect the fact that forest evapotranspiration processes play a larger role in the regional hydrology of that area (table 1) while water production (yield) is generally lower in this region. The maximum annual yield increase in of 11.7 % in the northern units represents only 23 mm of annual water production. Though absolute water yield increases (mm) on a unit area basis were still generally lower in southern planning units, these streamflow increases per unit area ECA are generally higher which reflects higher precipitation and runoff in those southern units.

Summary

Water yield projections based on ECA estimates outlined in the Spray Lakes DFMP were all below 15% increases in average annual water yield over the 200 yr planning horizon.

Figure 1 – Location of regional hydrometric and climate stations

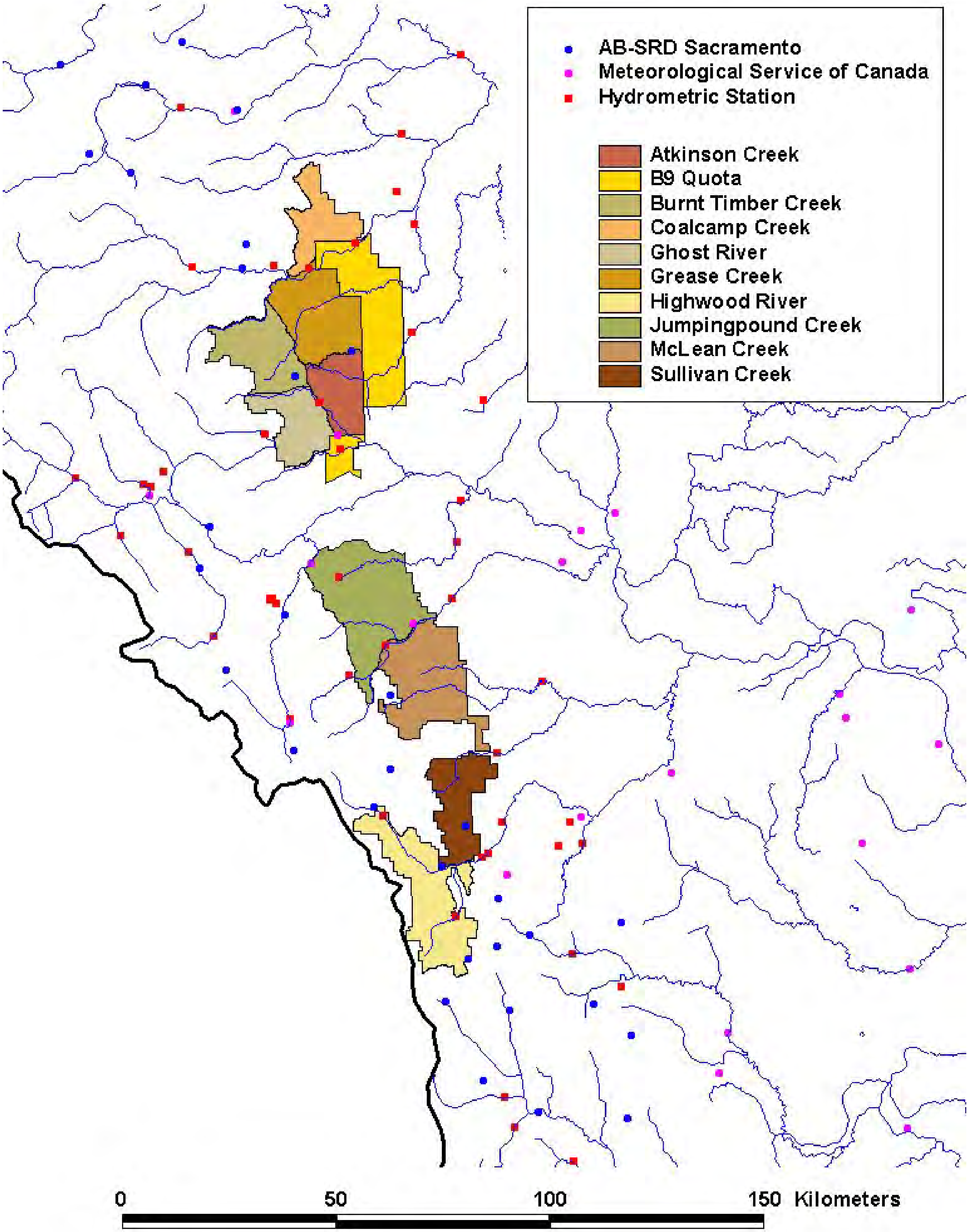


Table 2

Atkinson Creek

Year	TotalArea Cut(ha)	ECA(ha)	TotalAreaCut(%)	ECA(%)	AnnYieldIncr(%)	AnnYieldIncr(mm)
2001	0.0	0.0	0.00%	0.00%	0.0%	0.0
2006	647.0	647.0	3.59%	3.59%	2.3%	4.5
2011	1677.0	1601.1	9.32%	8.90%	5.3%	10.3
2016	1980.0	1708.2	11.00%	9.49%	4.7%	9.1
2021	2439.0	1938.3	13.55%	10.77%	4.6%	8.9
2026	3349.0	2570.7	18.61%	14.28%	6.0%	11.6
2031	3897.0	2742.2	21.65%	15.24%	5.6%	10.9
2036	4569.0	2984.6	25.39%	16.58%	5.9%	11.4
2041	4569.0	2491.4	25.39%	13.84%	3.6%	7.0
2046	5785.0	3233.6	32.14%	17.97%	6.3%	12.2
2051	5785.0	2640.6	32.14%	14.67%	3.9%	7.6
2056	7972.0	4262.3	44.29%	23.68%	10.2%	19.7
2061	7972.0	3515.1	44.29%	19.53%	6.6%	12.9
2066	8904.0	3800.5	49.47%	21.12%	7.3%	14.1
2071	8904.0	3095.1	49.47%	17.20%	4.4%	8.5
2076	9890.0	3439.4	54.95%	19.11%	5.8%	11.3
2081	9890.0	2777.2	54.95%	15.43%	3.5%	6.9
2086	11972.0	4266.2	66.52%	23.70%	9.5%	18.5
2091	11972.0	3506.7	66.52%	19.48%	6.2%	12.1
2096	13545.0	4354.3	75.26%	24.19%	9.4%	18.2
2101	13545.0	3564.1	75.26%	19.80%	5.9%	11.4
2106	14914.0	4179.3	82.86%	23.22%	8.1%	15.8
2111	14914.0	3451.3	82.86%	19.18%	5.0%	9.8
2116	15710.0	3550.7	87.29%	19.73%	5.7%	11.0
2121	15710.0	2859.1	87.29%	15.89%	3.4%	6.6
2126	16612.0	3104.6	92.30%	17.25%	5.1%	9.8
2131	16612.0	2446.9	92.30%	13.60%	3.1%	6.1
2136	17956.0	3170.0	99.77%	17.61%	6.6%	12.9
2141	17956.0	2569.4	99.77%	14.28%	4.3%	8.3
2146	19838.0	3880.2	110.22%	21.56%	9.3%	18.0
2151	19838.0	3225.5	110.22%	17.92%	6.0%	11.6
2156	21272.0	4031.7	118.19%	22.40%	8.6%	16.7
2161	21272.0	3357.8	118.19%	18.66%	5.4%	10.4
2166	22596.0	4035.1	125.55%	22.42%	7.7%	15.0
2171	22596.0	3317.9	125.55%	18.43%	4.8%	9.3
2176	24745.0	4781.7	137.49%	26.57%	10.4%	20.2
2181	24745.0	3941.3	137.49%	21.90%	6.7%	13.0
2186	26917.0	5309.8	149.56%	29.50%	11.8%	22.8
2191	26917.0	4383.2	149.56%	24.35%	7.5%	14.5
2196	28421.0	5000.9	157.91%	27.79%	9.6%	18.7
2201	28421.0	4109.3	157.91%	22.83%	5.9%	11.4
			max (200 yr horizon)	29.50%	11.76%	22.8
			max (1st 25 yr)	14.28%	5.98%	11.6

Table 3

B9 Quota

Year	TotalAreaCut(ha)	ECA(ha)	TotalAreaCut(%)	ECA(%)	AnnYieldIncr(%)	AnnYieldIncr(mm)
2001	0.0	0.0	0.00%	0.00%	0.00%	0.0
2006	1679.0	1679.0	3.63%	3.63%	2.35%	4.6
2011	2749.0	2552.1	5.94%	5.51%	3.13%	6.1
2016	3883.0	3365.6	8.39%	7.27%	3.66%	7.1
2021	5602.0	4636.2	12.10%	10.01%	4.72%	9.2
2026	7071.0	5464.9	15.27%	11.80%	4.98%	9.7
2031	8214.0	5811.2	17.74%	12.55%	4.66%	9.0
2036	10018.0	6708.0	21.64%	14.49%	5.34%	10.4
2041	10018.0	5621.0	21.64%	12.14%	3.25%	6.3
2046	12669.0	7226.3	27.36%	15.61%	5.51%	10.7
2051	12669.0	5919.6	27.36%	12.78%	3.44%	6.7
2056	13637.0	5640.9	29.45%	12.18%	3.32%	6.4
2061	13637.0	4460.5	29.45%	9.63%	1.96%	3.8
2066	15953.0	5731.7	34.45%	12.38%	4.23%	8.2
2071	15953.0	4554.2	34.45%	9.84%	2.72%	5.3
2076	17870.0	5470.8	38.59%	11.82%	4.30%	8.4
2081	17870.0	4400.3	38.59%	9.50%	2.71%	5.3
2086	21560.0	7149.9	46.56%	15.44%	6.67%	12.9
2091	21560.0	5948.7	46.56%	12.85%	4.33%	8.4
2096	23908.0	7144.4	51.63%	15.43%	5.85%	11.4
2101	23908.0	5949.6	51.63%	12.85%	3.62%	7.0
2106	27178.0	8073.0	58.70%	17.44%	6.53%	12.7
2111	27178.0	6664.2	58.70%	14.39%	4.14%	8.0
2116	30359.0	8497.5	65.57%	18.35%	6.85%	13.3
2121	30359.0	7001.0	65.57%	15.12%	4.33%	8.4
2126	32849.0	8060.4	70.95%	17.41%	5.92%	11.5
2131	32849.0	6541.1	70.95%	14.13%	3.65%	7.1
2136	35963.0	8209.6	77.67%	17.73%	6.37%	12.4
2141	35963.0	6726.5	77.67%	14.53%	4.03%	7.8
2146	39384.0	8732.3	85.06%	18.86%	7.11%	13.8
2151	39384.0	7149.2	85.06%	15.44%	4.51%	8.7
2156	41768.0	8023.1	90.21%	17.33%	5.90%	11.4
2161	41768.0	6533.1	90.21%	14.11%	3.62%	7.0
2166	44712.0	8058.0	96.57%	17.40%	6.10%	11.8
2171	44712.0	6584.7	96.57%	14.22%	3.84%	7.5
2176	48014.0	8482.2	103.70%	18.32%	6.83%	13.2
2181	48014.0	6933.5	103.70%	14.97%	4.33%	8.4
2186	51100.0	8543.0	110.36%	18.45%	6.79%	13.2
2191	51100.0	6992.8	110.36%	15.10%	4.25%	8.3
2196	54979.0	9393.1	118.74%	20.29%	7.82%	15.2
2201	54979.0	7767.5	118.74%	16.78%	4.97%	9.7
			max (200 yr horizon)	20.29%	7.82%	15.2
			max (1st 25 yr)	11.80%	4.98%	9.7

Table 4

Burnt Timber Creek

Year	TotalAreaCut(ha)	ECA(ha)	TotalAreaCut(%)	ECA(%)	AnnYieldIncr(%)	AnnYieldIncr(mm)
2001	0.0	0.0	0.00%	0.00%	0.00%	0.0
2006	228.0	228.0	0.92%	0.92%	0.59%	1.2
2011	643.0	616.3	2.58%	2.48%	1.49%	2.9
2016	2464.0	2362.1	9.90%	9.49%	5.76%	11.2
2021	3679.0	3289.4	14.79%	13.22%	7.07%	13.7
2026	4615.0	3799.0	18.55%	15.27%	7.02%	13.6
2031	5344.0	3999.9	21.48%	16.08%	6.21%	12.1
2036	6007.0	4062.8	24.14%	16.33%	5.32%	10.3
2041	6007.0	3404.0	24.14%	13.68%	3.06%	5.9
2046	7501.0	4264.2	30.15%	17.14%	5.51%	10.7
2051	7501.0	3485.4	30.15%	14.01%	3.46%	6.7
2056	8824.0	4065.9	35.47%	16.34%	5.46%	10.6
2061	8824.0	3225.0	35.47%	12.96%	3.44%	6.7
2066	9726.0	3359.3	39.09%	13.50%	4.26%	8.3
2071	9726.0	2653.6	39.09%	10.67%	2.59%	5.0
2076	10318.0	2659.1	41.47%	10.69%	2.95%	5.7
2081	10318.0	2099.1	41.47%	8.44%	1.77%	3.4
2086	12286.0	3586.2	49.38%	14.41%	6.09%	11.8
2091	12286.0	2947.2	49.38%	11.85%	4.03%	7.8
2096	13213.0	3263.9	53.11%	13.12%	4.86%	9.4
2101	13213.0	2676.7	53.11%	10.76%	2.96%	5.7
2106	13514.0	2417.2	54.32%	9.72%	2.33%	4.5
2111	13514.0	1939.6	54.32%	7.80%	1.29%	2.5
2116	16307.0	4279.5	65.55%	17.20%	7.94%	15.4
2121	16307.0	3586.2	65.55%	14.41%	5.36%	10.4
2126	18187.0	4799.3	73.10%	19.29%	8.22%	16.0
2131	18187.0	3982.8	73.10%	16.01%	5.17%	10.0
2136	19416.0	4429.3	78.04%	17.80%	6.01%	11.7
2141	19416.0	3672.5	78.04%	14.76%	3.62%	7.0
2146	21337.0	4868.4	85.76%	19.57%	6.98%	13.5
2151	21337.0	4016.5	85.76%	16.14%	4.45%	8.6
2156	22921.0	4785.8	92.13%	19.24%	6.72%	13.0
2161	22921.0	3848.6	92.13%	15.47%	4.20%	8.1
2166	23702.0	3740.3	95.27%	15.03%	4.36%	8.5
2171	23702.0	2997.5	95.27%	12.05%	2.58%	5.0
2176	25597.0	4188.3	102.89%	16.83%	6.30%	12.2
2181	25597.0	3429.1	102.89%	13.78%	4.08%	7.9
2186	26570.0	3678.0	106.80%	14.78%	4.97%	9.6
2191	26570.0	2961.0	106.80%	11.90%	3.03%	5.9
2196	27160.0	2870.5	109.17%	11.54%	3.13%	6.1
2201	27160.0	2288.6	109.17%	9.20%	1.84%	3.6
			max (200 yr horizon)	19.57%	8.22%	16.0
			max (1st 25 yr)	15.27%	7.07%	13.7

Table 5

Coalcamp Creek

Year	TotalAreaCut(ha)	ECA(ha)	TotalAreaCut(%)	ECA(%)	AnnYieldIncr(%)	AnnYieldIncr(mm)
2001	0.0	0.0	0.00%	0.00%	0.00%	0.0
2006	1346.0	1346.0	7.48%	7.48%	4.85%	9.4
2011	3474.0	3316.2	19.30%	18.42%	11.03%	21.4
2016	4027.0	3463.2	22.37%	19.24%	9.43%	18.3
2021	4319.0	3290.0	24.00%	18.28%	6.94%	13.5
2026	4853.0	3334.8	26.96%	18.53%	5.76%	11.2
2031	5312.0	3257.3	29.51%	18.10%	4.74%	9.2
2036	7477.0	4851.9	41.54%	26.96%	10.54%	20.5
2041	7477.0	4052.5	41.54%	22.52%	6.93%	13.4
2046	7728.0	3535.5	42.94%	19.64%	5.04%	9.8
2051	7728.0	2775.7	42.94%	15.42%	2.75%	5.3
2056	8411.0	2741.9	46.73%	15.23%	3.65%	7.1
2061	8411.0	2081.2	46.73%	11.56%	2.22%	4.3
2066	9709.0	2900.4	53.94%	16.11%	6.00%	11.6
2071	9709.0	2334.8	53.94%	12.97%	3.93%	7.6
2076	9837.0	1945.3	54.65%	10.81%	2.77%	5.4
2081	9837.0	1478.1	54.65%	8.21%	1.52%	2.9
2086	10818.0	2051.6	60.10%	11.40%	4.19%	8.1
2091	10818.0	1699.9	60.10%	9.44%	2.73%	5.3
2096	13169.0	3714.1	73.17%	20.64%	10.16%	19.7
2101	13169.0	3135.6	73.17%	17.42%	6.77%	13.1
2106	14250.0	3658.4	79.17%	20.33%	7.94%	15.4
2111	14250.0	3043.5	79.17%	16.91%	4.82%	9.4
2116	15761.0	3964.5	87.57%	22.03%	7.95%	15.4
2121	15761.0	3312.7	87.57%	18.40%	4.99%	9.7
2126	17211.0	4136.3	95.62%	22.98%	8.12%	15.8
2131	17211.0	3379.0	95.62%	18.77%	5.12%	9.9
2136	18148.0	3594.0	100.83%	19.97%	6.24%	12.1
2141	18148.0	2867.5	100.83%	15.93%	3.79%	7.4
2146	19528.0	3559.5	108.49%	19.78%	7.02%	13.6
2151	19528.0	2907.8	108.49%	16.16%	4.46%	8.7
2156	20884.0	3642.6	116.03%	20.24%	7.48%	14.5
2161	20884.0	2968.6	116.03%	16.49%	4.72%	9.2
2166	21699.0	3141.6	120.56%	17.45%	5.59%	10.8
2171	21699.0	2540.2	120.56%	14.11%	3.38%	6.6
2176	22804.0	3073.7	126.70%	17.08%	5.80%	11.2
2181	22804.0	2502.1	126.70%	13.90%	3.66%	7.1
2186	23811.0	2964.8	132.29%	16.47%	5.74%	11.1
2191	23811.0	2395.4	132.29%	13.31%	3.60%	7.0
2196	25706.0	3749.4	142.82%	20.83%	8.84%	17.1
2201	25706.0	3109.3	142.82%	17.27%	5.75%	11.1
			max (200 yr horizon)	26.96%	11.03%	21.4
			max (1st 25 yr)	19.24%	11.03%	21.4

Table 6

Ghost River

Year	TotalAreaCut(ha)	ECA(ha)	TotalAreaCut(%)	ECA(%)	AnnYieldIncr(%)	AnnYieldIncr(mm)
2001	0.0	0.0	0.00%	0.00%	0.00%	0.0
2006	53.0	53.0	0.27%	0.27%	0.18%	0.3
2011	895.0	888.8	4.58%	4.54%	2.91%	5.7
2016	1982.0	1870.9	10.13%	9.56%	5.61%	10.9
2021	2257.0	1914.6	11.54%	9.79%	4.67%	9.1
2026	2670.0	2067.4	13.65%	10.57%	4.26%	8.3
2031	2976.0	2070.8	15.21%	10.59%	3.46%	6.7
2036	3983.0	2748.3	20.36%	14.05%	5.26%	10.2
2041	3983.0	2312.8	20.36%	11.82%	3.33%	6.5
2046	4741.0	2651.1	24.24%	13.55%	4.46%	8.6
2051	4741.0	2161.8	24.24%	11.05%	2.73%	5.3
2056	5460.0	2414.6	27.91%	12.34%	3.86%	7.5
2061	5460.0	1894.2	27.91%	9.68%	2.39%	4.6
2066	8749.0	4747.8	44.73%	24.27%	12.24%	23.8
2071	8749.0	4024.7	44.73%	20.58%	8.23%	16.0
2076	9729.0	4323.8	49.74%	22.11%	8.29%	16.1
2081	9729.0	3583.2	49.74%	18.32%	4.93%	9.6
2086	10439.0	3603.9	53.37%	18.42%	4.78%	9.3
2091	10439.0	2932.2	53.37%	14.99%	2.77%	5.4
2096	12414.0	4267.6	63.47%	21.82%	8.07%	15.7
2101	12414.0	3483.1	63.47%	17.81%	5.30%	10.3
2106	14240.0	4561.5	72.80%	23.32%	9.23%	17.9
2111	14240.0	3689.6	72.80%	18.86%	5.86%	11.4
2116	14944.0	3564.8	76.40%	18.23%	5.61%	10.9
2121	14944.0	2919.4	76.40%	14.93%	3.28%	6.4
2126	16635.0	3994.7	85.05%	20.42%	7.29%	14.1
2131	16635.0	3279.4	85.05%	16.77%	4.69%	9.1
2136	17834.0	3795.5	91.18%	19.40%	6.77%	13.1
2141	17834.0	3056.3	91.18%	15.63%	4.22%	8.2
2146	18523.0	3043.5	94.70%	15.56%	4.58%	8.9
2151	18523.0	2433.6	94.70%	12.44%	2.73%	5.3
2156	19914.0	3246.6	101.81%	16.60%	6.07%	11.8
2161	19914.0	2661.9	101.81%	13.61%	3.92%	7.6
2166	22504.0	4693.8	115.05%	24.00%	10.90%	21.1
2171	22504.0	3909.3	115.05%	19.99%	7.16%	13.9
2176	23444.0	4096.4	119.86%	20.94%	7.34%	14.2
2181	23444.0	3382.5	119.86%	17.29%	4.36%	8.5
2186	25150.0	4405.4	128.58%	22.52%	7.86%	15.3
2191	25150.0	3637.5	128.58%	18.60%	4.97%	9.6
2196	27433.0	5185.9	140.25%	26.51%	10.50%	20.4
2201	27433.0	4267.9	140.25%	21.82%	6.77%	13.1
			max (200 yr horizon)	26.51%	12.24%	23.8
			max (1st 25 yr)	10.57%	5.61%	10.9

Table 7

Grease Creek

Year	TotalAreaCut(ha)	ECA(ha)	TotalAreaCut(%)	ECA(%)	AnnYieldIncr(%)	AnnYieldIncr(mm)
2001	0.0	0.0	0.00%	0.00%	0.00%	0.0
2006	2233.0	2233.0	7.09%	7.09%	4.60%	8.9
2011	2717.0	2455.1	8.63%	7.80%	4.18%	8.1
2016	2900.0	2322.0	9.21%	7.37%	3.08%	6.0
2021	3834.0	2924.1	12.18%	9.29%	3.71%	7.2
2026	5080.0	3738.0	16.13%	11.87%	4.70%	9.1
2031	6908.0	5000.9	21.94%	15.88%	6.70%	13.0
2036	8513.0	5844.9	27.03%	18.56%	7.64%	14.8
2041	8513.0	4920.8	27.03%	15.63%	4.79%	9.3
2046	9975.0	5492.0	31.68%	17.44%	5.67%	11.0
2051	9975.0	4470.7	31.68%	14.20%	3.32%	6.4
2056	12117.0	5640.2	38.48%	17.91%	6.20%	12.0
2061	12117.0	4619.4	38.48%	14.67%	3.98%	7.7
2066	12942.0	4502.4	41.10%	14.30%	4.00%	7.8
2071	12942.0	3526.3	41.10%	11.20%	2.36%	4.6
2076	13646.0	3371.5	43.33%	10.71%	2.65%	5.1
2081	13646.0	2566.7	43.33%	8.15%	1.58%	3.1
2086	16525.0	4811.7	52.48%	15.28%	6.81%	13.2
2091	16525.0	3986.6	52.48%	12.66%	4.55%	8.8
2096	18338.0	5009.3	58.23%	15.91%	6.51%	12.6
2101	18338.0	4143.9	58.23%	13.16%	4.06%	7.9
2106	20376.0	5353.3	64.71%	17.00%	6.38%	12.4
2111	20376.0	4470.4	64.71%	14.20%	3.99%	7.7
2116	21888.0	5134.2	69.51%	16.30%	5.39%	10.5
2121	21888.0	4204.7	69.51%	13.35%	3.33%	6.5
2126	24391.0	5820.9	77.46%	18.48%	6.98%	13.5
2131	24391.0	4736.2	77.46%	15.04%	4.48%	8.7
2136	27347.0	6659.6	86.84%	21.15%	8.71%	16.9
2141	27347.0	5529.5	86.84%	17.56%	5.58%	10.8
2146	29646.0	6745.2	94.14%	21.42%	7.92%	15.4
2151	29646.0	5567.2	94.14%	17.68%	4.92%	9.5
2156	32152.0	6946.4	102.10%	22.06%	7.87%	15.3
2161	32152.0	5720.0	102.10%	18.16%	4.94%	9.6
2166	34113.0	6508.8	108.33%	20.67%	6.84%	13.3
2171	34113.0	5269.4	108.33%	16.73%	4.23%	8.2
2176	36200.0	6178.2	114.96%	19.62%	6.63%	12.9
2181	36200.0	4989.7	114.96%	15.85%	4.15%	8.0
2186	38161.0	5821.5	121.18%	18.49%	6.39%	12.4
2191	38161.0	4724.5	121.18%	15.00%	4.00%	7.8
2196	41002.0	6521.9	130.21%	20.71%	8.09%	15.7
2201	41002.0	5357.5	130.21%	17.01%	5.19%	10.1
			max (200 yr horizon)	22.06%	8.71%	16.9
			max (1st 25 yr)	11.87%	4.70%	9.1

Table 8

Highwood River

Year	TotalAreaCut(ha)	ECA(ha)	TotalAreaCut(%)	ECA(%)	AnnYieldIncr(%)	AnnYieldIncr(mm)
2001	0.0	0.0	0.00%	0.00%	0.00%	0.0
2006	2265.0	2265.0	5.79%	5.79%	1.61%	5.6
2011	2780.0	2514.4	7.10%	6.42%	1.48%	5.2
2016	3643.0	3053.8	9.31%	7.80%	1.57%	5.5
2021	4151.0	3143.0	10.60%	8.03%	1.33%	4.6
2026	4685.0	3208.8	11.97%	8.20%	1.12%	3.9
2031	5838.0	3845.5	14.91%	9.82%	1.47%	5.1
2036	6081.0	3456.3	15.53%	8.83%	1.09%	3.8
2041	6081.0	2820.3	15.53%	7.20%	0.64%	2.2
2046	8136.0	4269.2	20.78%	10.90%	1.79%	6.3
2051	8136.0	3456.5	20.78%	8.83%	1.15%	4.0
2056	9407.0	3954.8	24.03%	10.10%	1.60%	5.6
2061	9407.0	3228.0	24.03%	8.25%	1.00%	3.5
2066	10866.0	4028.2	27.75%	10.29%	1.57%	5.5
2071	10866.0	3290.6	27.75%	8.41%	0.98%	3.4
2076	15685.0	7439.9	40.06%	19.00%	3.98%	13.9
2081	15685.0	6276.1	40.06%	16.03%	2.66%	9.3
2086	16728.0	6272.5	42.73%	16.02%	2.35%	8.2
2091	16728.0	5161.7	42.73%	13.18%	1.37%	4.8
2096	19060.0	6432.1	48.68%	16.43%	2.30%	8.0
2101	19060.0	5289.8	48.68%	13.51%	1.44%	5.0
2106	22211.0	7349.6	56.73%	18.77%	3.09%	10.8
2111	22211.0	6031.8	56.73%	15.41%	2.00%	7.0
2116	24011.0	6573.8	61.33%	16.79%	2.43%	8.5
2121	24011.0	5270.1	61.33%	13.46%	1.48%	5.2
2126	25381.0	5403.9	64.83%	13.80%	1.76%	6.1
2131	25381.0	4400.8	64.83%	11.24%	1.06%	3.7
2136	27035.0	5099.5	69.05%	13.03%	1.76%	6.1
2141	27035.0	4073.6	69.05%	10.41%	1.11%	3.9
2146	28590.0	4656.9	73.03%	11.90%	1.74%	6.1
2151	28590.0	3717.2	73.03%	9.49%	1.09%	3.8
2156	30244.0	4481.3	77.25%	11.45%	1.78%	6.2
2161	30244.0	3660.8	77.25%	9.35%	1.12%	3.9
2166	33276.0	5910.7	85.00%	15.10%	2.79%	9.7
2171	33276.0	4935.7	85.00%	12.61%	1.82%	6.3
2176	36729.0	7452.2	93.82%	19.03%	3.52%	12.3
2181	36729.0	6247.0	93.82%	15.96%	2.26%	7.9
2186	39452.0	7810.4	100.77%	19.95%	3.22%	11.2
2191	39452.0	6495.8	100.77%	16.59%	2.00%	7.0
2196	41197.0	6979.8	105.23%	17.83%	2.34%	8.2
2201	41197.0	5680.4	105.23%	14.51%	1.41%	4.9
			max (200 yr horizon)	19.95%	3.98%	13.9
			max (1st 25 yr)	8.20%	1.61%	5.6

Table 9

Jumpingpound Creek

Year	TotalAreaCut(ha)	ECA(ha)	TotalAreaCut(%)	ECA(%)	AnnYieldIncr(%)	AnnYieldIncr(mm)
2001	0.0	0.0	0.00%	0.00%	0.00%	0.0
2006	370.0	370.0	0.77%	0.77%	0.21%	0.7
2011	3210.0	3166.6	6.64%	6.55%	1.78%	6.2
2016	4832.0	4412.6	9.99%	9.13%	2.16%	7.5
2021	6395.0	5413.3	13.23%	11.20%	2.31%	8.1
2026	7511.0	5793.6	15.53%	11.98%	2.08%	7.3
2031	9128.0	6561.1	18.88%	13.57%	2.14%	7.5
2036	11089.0	7508.5	22.93%	15.53%	2.40%	8.4
2041	11089.0	6299.6	22.93%	13.03%	1.48%	5.2
2046	13758.0	7804.9	28.46%	16.14%	2.37%	8.3
2051	13758.0	6383.3	28.46%	13.20%	1.46%	5.1
2056	17662.0	8931.6	36.53%	18.47%	3.07%	10.7
2061	17662.0	7218.3	36.53%	14.93%	1.98%	6.9
2066	19506.0	7621.7	40.34%	15.76%	2.21%	7.7
2071	19506.0	6147.0	40.34%	12.71%	1.33%	4.6
2076	21270.0	6613.6	43.99%	13.68%	1.71%	6.0
2081	21270.0	5255.1	43.99%	10.87%	1.04%	3.6
2086	23548.0	6354.5	48.70%	13.14%	1.89%	6.6
2091	23548.0	5107.7	48.70%	10.56%	1.20%	4.2
2096	27961.0	8337.8	57.83%	17.24%	3.23%	11.3
2101	27961.0	6885.4	57.83%	14.24%	2.11%	7.4
2106	29201.0	6735.8	60.40%	13.93%	1.96%	6.8
2111	29201.0	5531.9	60.40%	11.44%	1.15%	4.0
2116	32366.0	7547.2	66.94%	15.61%	2.38%	8.3
2121	32366.0	6210.8	66.94%	12.85%	1.52%	5.3
2126	35958.0	8525.7	74.37%	17.63%	2.98%	10.4
2131	35958.0	7012.8	74.37%	14.50%	1.91%	6.7
2136	38220.0	7829.4	79.05%	16.19%	2.39%	8.3
2141	38220.0	6347.4	79.05%	13.13%	1.46%	5.1
2146	41152.0	7869.7	85.11%	16.28%	2.47%	8.6
2151	41152.0	6489.8	85.11%	13.42%	1.56%	5.4
2156	45093.0	9111.1	93.26%	18.84%	3.16%	11.0
2161	45093.0	7481.6	93.26%	15.47%	2.03%	7.1
2166	46960.0	7792.7	97.13%	16.12%	2.24%	7.8
2171	46960.0	6311.7	97.13%	13.05%	1.35%	4.7
2176	49006.0	6949.4	101.36%	14.37%	1.88%	6.6
2181	49006.0	5620.9	101.36%	11.63%	1.16%	4.0
2186	53618.0	8970.1	110.90%	18.55%	3.31%	11.5
2191	53618.0	7390.4	110.90%	15.29%	2.17%	7.6
2196	55972.0	8234.4	115.76%	17.03%	2.65%	9.2
2201	55972.0	6722.7	115.76%	13.90%	1.61%	5.6
			max (200 yr horizon)	18.84%	3.31%	11.5
			max (1st 25 yr)	11.98%	2.31%	8.1

Table 10

McLean Creek

Year	TotalAreaCut(ha)	ECA(ha)	TotalAreaCut(%)	ECA(%)	AnnYieldIncr(%)	AnnYieldIncr(mm)
2001	0.0	0.0	0.00%	0.00%	0.00%	0.0
2006	682.0	682.0	1.73%	1.73%	0.48%	1.7
2011	1686.0	1606.0	4.28%	4.07%	1.04%	3.6
2016	3800.0	3523.1	9.64%	8.94%	2.19%	7.6
2021	5498.0	4778.9	13.95%	12.12%	2.65%	9.3
2026	6443.0	5089.7	16.34%	12.91%	2.36%	8.2
2031	7304.0	5219.1	18.53%	13.24%	2.02%	7.1
2036	9238.0	6341.3	23.44%	16.09%	2.52%	8.8
2041	9238.0	5330.8	23.44%	13.52%	1.54%	5.4
2046	12243.0	7362.4	31.06%	18.68%	2.99%	10.4
2051	12243.0	6081.8	31.06%	15.43%	1.90%	6.6
2056	14576.0	7189.5	36.98%	18.24%	2.74%	9.6
2061	14576.0	5800.4	36.98%	14.71%	1.71%	6.0
2066	17661.0	7632.3	44.80%	19.36%	3.12%	10.9
2071	17661.0	6228.1	44.80%	15.80%	1.98%	6.9
2076	19885.0	7226.0	50.45%	18.33%	2.71%	9.5
2081	19885.0	5864.5	50.45%	14.88%	1.67%	5.8
2086	21328.0	6068.9	54.11%	15.40%	1.93%	6.7
2091	21328.0	4857.5	54.11%	12.32%	1.16%	4.1
2096	23323.0	5704.4	59.17%	14.47%	2.04%	7.1
2101	23323.0	4591.6	59.17%	11.65%	1.29%	4.5
2106	25328.0	5540.3	64.25%	14.05%	2.16%	7.5
2111	25328.0	4466.6	64.25%	11.33%	1.36%	4.8
2116	28261.0	6380.1	71.69%	16.19%	2.83%	9.9
2121	28261.0	5281.3	71.69%	13.40%	1.82%	6.4
2126	31225.0	7193.1	79.21%	18.25%	3.15%	11.0
2131	31225.0	5994.9	79.21%	15.21%	2.00%	7.0
2136	33823.0	7442.7	85.80%	18.88%	2.96%	10.3
2141	33823.0	6140.2	85.80%	15.58%	1.84%	6.4
2146	36550.0	7621.5	92.72%	19.33%	2.95%	10.3
2151	36550.0	6253.9	92.72%	15.87%	1.85%	6.5
2156	39356.0	7754.3	99.84%	19.67%	3.03%	10.6
2161	39356.0	6323.7	99.84%	16.04%	1.91%	6.6
2166	42049.0	7653.6	106.67%	19.42%	2.98%	10.4
2171	42049.0	6245.6	106.67%	15.84%	1.86%	6.5
2176	44583.0	7437.8	113.10%	18.87%	2.83%	9.9
2181	44583.0	6070.3	113.10%	15.40%	1.77%	6.2
2186	46333.0	6517.1	117.54%	16.53%	2.23%	7.8
2191	46333.0	5253.7	117.54%	13.33%	1.36%	4.7
2196	48737.0	6458.0	123.64%	16.38%	2.43%	8.5
2201	48737.0	5228.3	123.64%	13.26%	1.54%	5.4
			max (200 yr horizon)	19.67%	3.15%	11.0
			max (1st 25 yr)	12.91%	2.65%	9.3

Table 11

Sullivan Creek

Year	TotalAreaCut(ha)	ECA(ha)	TotalAreaCut(%)	ECA(%)	AnnYieldIncr(%)	AnnYieldIncr(mm)
2001	0.0	0.0	0.00%	0.00%	0.00%	0.0
2006	28.0	28.0	0.12%	0.12%	0.03%	0.1
2011	28.0	24.7	0.12%	0.11%	0.02%	0.1
2016	301.0	294.5	1.33%	1.30%	0.35%	1.2
2021	1299.0	1257.3	5.72%	5.54%	1.46%	5.1
2026	2072.0	1878.4	9.13%	8.28%	1.94%	6.8
2031	2072.0	1637.8	9.13%	7.22%	1.27%	4.4
2036	2826.0	2155.5	12.45%	9.50%	1.66%	5.8
2041	2826.0	1837.5	12.45%	8.10%	0.98%	3.4
2046	3950.0	2653.2	17.40%	11.69%	1.91%	6.7
2051	3950.0	2225.6	17.40%	9.81%	1.23%	4.3
2056	5029.0	2893.0	22.16%	12.75%	2.04%	7.1
2061	5029.0	2376.2	22.16%	10.47%	1.28%	4.5
2066	6394.0	3247.8	28.17%	14.31%	2.39%	8.3
2071	6394.0	2639.2	28.17%	11.63%	1.52%	5.3
2076	8974.0	4705.8	39.54%	20.73%	4.04%	14.1
2081	8974.0	3966.8	39.54%	17.48%	2.64%	9.2
2086	10345.0	4625.2	45.58%	20.38%	3.24%	11.3
2091	10345.0	3833.9	45.58%	16.89%	1.98%	6.9
2096	10559.0	3289.7	46.52%	14.49%	1.31%	4.6
2101	10559.0	2619.8	46.52%	11.54%	0.70%	2.4
2106	12250.0	3676.6	53.97%	16.20%	2.40%	8.4
2111	12250.0	2955.3	53.97%	13.02%	1.58%	5.5
2116	12900.0	2921.0	56.84%	12.87%	1.77%	6.2
2121	12900.0	2292.0	56.84%	10.10%	1.07%	3.7
2126	13906.0	2704.8	61.27%	11.92%	1.77%	6.2
2131	13906.0	2203.1	61.27%	9.71%	1.11%	3.9
2136	15399.0	3218.3	67.85%	14.18%	2.48%	8.6
2141	15399.0	2683.1	67.85%	11.82%	1.60%	5.6
2146	16454.0	3224.4	72.49%	14.21%	2.22%	7.8
2151	16454.0	2626.5	72.49%	11.57%	1.38%	4.8
2156	17646.0	3249.0	77.75%	14.31%	2.21%	7.7
2161	17646.0	2683.9	77.75%	11.82%	1.39%	4.8
2166	19918.0	4415.1	87.76%	19.45%	3.57%	12.5
2171	19918.0	3679.3	87.76%	16.21%	2.33%	8.1
2176	21607.0	4662.1	95.20%	20.54%	3.45%	12.0
2181	21607.0	3859.3	95.20%	17.00%	2.15%	7.5
2186	22760.0	4243.6	100.28%	18.70%	2.59%	9.0
2191	22760.0	3478.1	100.28%	15.32%	1.57%	5.5
2196	24271.0	4258.7	106.93%	18.76%	2.71%	9.4
2201	24271.0	3461.0	106.93%	15.25%	1.71%	6.0
			max (200 yr horizon)	20.73%	4.04%	14.1
			max (1st 25 yr)	8.28%	1.94%	6.8

8.4.4 Follow-up Assessment

The model can be rerun in 10 years with actual harvest information. Inputs can include actual areas, species, and site quality values. The results can then be compared to the current information. Variations can be assessed for significance.

As refined input values related to age of hydrologic recovery, regeneration lag, and watershed area information comes available it will be incorporated into the model.

We will strive to improve our knowledge regarding the significance of the ECA output values and assess new watershed information for incorporation into the next DFMP.

8.5 Preferred Forest Management Strategy

In selecting a preferred forest management strategy, the 8 scenarios generated by Tesera Systems in November 2004 were evaluated against a number of the objectives contained in Chapter 5. These objectives were considered within the context of the Forest Management Agreement (FMA). The FMA states:

WHEREAS *the Minister desires to provide for sustainable development of all resources and to provide for the fullest possible utilization of timber from the forest management area and stable employment in local communities by maximizing the timber resource base while maintaining a forest environment of high quality;* and

8. (1) It is recognized by the Minister that the Company's use of the forest management area for establishing, growing, harvesting and removing timber is to be the primary use thereof (the "primary use") and that it is to be protected therein in keeping with the principles of sustainable forest management. In keeping with public values and recognizing that certain portions of the forest management area may have other resource values, the Minister, subject to the primary use, reserves all land rights on the forest management area not specifically given hereby…

The following two tables were developed to assist in the review of the different options. The volume numbers are the sustainable harvest levels prior to the 10.57% deduction detailed in the Tesera report (Section 8.2)

			Timber Supply Analysis - Run Summaries			
Run Number		Conifer AAC	Conifer Growing Stock > MHA	Total Conifer Growing Stock	Area Harvested	Wtd. Ave. Final Harvest Age
2		380000	597227	9876790	429103	89
3		324000	7041617	14813086	365083	110
4	surge evenflow	356000 323500	6649311	14577824	374876	111
5	north	184000	4028344	8314438	205681	108
6	south	127500	5391917	8456889	144495	114
5+6	total	311500	9420261	16771327	350176	
7	south surge	137000	5376561	8472849	145888	115
	s - evenflow	127000				
8	north surge	197750	4738006	8864899	200698	110
	n - evenflow	180000				
7+8	surge	334750	10114567	17337748	346586	
	evenflow	307000				

Following is a brief description of each run from the Tesera report. Details of each run are contained in the report.

- **Run 1** - Detailed Theoretical Long-Run Sustained Yield Average (LRSYA) Calculation (Run 4 in 1998 Supplemental Guidelines)
- **Run 2** – FMA Even Flow without Adjacency & Operational Harvest Sequencing (Run 1 in 1998 Supplemental Guidelines)
- **Run 3** – FMA Even Flow with Adjacency & Operational Harvest Sequencing using SLS Management Options (Run 2 in 1998 Supplemental Guidelines)
- **Run 4** – FMA Surge Cut with Adjacency & Operational Harvest Sequencing
- **Run 5** – North FMU Even Flow with Adjacency & Operational Harvest Sequencing
- **Run 6** - South FMU Even Flow with Adjacency & Operational Harvest Sequencing
- **Run 7** – South FMU Surge Cut with Adjacency & Operational Harvest Sequencing
- **Run 8** – North FMU Surge Cut with Adjacency & Operational Harvest Sequencing

Since this initial analysis, mountain pine beetle issues, which were a priority consideration, now dominate. Two additional Runs (Run 9 - aspatial and Run 10 - spatial) were completed (refer to TSA Addendum) based on the DFMP Decision Document, April 28, 2005 which stated:

By September 4, 2006, SLS shall complete an updated timber supply analysis incorporating the changes mandated in this Section 9 that is acceptable to the Senior Manager, Forest Planning Section and the Senior Manager, Resource Analysis Section.

The additional runs were based on the approved Annual Allowable Cut as directed by the Decision Document and on the modeling parameters associated with Run 4 but including provisions for enhanced targeting of susceptible Mountain Pine Beetle stands.

Objectives	Run 2	Run 3	Run 4 and 10	Run 5 and 6	Run 7 and 8
Minimizing access development	-	√	√	√	+
Mitigating impacts on visual resources	-	√	√	√	+
Maintaining biodiversity	partial	√	√	√	√
CTU Program sequence	n/a	√	+	√	√
Mountain Pine Beetle priority areas	-	√	+	√	√
Community fire smart zones	-	√	+	√	√
Historical resource protection	√	√	√	√	√
Integration with other users and values	partial	√	√	√	√
Sustainable timber supply	√	√	√	√	√
Optimized timber supply	√	-	+	-	-
Water yield	n/a	n/a	√	n/a	n/a

n/a = not assessed.
partial = objective partially met.
√ = objective met
+ = best option
- = objective not met

In the November 2004 DFMP submission, Run 4 was selected by SLS as the Preferred Forest Management Strategy (PFMS). SLS believed this run represented the best balance between the economic, social and ecological objectives. The timber harvest was optimized while recognizing other resource values and priorities.

The objective of Run 4 was to determine the capacity of the land base to sustain a coniferous surge cut on the entire FMA for the first 20 years of the planning horizon followed by an even-flow harvest level that would be sustainable for 180 years. (Tesera 2004) The basic constraints include a 20 year adjacency requirement and a five year regeneration lag. Section 8.2 outlines all the timber supply parameters modeled in detail. As stated in the Tesera report, "The results show that the higher harvest levels identified in Run 4 can be maintained for 20 years without affecting the sustainability of the coniferous resources."

The Preferred Forest Management Strategy was accepted by SRD in the Decision Document. Since that time, the net land base was re-established and the Mountain Pine Beetle threat became more imminent. As well, agreement was reached with the members of the Community Timber Use program in terms of harvest sequence areas. The Addendum Report outlines the specific parameters used in the MPB enhanced Run 10 and also contains 25 year harvest sequence maps that include areas sequenced for the CTU program. In short, the surge harvest was focused on stands rated as highly susceptible to MPB attack. The harvest sequence maps for Run 4 have been retained as part of the original report for reference purposes. However, the Addendum Report harvest sequence maps now form the base for harvest design planning, monitoring and reporting.

Following is an explanation of how the PFMS (Run 4/Run 10) addresses a number of the management objectives identified in Chapter 5. Many of the objectives in Chapter 5 are addressed through operational strategies but a number are partially addressed through the TSA parameters. The enhancements made in Run 10 to focus on MPB susceptible stands are addressed specifically in the MPB discussion.

- All runs, with the exception of Run 2, through the Operational Harvest Sequencing function of the TSA model address minimizing access development. A finer resolution was achieved by using watersheds to concentrate harvest areas rather than the broader compartments. In addition, SLS is committed to minimizing access requirements and prompt reclamation as indicated in Chapter 5 and monitoring access construction/reclamation as indicated in Chapter 10.

- Mitigating timber harvest impacts on visual resources is accommodated a number of ways. In establishing the net productive forest land base, 34% of the FMA/B9 Quota gross area was set aside including approximately 25% of the forested area. The 20 year adjacency constraint and operational harvest sequencing results in a reduction in harvest volume of 13.3% from the unconstrained Run 2 leaving yet more unharvested area on the landscape. As a final step, SLS has elected to further reduce the sustainable harvest level by another 7.5% to minimize risk and be conservative given uncertainty around some of the other objectives related to other resource values. Chapter 5 further outlines operational commitments to reducing the visual impact of harvesting including stakeholder referrals, computer modeling and detailed block planning.

- Biodiversity is addressed in a similar fashion to aesthetics. In establishing the net productive forest land base, 34% of the FMA/B9 Quota gross area was set aside including approximately 25% of the forested area. The 20 year adjacency constraint and operational harvest sequencing results in a reduction in harvest volume of 13.3% from the unconstrained Run 2 leaving yet more unharvested area on the landscape. As a final step, SLS has elected to further reduce the sustainable harvest level by another 7.5% to minimize risk and be conservative given uncertainty around some of the other objectives related to other resource values.

  It is important to note that a minimum of 9.6 million m^3 of coniferous growing stock is present within the inoperable portion (passive land base) of the gross land base during the planning horizon. (Tesera report Run 4 summaries) In addition, the age class distribution improves on the net or active land base. However, in the absence of disturbance, the passive land base continues to age. The volume and age of the conifer growing stock on the passive land base could represent a significant challenge for dealing with Mountain Pine Beetle infestations.

  The spatial harvest sequence avoids for the most part rare ecosites identified in the landscape assessment. (Tesera report Appendix 7 maps) The rare ecosite maps will be further referenced at the time of operational harvest design planning.

  Block sizes for the most part are limited to current ground rule maximums. As stated in the Fire Regime study, harvest block sizes fall within the natural range of variation of fire size but is not representative of the natural range of variation because all harvest blocks are found at the bottom end of the spectrum. Block size will have to be re-assessed during the next ten year period in preparation for the next DFMP based on the completed Fire Regime study and the updated forest inventory.

  The URSUS report further assesses the impacts of timber harvesting (Run 2 and Run 4) on vegetation and wildlife. Information from the URSUS report (Section 8.3) indicates the following:

  - Old growth (>170 years) White x Engelmann Spruce forest supply increases steadily and markedly for both timber harvest scenarios (Runs 2 and 4). For example the Surge Cut scenario with adjacency and operational harvest sequencing in the south FMA resulted in a 48.2% greater supply of spruce forest (all old growth) in 200 years.

  - Differences in approach to timber harvest (i.e. Even Flow-Run 2 vs. Surge Cut –Run 4) did not appear to significantly alter the supply of high quality habitat for wildlife indicator species at the various time periods assessed.

  - Both Run 2 and Run 4 resulted in a more evenly balanced age class distribution of Lodgepole Pine forest than the current status, which is dominated by mid-seral stands.

    - The number of large (>100 ha) patches of high quality habitat for old growth forest wildlife indicator species generally increased at from 100 to 200 years.

    - Timber harvest approach did not significantly affect high quality patch size frequency for wildlife indicator species – indicating a strong natural succession effect.

    - Projection modeling shows that natural vegetation succession in the absence of fire will lead to a significant decline in deciduous and mixedwood forest cover types at from 50 to 100 years. High quality habitat supply for mixedwood dependent species also declines markedly at this time period.

  SLS will review the deciduous/mixedwood succession issue in preparation for the next DFMP.

- Harvest areas for the Community Timber Use Program (CTU) are identified as part of the spatial harvest sequence. (Tesera Addendum report – Run 10 – 25 year SHS maps) Blocks are scheduled for the north unit quota holders through to 2026. The CTP Open Category blocks and blocks for the south unit timber operators are identified through to 2016.

- Mountain pine beetle priority areas as identified by SRD were assigned the highest harvest priority available for all runs in the timber supply model with the exception of Run 2. Initially three areas were identified in the November 2004 analysis. The surge harvest (Run 4) does a better job of meeting the objective by harvesting more mature pine volume up front. Subsequent to the initial Timber Supply Analysis, a number of Provincial initiatives have been launched. (Refer to Chapter 5.7.2) As well a fourth MPB priority area was identified in July 2006 and factored into the MPB enhanced Timber Supply Analysis (Run 10).

  The mountain pine beetle priority areas, were assigned compartment ratings of “high” and therefore given the highest harvest priority in the timber supply analysis. Pine stands were also targeted across the FMA in the enhanced Preferred Forest Management Strategy within the constraints of the approved AAC focusing on Pine leading Rank 1 and Rank 2 areas as defined in the *Interpretative Bulletin - Planning Mountain Pine Beetle Response Operations*.

  In terms of the Prevention (Pine) Strategy (Chapter 5.7.2), SLS is working with SRD to interpret the MPB Stand Susceptibility Ranking results to set priority criteria for re-planning relative to the 25% in twenty years target. The forest land base retained on the landscape through the net land base exercise and adjacency constraints in the TSA modeling benefit other resource values but may prove to be problematic depending on how the MPB threat unfolds on the FMA/B9 Quota area. SLS will model more aggressive removal strategies outside this DFMP to assess against the target for review by SLS and SRD.

In the short-term, SLS has initiated a re-sequencing exercise. SLS has prepared Preliminary Harvest Designs for the MPB priority areas using the July 24, 2006 version of the MPB SSI as the guide (ASRD/Industry Mountain Pine Beetle Committee Meeting August 30, 2006 Minutes) and targeting stands within the net land base >= 50 for removal. SRD and SLS will re-evaluate the compartment risk annually based on beetle activity as part of the General Development Plan review. For more information on the timber supply analysis and the re-sequencing refer to Chapter 6 (inclusion of MPB Ranking in the net land base file) and Chapter 8 (incorporation of MPB ranking in the TSA).

- Community fire smart zones around Waiparous Village and West Bragg Creek where assigned the highest harvest priority available for all runs in the timber supply model with the exception of Run 2. The surge harvest does a better job of meeting the objective by harvesting more mature volume up front improving the age class distribution. SRD has initiated the planning process for the fire smart zone around the Waiporous Village. Fire smart planning has yet to be initiated by SRD in the West Bragg Creek zone.

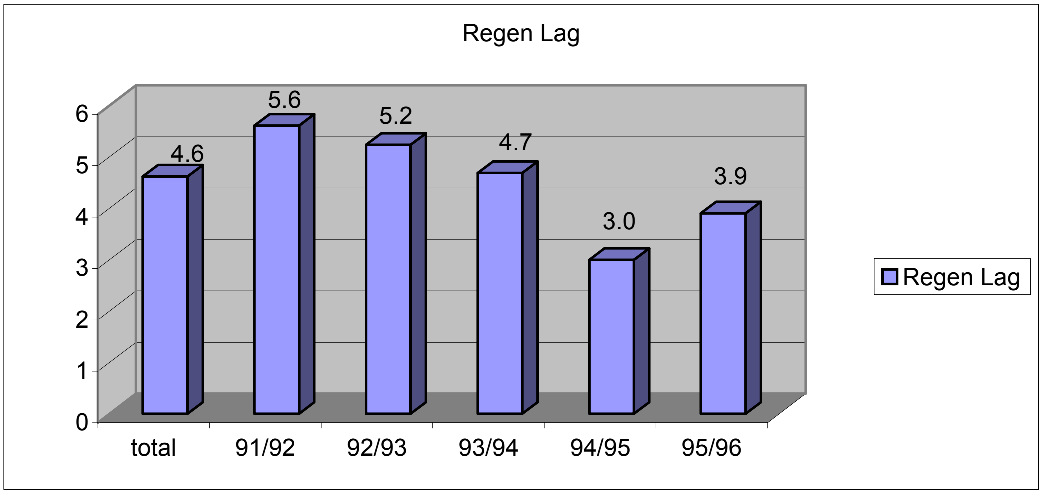
- Many historical resources are found along rivers and streams which have been removed from the net productive forest land base. In addition, a .5% reduction in the sustainable timber harvest level was included (part of the 7.5%) in the event further sites need to be set aside from the net productive land base. SLS is following an annual operational assessment process approved by Alberta Community Development.

- Integration objectives are in part accommodated through reductions to the harvest level. In establishing the net productive forest land base, 34% of the FMA/B9 Quota gross area was set aside including approximately 25% of the forested area. The 20 year adjacency constraint and operational harvest sequencing results in a reduction in harvest volume of 13.3% leaving yet more unharvested area on the landscape. As a final step, SLS has elected to further reduce the sustainable harvest level by another 7.5% to minimize risk and be conservative given uncertainty around some of the other objectives related to other resource values.

- To address reforestation realities, a five year regeneration lag was built into all the runs of the timber supply analysis. The lag was determined using an assessment protocol provided by SRD.

Regeneration Lag Assessment

Spray Lake Sawmills assessed the regeneration lag according to the September 20, 2004 criteria provided by SRD. Using the SRD methodology the regeneration lag was determined to be 4.62 years that has been rounded up to 5 years. The following graph summarizes the regen lag calculation.



The SRD assessment methodology is based on:

- Individual harvest areas within a stratum are assigned a regeneration lag.
- The individual harvest area regeneration lag values are averaged using area weighting.
- The regeneration lag for the stratum is the area-weighted average value. Depending on the means of input to the TSA this may have to be rounded, if this is the case then round up to the nearest whole number of years, i.e. a calculated value of 3.22 for a given strata would be input into the timber supply model as 4.
- Use the definitions for post-harvest strata described in the TSA to group harvest areas into strata.
- Do not include areas harvested prior to March 1, 1991 in the regeneration lag assessment. All regeneration lag assessment periods begin on March 1, 1991.
- Include all harvest areas for any given harvest year.
- Calculate a regeneration lag for each strata used in the TSA.

- Sustainable timber supply is the objective of all the TSA scenarios. Run 4 produces similar results to the even flow scenarios in final growing stock (total and operable), in age class distribution and in long-term harvest levels. Run 4 optimizes the timber supply available to the mill by producing the highest level of harvest without compromising other values on the landscape. Run 10 further enhances the positive attributes of Run 4 by focusing the surge harvest on Rank 1 and Rank 2 MPB susceptible stands. The spatial harvest sequence for Run 10 more accurately represents the spatial disturbance level as it was modeled based on the approved AAC, rather than the sustainable level (Run 4) prior to the subjective 10.57% AAC deductions.

Summary

Run 2 was not selected because although it met the mills economic and timber supply objectives, it did not meet the other social and environmental objectives as well as the other scenarios. The forest on the net land base under this scenario is very close to a fully regulated forest in terms of growing stock and age class distributions.

Run 3 produces similar results to Run 4 over the planning horizon. However, Run 4 produces more favorable results in terms of an optimized sustainable timber supply to the mill and in terms of dealing with the Mountain Pine Beetle priority areas and the Community fire smart zones.

Run 4 also met the optimized timber supply objectives better than the scenario runs that treated the FMA as two separate units. The model was able to produce a balanced timber harvest distribution between the north and the south while achieving efficiencies in terms of harvest polygon scheduling. Run 4 optimizes the sustainable harvest level without compromising other values on the landscape, including wildlife habitat values. Run 10 further enhances the positive attributes of Run 4 by focusing the surge harvest on Rank 1 and Rank 2 MPB susceptible stands.

8.6 DFMP Harvest Level

Following is Table 12 from the Timber Supply Analysis report (section 8.2). This table includes the 10.57% reduction to the sustainable timber harvest level as documented in the report.

Table 12 Net Average Harvested Volumes from the Preferred Management Option (Run 4)

Period	Net Average Conifer Target Level (m^3/year)	Net Average Annual Deciduous Volume (m^3/year)	Calculated Conifer AAC (m3/year)
2001-2006	318,523	42,326	318,602
2006-2011	318,622	48,951	318,602
2011-2016	318,873	49,014	318,602
2016-2021	318,391	47,455	318,602
2021-2026	289,630	51,014	289,815
2026-2031	291,407	45,936	289,815
2031-2038	290,662	59,190	289,815
2038-2048	289,585	49,702	289,815
2048-2058	289,826	51,976	289,815
2058-2068	289,420	62,829	289,815
2068-2078	289,330	55,773	289,815
2078-2088	289,574	56,112	289,815
2088-2098	290,693	60,978	289,815
2098-2108	289,383	59,732	289,815
2108-2118	289,330	51,438	289,815
2118-2128	290,142	53,124	289,815
2128-2138	289,346	56,969	289,815
2138-2148	290,074	55,762	289,815
2148-2158	290,222	52,711	289,815
2158-2168	289,488	59,047	289,815
2168-2178	289,447	56,321	289,815
2178-2188	289,512	49,478	289,815
2188-2198	289,404	58,725	289,815

Next is Table 7 from the Timber Supply Analysis Addendum showing the results from the MPB enhanced run.

Table 7. Preferred Management Strategy Harvest Results (Run 10)

Period	Average Annual Coniferous Volume (m^3/year)	Average Annual Deciduous Volume (m^3/year)	Annual Coniferous Volume Request (m^3)
2001-2006	320,876	41,396	318,602
2006-2011	319,015	44,530	318,602
2011-2016	319,072	43,972	318,602
2016-2021	318,834	47,249	318,602
2021-2026	319,154	46,512	318,602
2026-2033	290,360	33,681	289,815
2033-2043	289,917	47,715	289,815
2043-2053	289,960	46,612	289,815
2053-2063	289,997	46,716	289,815
2063-2073	289,468	50,469	289,815
2073-2083	290,770	52,795	289,815
2083-2093	290,196	54,253	289,815
2093-2103	290,475	61,613	289,815
2103-2113	289,923	48,519	289,815
2113-2123	290,626	48,652	289,815
2123-2133	291,159	51,870	289,815
2133-2143	289,917	49,510	289,815
2143-2153	290,028	45,566	289,815
2153-2163	290,365	44,848	289,815
2163-2173	290,310	40,371	289,815
2173-2183	291,568	47,046	289,815
2183-2193	290,060	48,448	289,815
2193-2203	290,416	42,829	289,815

SLS is formally requesting the coniferous AAC for the FMA/B9 Quota be maintained as approved in the DFMP Decision Document – April 28, 2005.

- 2001 – 2021 – 318,000 m^3/year
- 2021 – 2198 – 289,000 m^3/year

The Community Timber Use Program has a fixed volume of 36,100/m^3/year or 180,500m3 per five year quadrant.

The SLS harvest levels would be:

Period	Total AAC	Periodic Allowable Cut	FMA AAC	B9 Quota AAC
2001-2006	281,900	1,311,416*	243,587	38,313
2006-2011	281,900	1,409,500	243,587	38,313
2011-2016	281,900	1,409,500	243,587	38,313
2016 - 2021	281,900	1,409,500	243,587	38,313

* first quadrant is 4.65206 years.

Timber Supply Analysis

Spray Lake Sawmills DFMP

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1.0 Introduction

This Timber Supply Analysis has been prepared as an integral component of Spray Lake Sawmill's (SLS) 2004 Detailed Forest Management Plan submission for DFMP #1. A DFMP is a rolling 10-year plan that ensures forest activities on the land base are performed at a sustainable level. This DFMP will cover the land base illustrated in Figure 1, which shows a map of Spray Lake Sawmill's Forest Management Agreement (FMA) Area.

The intent of the Timber Supply Analysis is to provide an assessment of the landscape's capacity to support harvesting while maintaining other resource values. Specifically, SLS is interested in the coniferous timber supply that can be sustained on the land base. Additionally, SLS does have a requirement within the FMA agreement to provide for fixed volumes of coniferous and deciduous timber for Commercial Timber Permit (CTP) holders. The Forest Estate Model being used for this analysis, provided a number of flow options based on coniferous volume, with all deciduous volume being treated as incidental volume (deciduous stands are not targeted but deciduous volume is reported and harvested based on being in the targeted coniferous stands).

The Timber Supply Analysis incorporates several key components including:

- Public Involvement Process to account for society's concerns;
- Growth and Yield Analysis (completed by Golder Associates Ltd.);
- Net Land Base Definition (completed by Golder Associates Ltd.);
- Maintenance of biodiversity and wildlife values on the landscape; and
- Integration of existing operational (SLS's and other permit holder's) harvest plans.

Spatially explicit modeling is necessary to examine in detail the impacts of activities on the land base. The use of a spatial model ensures that resolution is maintained, whereby exact locations upon the land base are retained and adjacency impacts due to management objectives can be assessed. Spatial modeling also ensures the alignment between operational and strategic level management objectives is maintained. The operational plans that result from the analysis can be implemented easily by operations staff due to the fact that each polygon is capable of being mapped and sequenced, thereby proving an annual or periodic list of areas that need to be developed. An output of the spatial modeling is an explicit 15-year harvest sequence that is provided to Alberta Sustainable Resource Development (ASRD) in a set of maps. Additional summaries are provided in graphical or tabular formats.

The spatially and temporally explicit resource modeling provided by Tesera Systems Inc. (Tesera) uses inventory data, growth and yield information, selected indicators and chosen management regimes to represent how landscapes can be affected over extended planning horizons. The Forest Estate Model used for this analysis, is the Tesera Scheduling Model (TSM) - which has been developed and maintained by Tesera Systems Inc. The spatial modeling and other services provided by Tesera, forms the basis of the Tesera System for Sustainable Resource/Integrated Landscape Management, which is based on an adaptive management framework, illustrated in Figure 2.

Figure 1. Map of Spray Lake Sawmill's Forest Management Agreement Area

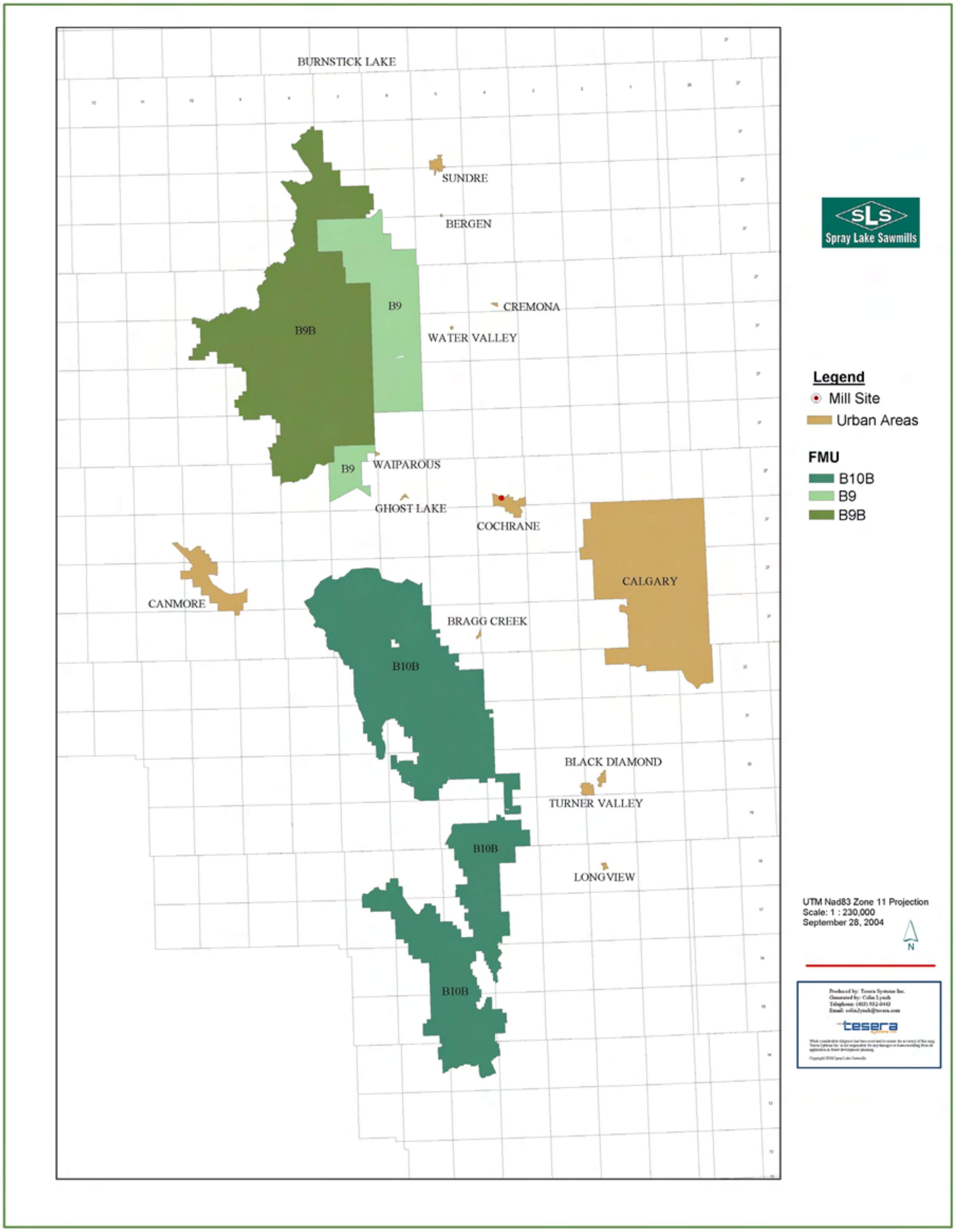
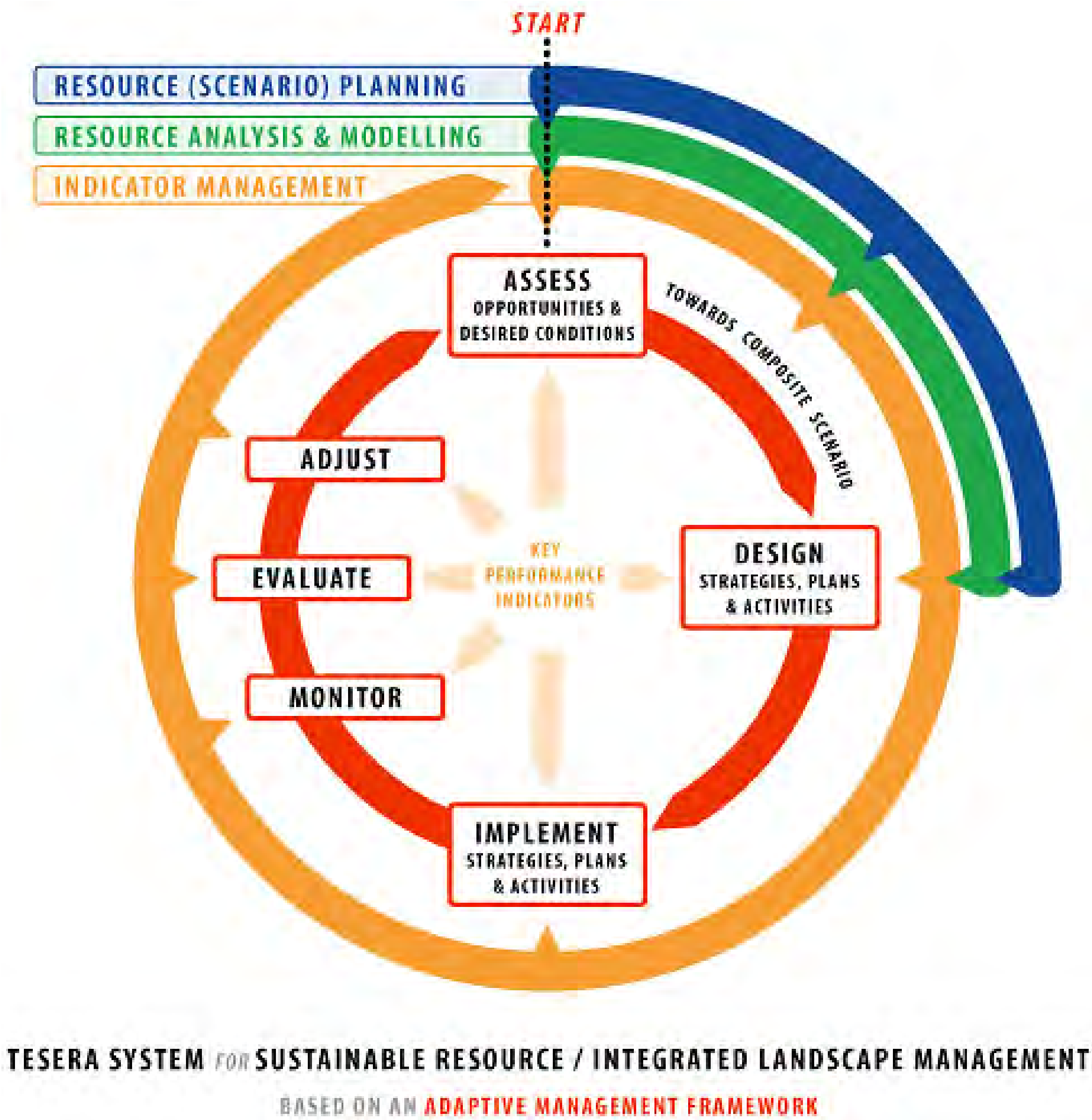


Figure 2. Tesera System for Sustainable Resource/Integrated Landscape Management



2.0 Land Base Description

This analysis featured a land base determination by Golder Associates Ltd.

2.1 Timber Harvesting Land Base Determination Derived By Golder Associates Ltd.

One of the most critical components of the Timber Supply Analysis is the netdown procedure used for determining the Timber Harvesting Land Base (THLB). Golder Associates Ltd. completed this component of the analysis, which dealt with preparation of GIS data layers and netdown processing. A detailed description of the process can be found in the report "Detailed Forest Management Plan Net Land Base Calculations Report" and the final THLB summary table is provided in Table 1.

Table 1. Golder Netdown Summary Table

Summary Criteria		Area (ha)
NOTE: All percentages are the proportion of the gross land base, unless otherwise noted.		
Gross FMA/Quota Land base		
	Gross Forested Land	295 147.50
	Gross Non-forested Land	42 299.76
	Total Gross Stand Area	**337 447.29***
Horizontal Stand Reduction		
	Horizontal Stands	3 100.26
		334 347.03
Gross Private Land*	Private Land	8 873.55
*Includes Facility, Industrial and Patent		
Gross Areas of Restricted Operability Due to Land Status (by type)		
1	Agriculture	66.86
	Facility	171.77
	Industrial	262.37
	No esip (facility)	19.59
	No esip (Patent)	8 439.42
	Prime Protection	13 317.15
	RMA 'A'	341.19
	Special Use	2.03
	Water	2.55
2	Recreation Areas	1 856.80
3	Permanent Sample Plots	90
	Subtotal	**24 569.72**
		309 777.27
Gross Polygonal Hydrography		
4	Polygonal Hydrography	1 073.52
		308 703.75
Non-forested Land (excludes cutblocks)		
5	Non-forested land	30 310.42
		278 393.33
Gross Operability and Slope Constraints (includes SLS deletion)		

Summary Criteria		Area (ha)
6	Slope 46-55%	9 778.30
	Slope 55+%	6 507.73
7	SLS Deletion	578.99
	Subtotal	**16 865.02**
		261 528.31
Access Features (not captured in AVI)		
8	Paved Roads	31.23
10	Gravel Roads	114.88
11	Pipelines	31.15
12	Truck Trails	89.48
13	Cutline/Sesmic/Trail	1 576.58
	Subtotal	**1 843.33**
		259 684.98
Riparian/Hydrography Buffers		
14,15,16	Riparian/Hydro Buffers	5 315.16
		254 369.82
Subjective Deletions (all excludes cutblocks)		
17	Non-merchantable	11 965.92
	Larch Component	516.69
	Black Spruce	1 135.64
	Pine (<=6m & older than 1945)	370.95
	Pine (6<=x<=12m & older than 1925)	17 971.49
	Subtotal	**31 960.68**
Net Stand Area Contributing to Harvest Levels		**222 409.13**

* Gross Area does not represent 230.42 ha of area identified in the database as FMU = “OUT”.
Referenced from: “Detailed Forest Management Plan Net Land Base Calculations Report”, Golder Associates Ltd.

2.2 Adjustments to Golder’s Net Land Base

The net land base file provided by Golder did not have all the data required for completing this analysis. Additionally the net land base also required updates to account for blocks that were previously harvested but not part of the ASRD depletion coverage provided to Golder by the ASRD. These adjustments were necessary to accurately reflect the land base at Time 0. These adjustments are described in detail in the following sections.

2.2.1 Area Rounding

During the processing of the data to re-format the land base data for use with TSM, some minor rounding occurred. This rounding had occurred on over 200,000 polygons resulting in an initial gross area of 336,381.22 ha. This resulted in a 1,066.07 ha difference between Golder’s gross land base area (337,447.29 ha) and Tesera’s gross land base area (336,381.22 ha). Due to the rounding occurring over a large number of polygons (over 200,000), this artifact does not have a substantive impact on the various land base attributes or the classifications developed as part of the net down process.

2.2.2 Horizontal Stand Reduction

Golder accounted for the horizontal stands in the net land base by applying a percent reduction to each polygon to develop a new area (ha) which contributed to the merchantable area (Refer to the "Detailed Forest Management Plan Net Land Base Calculations Report" performed by Golder). This horizontal stand reduction was detailed in the net down table, however it was not explicitly applied to stands within Golder's net land base file. As a result, Golder's percent reduction process had to be applied explicitly to the stands in the analysis dataset.

To provide an efficient way to make these adjustments, Golder provided an MS Access database that had listed by polygon, the horizontal stands and percent reductions in hectares to be applied to the gross area of each polygon. This percentage reduction was made within the model, in order for each polygon to account for the horizontal stands within the TSM land base file.

2.2.3 Harvest Units Not in the ASRD Depletion Update

ASRD is responsible for maintaining and updating the depletion updates for quota holders. Prior to 2001, SLS was a quota holder so the updates were the responsibility of ASRD. During the later stages of the Timber Supply Analysis and after the net land base was submitted by Golder, it was noted that several blocks from the 1995, 2000 and 2001 harvest seasons were not included in the ASRD depletion updates. These blocks were re-aged to the known age through SLS's records and assigned to the appropriate yield strata. Appendix 1 shows the blocks that were updated by Tesera.

2.2.4 Additional Data Layers

Additional data layers were incorporated into the analysis after Golder completed the net land base. This was necessary to provide more flexibility in terms of modeling by prioritizing harvesting in particular regions, such as the 10 kilometer FireSmart areas around populated areas and the beetle priority zones identified by ASRD.

2.2.4.1 Blocking Coverages

The initial intent was to use the Alberta Vegetation Inventory (AVI) as the blocking coverage, however, since the AVI had large polygons greater than 100 ha that would require manually splitting the polygons – an automated approach of developing the blocking coverage was used. Therefore, Tesera used specialized GIS routines developed outside the model to aggregate stands, which can consider operational issues such as age classes, species mix and harvest parameters.

At this time, TSM does not perform aggregation internally within the model. Individual resultant polygons can be scheduled but the result is a fragmented harvest schedule since the model can not perform aggregation. To enable greater flexibility in modeling, 2 blocking coverages were incorporated into the resultant – a 20 ha and a 100 ha maximum blocking coverage. This allows various block sizes to be modeled and assessed throughout the planning horizon, while using blocks that may represent operational reality.

These blocking coverages were overlaid onto the Golder netdown coverage and small slivers were removed to reduce the dataset size, from over 1.2 million records to 666,553 records. The sliver removal was restricted to stands less than 1 square metre (m^2) in area, so the impact to the resulting land base and how it is represented was minimal.

To maintain the dataset at a manageable size (666,553 records) the following coverages were attribute tagged to the revised resultant coverage that was created. The attributes for the coverages were attribute tagged using a 50:50 rule, 50% of the target polygon (Community FireSmart buffers, Beetle Zones, and

Watershed) must be within 50% of the resultant polygon (resultant coverage containing 666,553 polygons) to be tagged as within the FireSmart Buffer, Beetle Zone and Watershed). Given the high number of polygons in the resultant file, the tagging matched up well with the original vector coverages.

2.2.4.2 Community FireSmart Areas

The Community FireSmart areas are identified as a 10 kilometer radius buffer around the communities of Waiparous and West Bragg Creek. Within these areas, the intent is to reduce the wildfire threat by removing the fuels having higher hazard rates. To remove the fuels of the higher hazards classes, harvesting will be concentrated within these 10 km Fire Smart buffers. These areas are predominately pine of various age ranges and any stands within these areas, which met the minimum harvest ages were assessed for harvesting opportunities prior to stands outside the FireSmart zones.

2.2.4.3 Mountain Pine Beetle Priority Areas

The Mountain Pine Beetle (MPB) epidemic is a growing concern and is resulting in re-allocation of timber supply Allowable Annual Cut (AAC)'s in many parts of British Columbia. Currently, MPB is found in sections around Banff, as well as the Bow River Valley, outside the SLS FMA. The ASRD identified 3 regions within the SLS FMA that are high potential entry points for MPB. In an effort to stop the spread of MPB into the FMA from areas adjacent to the FMA, a concerted effort in targeting mature to over-mature timber stands within the high potential entry points for harvesting was utilized. Targeting the harvesting of these stands prior to considering stands outside these zones, will accomplish that. With the exception of the stands within the 10 km FireSmart buffers (above), any stands that meet the harvest criteria were assessed for harvest prior to other stands within the FMA. MPB susceptible stands and the FireSmart areas were assigned the highest harvest priority (1) available within the model.

2.2.4.4 Watersheds

To further refine the land base and allow for easier operational implementation of spatial harvest areas – the watersheds were used to prioritize the harvest during the 200-year planning horizon. This coverage was developed from the Fire Regime Study performed by Wildland Disturbance Consulting. This allowed the model to sequence stands to a finer resolution rather than only using compartments, thereby providing a more realistic operational plan. For example, the model could sequence stands based on drainages (following heights of land, etc.) thereby allowing easier operational implementation of the resulting management plan.

2.3 Timber Harvesting Landbase Determination Derived By Tesera Systems Inc.

Table 2 illustrates the net land base area that resulted from the Golder process and the corresponding net land base area when the changes outlined in sections 2.2.1 – 2.2.3 were addressed. The net land base definition for each polygon in the resultant was adjusted to reflect the actual/planned blocks and blocks that were not in the ASRD depletion updates. For example, if a portion of a planned block or an existing cut block was coded in the Golder net down file as being outside the net land base, it was re-assigned to being inside the net land base (i.e. capable of being harvested). A brief description of the GIS and Access processing steps is outlined in Appendix 2.

Table 2. Tesera Net Land Base Area

Net Land Base Calculation from Golder (ha)	Additional Proposed Cutblocks outside Golder Net Land Base Area (ha)	Tesera Net Land Base (ha)
222,409.13	350.13	222,759.26

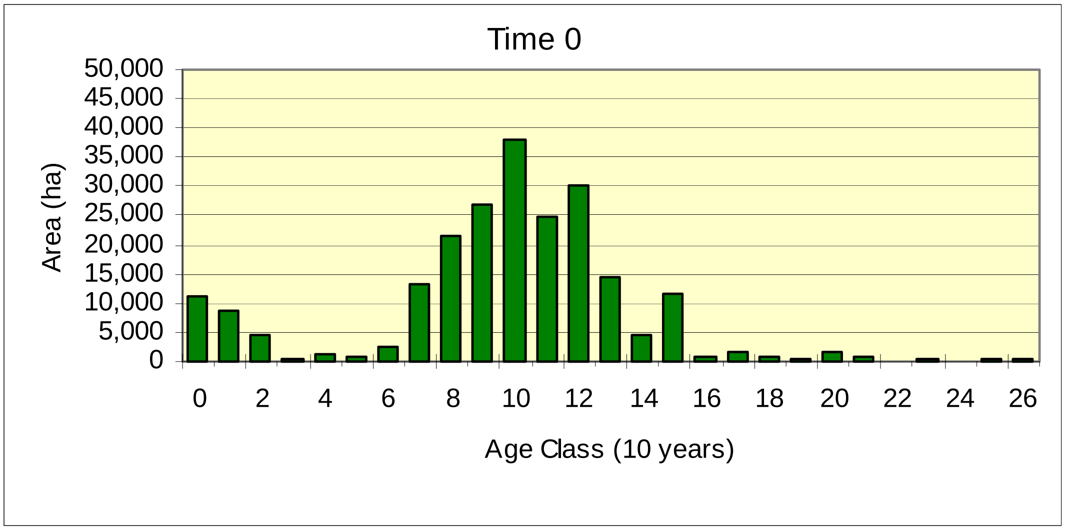
2.4 Description of landbase

The age class distribution within the net land base at Time 0 is shown in Table 3 and Figure 3. This is based on the current inventory data and adjustments made to the TSM dataset as part of the modeling process. A map of the age class distribution is also provided for the net and gross land base (Appendix 3).

Table 3. Time 0 Age Classes in 10-Year Periods

Age Classes (10 years)	Area (ha)	Percentage (%)
0	11,265	5.06
1	8,722	3.92
2	4,667	2.09
3	223	0.10
4	1,343	0.60
5	1,008	0.45
6	2,584	1.16
7	13,185	5.92
8	21,302	9.56
9	26,740	12.00
10	38,113	17.11
11	24,659	11.07
12	30,302	13.60
13	14,283	6.41
14	4,471	2.01
15	11,469	5.15
16	1,027	0.46
17	1,541	0.69
18	808	0.36
19	599	0.27
20	1,796	0.81
21	1,004	0.45
22	124	0.06
23	454	0.20
24	103	0.05
25	398	0.18
26	568	0.26
Total	**222,759**	**100**

Figure 3. Time 0 Age Class Graph



3.0 Yield Tables

Yield curves are used within the Timber Supply Analysis to project stand volumes over time. For this analysis, all yield curves were developed by Golder Associates Ltd. and the process used to develop the data is detailed in the report “The Growth and Yield Component of Spray Lake Sawmills Detailed Forest Management Plan”.

The yield tables are based on 10-year intervals and contain both coniferous and deciduous volumes with accompanying Mean Annual Increment (MAI). All stands are assumed to regenerate back to the same strata type. For those stands where the strata could not be determined (past cutblocks that pre-date spatial silviculture records, etc.), a composite curve was used to represent the stand. For information on how the composite curves were developed, also refer to the Golder report, “The Growth and Yield Component of Spray Lake Sawmills Detailed Forest Management Plan”.

The assignment of yield curves to polygons was performed by Golder during development of the net land base. For further information on the yield strata assignments, refer to the Golder report titled “Detailed Forest Management Plan Net Land Base Calculations Report”. During the Timber Supply Analysis, any areas within the THLB that did not have an assigned strata (yield curve) were assigned to the composite strata, e.g. (cut blocks that were missed in the SRD depletion updates).

The yield curves developed by Golder were only projected to 300 years of age. During model forecasting, stands can remain on the land base for a duration exceeding 300 years. Therefore, stands older than 300 years of age were assumed to have the same values as the 300 year old stands since information was not available for stands older than 300 years. This assumption has a minimal effect on stands within the net land base, since 0.92 ha is over 300 years of age at the start of the analysis. Outside the net land base, stands greater than 300 years of age comprise approximately 105 ha at Time 0 of the analysis (2001). The yield strata assignments at Time 0 are shown in Table 4.

To model the entire land base including non-forest, a zero volume curve (No_Vol) was added to the strata list in the model. This curve had no volumes or MAI and was only assigned to polygons that were non-forested areas. There was a total of 42,553.64 ha that received the zero volume curve assignment.

Table 4. Time 0 Area (ha) within Each Yield Strata

Yield Strata	Gross Area (ha)	Net Land Base (ha)
B10B Pine	93,000.59	63,715.09
B10B Spruce	33,977.70	21,789.21
B9 Pine	93,367.79	76,842.67
B9 Spruce	24,769.62	17,735.37
Mixed wood	18,928.88	15,869.08
Deciduous	20,799.82	17,876.49
Composite	8,983.18	8,929.63
No Volume	42,553.64	1.72
Total	**336,381.22**	**222,759.26**

4.0 Timber Supply Analysis Model

Timber Supply Analysis Model Name: Tesera Scheduling Model (TSM).

Creator: Tesera Systems Inc.

Version Number: 1.1

Model Type: Spatially explicit integrated simulation/optimization model

Model Capabilities: TSM is a proprietary software developed by Tesera Systems Inc. and is often termed a “forest estate model”. The Tesera Scheduling Model is supported and maintained by the Tesera Systems Inc. through internal research and development and represents one of the many tools Tesera uses to provide clients with professional products such as mapping, reporting and visualizations, as well as resource agency and public sector facilitation an decision support services.

TSM is an analysis tool designed to assess the impact of spatial and non-spatial objectives and targets over time and space. It is an integrated simulation/optimization model that works on vast land areas – which makes it ideal for cumulative effects assessment and for linking strategic, tactical and operational planning levels. TSM is ideally suited to support initiatives such as integrated resource management (IRM) planning, Environmental Management System planning (e.g. ISO 14000), and sustainable forest management certification (e.g. CSA-SFM Z809-2002) since it can model present and potential future land and environment conditions (indicators) and identify and forecast potential changes to those indicators over time.

TSM forms the basis of a comprehensive integrated resource management modeling suite, when used in conjunction with its supporting applications (for automated treatment unit generation [block coverages] and road network creation). Together these modeling tools allow resource planners and managers to analyze how entire land bases (often many millions of hectares in size) can be managed in order to provide a sustainable flow of social, economic and environmental benefits over time.

TSM is a hybrid between simulation-based models and heuristic-based optimization models, and draws on the strengths of each approach towards solving resource management problems. TSM can be run in either aspatial or spatial modes, and in either of two algorithmic approaches – sequential simulation or simulated annealing (optimization).

For the SLS Timber Supply Analysis, TSM was used in the spatial mode using the simulation algorithm, which has been described below.

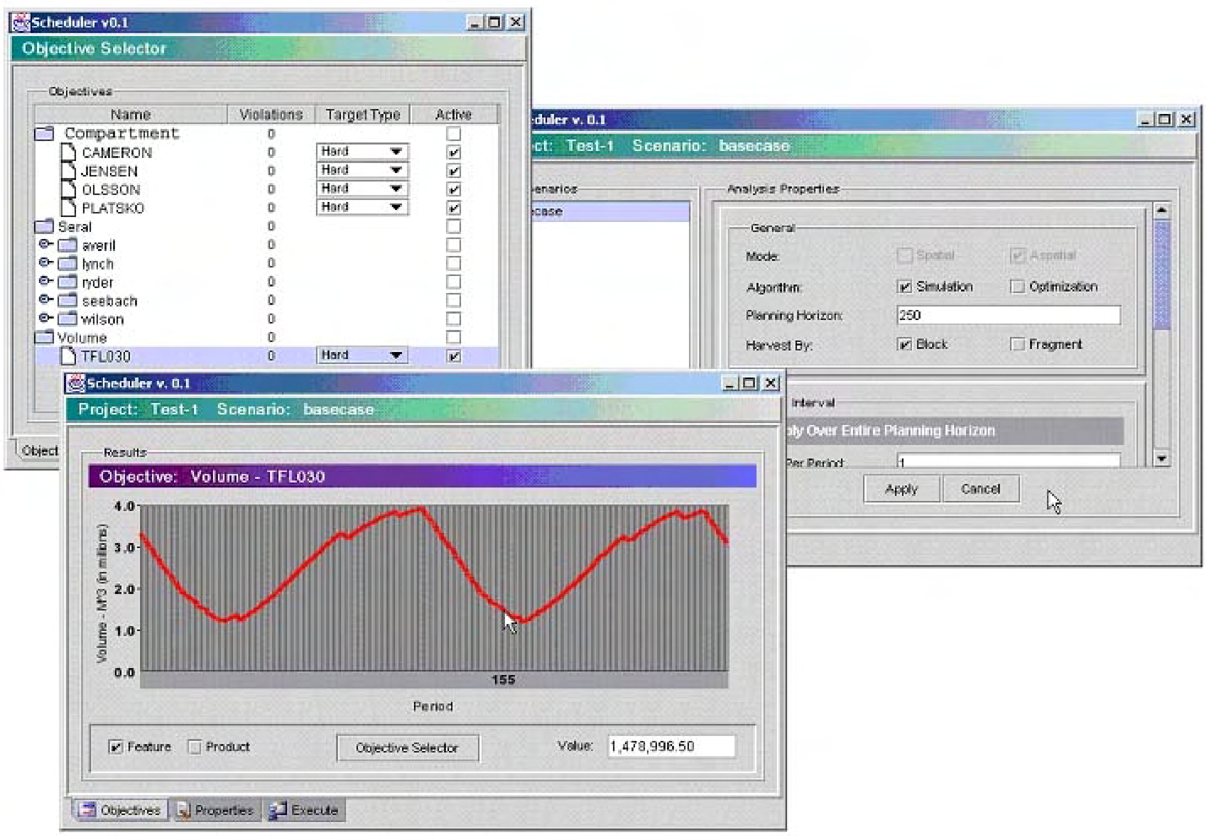
In its spatial mode, TSM provides comprehensive decision support for both strategic and operational planning initiatives across a wide range of planning scales. Since TSM maintains the spatial location of forest stands, harvest units, resource development zones, special management areas, and other land base resource and values, it is capable of not only providing estimates of timber supply, forest inventory and resource indicator changes over time. TSM also provides a direct linkage between strategic, tactical, and operational planning since analysis results can be displayed on a map and land-based inventory (i.e. forest cover) changes are clearly tied to treatment unit polygons.

Spatial relationships between polygons within the dataset are defined through an adjacency table, generated via GIS, which lists for each polygon in the dataset its adjacent neighbour polygons. Spatial constraints and/or targets such as adjacency and block size can be modeled explicitly rather than through the forest cover target approximations required under an aspatial approach if the data is available. As a result, indicator forecasts obtained using TSM's spatial mode tend to be more reliable and offer a more accurate picture of how a land base responds under multiple management regimes.

As with other models which use sequential simulation, targets applied are typically hard (i.e. targets must be achieved and no variance is permitted) and the resource utilization/harvest "queue" is subject to priority settings required under the scenario. As a result, outcomes using a simulation algorithm can be explained more readily and resource conflicts can be clearly identified and quantified – making this algorithm more useful for developing resource management objectives, strategies and targets than an optimization algorithm.

Examples of some of the graphical user interfaces (GUIs) developed for the Tesera Scheduling Model are shown in Figure 4.

Figure 4. TSM User Interfaces



The next few paragraphs describe how the model sequences stands for harvesting.

Based on the state of the land base at the midpoint of the period, scheduling occurs relative to the harvest scheduling priorities specified. Harvest scheduling priorities and constraints may be changed and/or made inactive within user-specified portions of the planning horizon. TSM supports the following harvest scheduling priorities which are evaluated in the order listed as follows:

1. Fixed Schedules or Prescribed Harvests. This option is typically used where areas have been approved for harvest under existing plans. TSM will harvest these areas regardless of constraint

violations except for minimum harvest age requirements and land base reductions (netdowns) in the periods specified.

2. Treatment Unit. Blocks prioritized for harvest will always be allocated to the top of the harvest queue in each period but will only be harvested if minimum harvest age criteria are met and no constraint violations would occur.
3. Geographic Zone. TSM supports several user defined zonation hierarchies (resource emphasis zonation, landscape units, operating areas, watersheds, etc) to which harvest scheduling priorities may be assigned.
4. Stand Group. TSM's file structure supports user defined stand classification and aggregation schemes. Stand groups may represent individual inventory forest cover polygons or aggregates. Priorities can be assigned to individual and multiple stand groups.
5. Harvest Selection Method. The options are:
    - Relative Oldest First
    - Oldest First
    - Youngest First
    - Relative Youngest First
    - Maximum Volume
    - Maximum Volume/Hectare
    - Unsorted
    - Randomize

Once the harvest queue for the period has been sorted as specified by harvest scheduling priorities, TSM goes to the polygon or block that has the highest harvest priority that is eligible for harvest (not reserved, meets minimum age requirements and not excluded due to adjacency) and temporarily harvests the polygon or operable polygons within the block. At the same time it checks that all constraints have been applied, and then projects the impacts into the future. If no constraint violations occur, TSM accepts the harvest of the polygon or block, updates the polygon attributes and goes to the next polygon or block in the queue. If constraint violations do occur, TSM rejects the harvest of the polygon or block, and goes to the next polygon or block in the queue. This continues until no further harvest opportunities are available or until the target harvest level set for the period has been achieved. The cycle is repeated until the end of the planning horizon is reached.

TSM supports clearcut and/or user specified prescriptions and location specific partial cut silviculture systems. TSM can support both uneven-aged (single tree selection) and even-aged (group selection) partial cutting systems. Uneven-aged systems require input of growth and yield curves from external models. Even-aged partial cutting systems within TSM are expressed as a percentage of area retained within a polygon. The age class composition of partially cut polygons using even-aged systems are explicitly tracked and assessed. Silviculture treatments are handled through new curve sets supplied or via base curve set modifiers which are applied post treatment.

4.1 History of Model and Model Use in Alberta and Canada

Established in British Columbia in 1997, **Tesera Systems Inc**. developed TSM and other proprietary software tools and applications to support a complete suite of comprehensive services for the Sustainable

Forest Management/Sustainable Resource Management communities of interest. In this regard, much of the initial use and application of TSM has been in BC. To support the application of TSM in BC, the BC Ministry of Forest's Timber Supply Branch reviewed TSM in all its potential modes of operation and accepted the use of TSM for providing decision support related to AAC determinations (letter of reference is located at www.tesera.com). Tesera Systems has successfully applied these technologies in the following areas in BC:

- **Kidprice Landscape Unit Analysis** (101,000 ha.), prepared for Northwood Inc. (now Canadian Forest Products Limited), Houston, BC.
- **Mackenzie Land & Resource Management Plan (LRMP) Impacts Analysis** (6 million ha), prepared for the Prince George Forest Region, BC Ministry of Forests, Prince George, BC.
- **Robson Valley Enhanced Forest Management Pilot Project Scenario Planning Project** (1.2 million ha), prepared for the Robson Valley Forest District, BC Ministry of Forests, McBride, BC.
- **Robson Valley Timber Supply Area** (1.2 million ha), and **Mackenzie Timber Supply Area** (6 million ha) **Type 2 Incremental Silviculture Analyses**, north-central BC.
- **Morice & Lakes TSAs Innovative Forest Practices Agreement** (2.6 million ha), north-central BC.

The Timber Supply Analysis being conducted for the Spray Lake Sawmills (1980) Ltd. Forest Management Agreement represents the first application of TSM in the province of Alberta. Though the province of Alberta does not "approve" models for Timber Supply Analysis, the Resource Analysis Section of the Alberta Ministry of Sustainable Resource Development has reviewed TSM and has indicated that it appears appropriate for use in Alberta (personal communication ASRD 2003). Due to the flexible nature of TSM and its utility for integrated resource management, it is being considered for use by other organizations in Alberta to address spatial and temporal aspects for integrated resource and land management.

5.0 Data Preparation

Golder delivered the netdown coverage in September of 2004. Once received, Tesera GIS personnel overlaid the blocking coverages and attribute tagged the FireSmart 10km community buffers, the MPB priority zones and the watershed data onto a new resultant that produced 666,553 records.

Once the GIS processing was completed, the rest of the work involved to format the land base file and modeling criteria for use with TSM were developed using a combination of MS Access and data preparation executables developed by Tesera. Enclosed with this submission, is a CD containing the MS Access databases that were used to develop the TSM dataset and the associated csv text files used for each run.

6.0 Timber Supply Analysis Parameters

The following sections will outline the parameters used for this analysis.

6.1 Harvest Periods & Planning Horizon

The Timber Supply Analysis model was run with a 197-year planning horizon incorporating 5, 7 and 10 year harvest periods as shown in Table 5.

Table 5. Periods with Corresponding Harvest Year

Period	Year	Period Length (years)
1	2001-2006	5
2	2006-2011	5
3	2011-2016	5
4	2016-2021	5
5	2021-2026	5
6	2026-2031	5
7	2031-2038	7
8	2038-2048	10
9	2048-2058	10
10	2058-2068	10
11	2068-2078	10
12	2078-2088	10
13	2088-2098	10
14	2098-2108	10
15	2108-2118	10
16	2118-2128	10
17	2128-2138	10
18	2138-2148	10
19	2148-2158	10
20	2158-2168	10
21	2168-2178	10
22	2178-2188	10
23	2188-2198	10

6.2 Forced Harvest

Harvest units within SLS's Annual Operating Plans (AOPs) were assumed to be harvested within the first period (2001-2006). The CTP holder's operational plans were also incorporated into this DFMP. Based on the CTP holder's input on October 7th, 2004, the first-pass harvest units were forced to be harvested within period 1 and period 2. Second-pass harvest units were not forced to be harvested by the model, rather the approach was to sequence the second-pass blocks using the model's harvest prioritization rules.

On October 21st, 2004 an additional meeting with the CTP holders revealed that some of the dates planned for harvesting within the Dogpound CTP area, were reversed. What was forced to be harvested by the model in Period 1, was in reality going to be harvested in Period 2 and what was going to be harvested in Period 2 was actually being harvested in Period 1, within the next 2 years. Since the scenarios and reports were already generated, SLS staff had discussed this issue with local ASRD personnel and they indicated that the issue of re-arranging CTP blocks would not have to be dealt with in the modeling environment (i.e. the runs were already performed and would not have to be redone).

6.3 Harvest Priorities

Harvest priorities refer to how the model prioritizes the harvest queue. In this case the harvest queue is sorted by “Relative Oldest First”. Relative Oldest First, attempts to minimize the loss of volume on a stand by sorting the polygons based on oldest first, and then calculating the volume loss of each fragment for the period. The fragments that are losing higher proportions of volume are sorted higher in the harvest queue. This differs from “Oldest First” harvest priority, whereby Oldest First just assesses the age of the stand and not the volume loss. Typically Relative Oldest First is used, so that stands of older age classes and declining volume losses are prioritized for harvesting prior to stands that are old but are still maintaining volume or aren’t experiencing significant volume losses.

As previously discussed, harvest priorities were used to ensure that stands within the Mountain Pine Beetle Zones and the 10km FireSmart buffers around communities were assessed for harvest opportunity prior to other stands being assessed. Once the model sorted through these stands, it was then prioritized by areas where current harvest operations were underway using the watershed layer. The watershed layer had finer resolution than the compartment layer, allowing for better concentration of harvesting within areas where operations were ongoing. The sequencing based on selected watersheds remained until period 6 (30 years into the future), after which all areas within the harvestable land base were available for harvesting.

6.4 Cover Constraints

Given the fact that this was SLS’s first DFMP and data in terms of appropriate targets and thresholds were unknown at this point, SLS decided that the best approach would be to develop an annual monitoring program to assess these indicators rather than develop hard targets or thresholds. This initial monitoring program would be based on using professional judgment of specialists to manage the resources accordingly.

Growing stock was treated as “indicator only” in this analysis and harvest opportunity was not limited based on minimum required growing stock levels – the intent of this analysis was to ensure sustainable growing stock and harvest levels over time.

To account for horizontal stands, a cover constraint within the TSM model was used. This was a modeling artifact, since many models do not have the ability to perform netdowns directly within the model – this is a unique feature within TSM. A cover constraint was used to calculate the aspatial netdown to account for the horizontal stands and corresponding percent reductions to merchantable area, as identified by Golder Associates Ltd.

Other issues modeled within this analysis acted to limit harvesting opportunities on the land base, such as adjacency, spatially identifying areas within and outside the net land base – including riparian buffers, subjective deletions, etc. This will be described in subsequent sections.

6.5 Adjacency

For this analysis, adjacency was used as a surrogate to model for other resource values in the absence of value specific data. The ASRD provincial default guideline of 20 years of age for coniferous stands was used for this analysis. Based on SLS regeneration/free growing surveys, this green-up age of 20 years corresponds to trees reaching an approximate green-up height of 3 metres.

Within the land base there were many small blocks resulting from the AVI polygons not being rectified against the existing harvest units identified in the aerial photography, slope coverages, etc. When adjacency was applied to these small blocks, they in effect had locked up the land base to preclude harvesting. It was decided that only blocks greater than or equal to 4.0 ha. would be required to meet the adjacency guidelines. This 4.0 ha benchmark was used since this is the smallest polygon size that the AVI recognizes.

To mitigate adjacency issues, other silvicultural systems can be utilized such as partial cutting which negates the need of a 20 year adjacency rule, since there's always a dispersed amount of standing basal area (or volume) in the stand. There was not ample time to assess the impact of using partial cut silvicultural systems on the land base but this is an issue that should be explored in the next DFMP or updates to this DFMP if necessary. Although the model considered Aspen volume as being harvested, operationally Aspen will be left intact where possible for other resource values.

6.6 Regeneration Delay

The regeneration delay for this analysis was set at 5 years. Regeneration delay is the period of time from harvest to successful regeneration of the stand. SLS studies confirmed a 5 year regeneration delay was appropriate using the silviculture records and the regeneration delay model developed by ASRD.

6.7 Maximum Block Size

Generally, the maximum block size used for this analysis was 100 ha. However, in a few instances where a particular stand was surrounded on three sides by areas not within the THLB, the stand was combined into a unit that was already at the 100 hectare limit – creating a harvest unit of 117 hectares. Blocks that were forced to be harvested in the first and second periods were not adjusted to meet the maximum block size restrictions. Blocks that were forced to be harvested, were harvested regardless other modeling parameters including minimum age, block size restrictions or adjacency.

6.8 Minimum Harvest Age

The minimum harvest age for existing stands and regenerating stands was set to 80 years of age. This minimum harvest age is only a minimum and does not imply that stands are targeted for harvesting at 80 years of age. The relative oldest first harvest priority rules and constraints on the land base are still enforced and if a stand is still capable of being harvested, the minimum harvest age is assessed. If the stand meets the minimum harvest age and meets all other criteria, and the target harvest volume to be achieved has not been met, then the stand will be harvested if it is over 80 years of age.

6.9 Silvicultural Systems

The clearcut harvest method was the only silvicultural system modeled in this analysis. As such, retention percentages were not provided – they will be applied and monitored external to the modeling exercise.

6.10 Cull Reductions

Cull reductions were not applied within TSM. The reductions due to cull were applied externally to the model. For details on the cull reductions, refer to Golder's report titled The Growth and Yield Component of Spray Lake Sawmills Detailed Forest Management Plan".

7.0 Scenario Definitions

Spray Lake Sawmills determined that eight scenarios would be modeled and assessed in order to investigate the implications of various management options upon the FMA area. Some of these scenarios were required through policy documents and others were requested in support of management policies being considered by SLS.

- **Run 1 -** Detailed Theoretical Long-Run Sustained Yield Average (LRSYA) Calculation (Run 4 in 1998 Supplemental Guidelines
- **Run 2** – FMA Even Flow without Adjacency & Operational Harvest Sequencing (Run 1 in 1998 Supplemental Guidelines
- **Run 3** – FMA Even Flow with Adjacency & Operational Harvest Sequencing using SLS Management Options (Run 2 in 1998 Supplemental Guidelines
- **Run 4** – FMA Surge Cut with Adjacency & Operational Harvest Sequencing
- **Run 5** – North FMU Even Flow with Adjacency & Operational Harvest Sequencing
- **Run 6 -** South FMU Even Flow with Adjacency & Operational Harvest Sequencing
- **Run 7** – South FMU Surge Cut with Adjacency & Operational Harvest Sequencing
- **Run 8** – North FMU Surge Cut with Adjacency & Operational Harvest Sequencing

Generally, the run parameters, which remain unchanged for all the runs include:

- Areas reserved from harvest;
- Productive and the Net Land Base (THLB); and
- Growth and Yield Data, and Yield Strata assignments.

All input, output and result summary files for each of the runs can be found in Appendix 4, (CD-ROM/DVD). The input files for each run consist of the following text files (csv format) located in a directory named after the run, under the data directory. The files along with a brief description are listed below:

- Batch.txt – the set-up file used to provide instructions to the model regarding the type of run, harvest priorities, etc.
- Block Adjacency.csv – lists the blocks adjacent to each other.
- Curves.csv – yield curve file.
- Fragment Adjacency.csv – lists the fragments adjacent to each other.
- Fragments.csv – the land base file, links resultant polygons to yield strata, identifies THLB at Time 0 and provides area summaries at Time 0 and into the future.
- Greenup.csv – lists the green-up parameters, and blocks that contribute to the assessment of green-up.
- Prescribed.csv – lists the blocks forced to be harvested.
- Priorities.csv – sets the harvest priorities within the model, based on geographic zones or standgroups.

- Targets.csv – lists the targets to be met in the analysis. This includes volume targets, constraint targets and patch size targets. This file also includes a fragment list, which indicates the assessment area that the targets will be evaluated against
- Treatments.csv – lists the regeneration pathways and the regeneration delays to be used within each strata.
- Zone Priority.csv – used in combination with the priorities.csv file, to identify the geographic units used (Access Unit, Zone, Range and Block) and how these geographic units relate to the land base.

Of the files above, only the batch.txt, greenup.csv, priorities.csv, targets.csv and treatments.csv were changed significantly during the runs to accomplish different modeling objectives. The other files (block adjacency.csv, fragments.csv, fragment adjacency.csv, prescribed.csv) were edited only to isolate and model the North FMU separate from the South FMU.

Initial model runs were forecasted past year 2198 to 2251 (250 year planning horizon) to ensure that growing stock levels would be sustainable. This was done in an aspatial context during the testing and validation phase of the input dataset and also tested aspatially for an even-flow harvest level of 340,000 m^3/yr using the updated land base data produced by Tesera. The growing stock for the aspatial 340,000 m3/yr run for the 250-year period was sustainable. Therefore, the spatial scenarios were only forecasted for 200 years into the future and the growing stock was assumed sustainable.

7.1 Run 1 - Detailed Theoretical Long-Run Sustained Yield Average (LRSYA) Calculation (Run 4 in 1998 Supplemental Guidelines

The Long-Run Sustained Yield Average (LRSYA) provides a theoretical sustained yield that can be derived from the land base given a fully regulated forest and assuming that stands are harvested at the culmination age (first point at which stands achieve their maximum MAI). The theoretical detailed LRSYA AAC is the harvest level that can be sustained without the influence of maximum block size, adjacency requirements and operational limitations, which prevent stands from being harvested at culmination. As such, LRSYA is an unrealistic goal to achieve with the other considerations that have to be accommodated on the FMA.

To calculate LRSYA for the harvestable land base, each polygon area was multiplied by the culmination MAI as defined in the yield curves, developed by Golder. Refer to Table 6, for a list of strata and the culmination MAI used for the LRSYA calculation.

The culmination MAI of the stands was based on the coniferous components of the stands. The deciduous component of the stands were harvested at the same time as the coniferous stand component.

Table 6. Culmination Data for Yield Strata

Yield Strata	Age at Culmination (years)	Coniferous Mean Annual Increment (MAI)	Deciduous Mean Annual Increment (MAI)
B10B Pine	100	1.68	0.2
B10B Spruce	79	1.74	0.13
B9 Pine	94	1.73	0.19
B9 Spruce	80	1.77	0.19
Mixedwood	76	1.2	0.96
Deciduous	50	0.87	1.04
Composite	100	1.57	0.22

7.2 Run 2 - FMA Even Flow without Adjacency & Operational Harvest Sequencing (Run 1 in 1998 Supplemental Guidelines)

The objective of this scenario, is to determine the FMA sustainable harvest flow without adjacency or operational sequencing parameters to provide a benchmark for assessing the effects of adjacency and operational harvest sequencing on the coniferous harvest levels. Using this run in conjunction with other model runs allows forest planners to evaluate how adjacency and operational harvest sequencing impact the sustainability of the timber supply.

7.3 Run 3 - FMA Even Flow with Adjacency & Operational Harvest Sequencing using SLS Management Options (Run 2 in 1998 Supplemental Guidelines)

The objective of this scenario was to determine the coniferous Non-Declining Even Flow (NDEF) harvest level on the FMA as a whole unit for 200 years. Management objectives that were modeled were:

- SLS management practices of green-up adjacency requirement of 20 years and a regeneration delay of 5 years; and
- Operational harvest sequencing was enacted.

7.4 Run 4 - FMA Surge Cut with Adjacency & Operational Harvest Sequencing

The objective of this scenario, was to determine the capacity of the land base to sustain a coniferous surge cut on the entire FMA for the first 20 years of the planning horizon, followed by a harvest level that would be sustainable for 180 years. Management objectives that were modeled were:

- SLS management practices of green-up adjacency requirement of 20 years and a regeneration delay of 5 years; and
- Operational harvest sequencing was enacted.

7.5 Run 5 - North FMU Even Flow with Adjacency & Operational Harvest Sequencing

The objective of this scenario was to determine the coniferous Non-Declining Even Flow (NDEF) harvest level for the Northern FMU for the 200-year planning horizon. Management objectives that were modeled were:

- SLS management practices of green-up adjacency requirement of 20 years and a regeneration delay of 5 years; and
- Operational harvest sequencing was enacted.

7.6 Run 6 - South FMU Even Flow with Adjacency & Operational Harvest Sequencing

The objective of this scenario was to determine the coniferous Non-Declining Even Flow (NDEF) harvest level for the Southern FMU for the 200-year planning horizon. Management objectives that were modeled were:

- SLS management practices of green-up adjacency requirement of 20 years and a regeneration delay of 5 years; and
- Operational harvest sequencing was enacted.

7.7 Run 7 - South FMU Surge Cut with Adjacency & Operational Harvest Sequencing

The objective of this scenario, was to determine the capacity of the land base to sustain a coniferous surge cut on the Southern FMU for the first 20 years of the planning horizon, followed by a harvest level that would be sustainable for 180 years. Management objectives that were modeled were:

- SLS management practices of green-up adjacency requirement of 20 years and a regeneration delay of 5 years; and
- Operational harvest sequencing was enacted.

7.8 Run 8 - North FMU Surge Cut with Adjacency & Operational Harvest Sequencing

The objective of this scenario, was to determine the capacity of the land base to sustain a coniferous surge cut on the Northern FMU for the first 20 years of the planning horizon, followed by a harvest level that would be sustainable for 180 years. Management objectives that were modeled were:

- SLS management practices of green-up adjacency requirement of 20 years and a regeneration delay of 5 years; and
- Operational harvest sequencing was enacted.

8.0 Analysis Results and Discussion

The following sections summarize the results for the various scenarios of this analysis. Detailed reports from all runs are found in Appendix 4 (CD/DVD) and Appendix 5 (hardcopy). The results are contained within directories for each run, summarized using AccessXP and graphed using ExcelXP. The tables within the AccessXP databases correspond to the standard TSM reports, for TSM version number 1.1:

- FragmentStatistcsByPeriod.csv
- HarvestScheduleByPeriod.csv

All the summaries were derived from the FragmentStatisticsByPeriod.csv and HarvestScheduleByPeriod.csv files. Tesera developed AccessXP Routines to classify the future land base according to age class naming conventions and provide summaries by compartment and yield strata.

A data dictionary of the database fields for the input, output and resultant database files is included in Appendix 6. All of the results have been compiled from the files and associated AccessXP databases.

The FMA already had areas reduced from the harvestable land base within the net land base process to account for issues such as riparian buffers, subjective deletions, slope stability concerns, etc. The area within the FMA dropped from 337,447.29 ha (gross area) to 222,759.26 ha (net land base area), representing a 34.0% reduction of the land base which is not available for timber harvesting. The incorporation of adjacency also allows stands to be utilized for other resource values until such time as adjacency issues with that area are resolved.

Given the spatial nature of the modeling and the relationship between the harvest levels and the growing stock, the growing stock was monitored but not limited in any way. The main issue was to ensure that the growing stock and corresponding harvest levels were sustainable over time (Pers. Comm., Bev Wilson-ASRD September 2004). To address this issue, the land base was modeled aspatially for 250 years using a coniferous harvest request of 340,000m^3/yr. Under this scenario, coniferous growing stock was sustainable over the 250-year timeframe and was not an issue.

All of the figures in the succeeding sections do not incorporate deductions for cull or other wildlife, aesthetic or recreation values. The appropriate deductions are incorporated into the AAC levels and summarized in section 8.6. Incidental coniferous within the deciduous stands contributes to the coniferous AAC, likewise incidental deciduous volumes within the coniferous stands contributes to deciduous volumes. No assumptions were developed with respect to targeting coniferous, mixedwood or deciduous stand types.

To note in all the harvest summaries, the actual volumes predicted from the model are shown on the graphs rather than just the requested annual harvest target levels. This was provided so that the harvested areas and the corresponding volumes would correspond. The harvest request has also been provided in selected tables in the Appendices.

8.1 Coniferous Harvest Summaries

For comparison, the harvest summaries for the coniferous AACs are presented in Table 7. The AAC for the separate North and South FMU modeled runs have be added together, but the AAC numbers for the individual runs are also shown.

Table 7. Coniferous Harvest Summary

Scenario	Annual Conifer AAC Request (m^3/yr)	Total AAC for the Planning Horizon (m^3)	Annual Conifer AAC Combined North & South Runs (m^3/yr)	Combined AAC for the Planning Horizon (m^3)
Run 1 - Detailed Theoretical Long-Run Sustained Yield Average (LRSYA) Calculation	2001-2198: 358,054	71,610,800	n/a	n/a
Run 2 - FMA Even Flow without Adjacency & Operational Harvest Sequencing	2001-2006: 260,605* 2006-2198: 380,000	74,363,370	n/a	n/a
Run 3 - FMA Even Flow with Adjacency & Operational Harvest Sequencing using SLS Management Options	2001-2006: 260,605* 2006-2198: 324,000	63,583,071	n/a	n/a
Run 4 - FMA Surge Cut with Adjacency & Operational Harvest Sequencing	2001-2021: 356,000 2021-2198: 323,500	64,474,613	n/a	n/a
Run 5 - North FMU Even Flow with Adjacency & Operational Harvest Sequencing	2001-2006: 202,699* 2006-2198: 184,000	36,432,636	2001-2006: 330,199 2006-2198: 311,500	61,659,319
Run 6 - South FMU Even Flow with Adjacency & Operational Harvest Sequencing	2001-2198: 127,500	25,226,683		
Run 7 - South FMU Surge Cut with Adjacency & Operational Harvest Sequencing	2001-2021: 137,000 2021-2198: 127,000	25,309,563	2001-2006: 339,699 2006-2021: 334,750 2021-2198: 307,000	61,220,240
Run 8 - North FMU Surge Cut with Adjacency & Operational Harvest Sequencing	2001-2006: 202,699* 2006-2021: 197,750 2021-2198: 180,000	35,910,677		

* Forced harvest in the 2001-2006 was the only harvest request, therefore the volume harvested in the first period (2001-2006) is lower than the other runs.

At the start of the analysis, SLS specified that the first period should only contain blocks from the actual operating plans – this resulted in lower volumes in the first period than in the second period. For Runs 4, 6, and 7 SLS requested an extra "top-up" for the first period volume request to match the volume requested in the second period. Due to time constraints Runs 2, 3, 5 and 8 were not re-run with the "top-up" volume request.

The Preferred Management Strategy is Run 4 (FMA Surge Cut with Adjacency & with Operational Harvest Sequencing). This Run will be used to guide the operational implementation of the management assumptions listed within the SLS DFMP report.

Run 2 (FMA Even Flow without Adjacency & Operational Harvest Sequencing) assesses the timber supply availability when green-up or operational sequencing is not applied. The model harvested stands based solely on their ranking relative to age and volume loss (Relative Oldest First). When Run 2 is compared to Run 3 (FMA Even Flow with Adjacency & Operational Harvest Sequencing using SLS Management Options), a 14.5% decrease in AAC over 200 years is attributed to green-up requirements (in part to accommodate other resource values) and operational harvest sequencing. When Run 2 is compared to the Preferred Management Strategy (Run 4) the harvest level dropped by 13.3% due to the adjacency rules and operational harvest sequencing.

The results show that the higher harvest levels identified in Run 4 can be maintained for 20-years without affecting the sustainability of the coniferous resources. After the initial 20-year period, the harvest will be dropped by 10% to the Long-Term Harvest Level (LTHL).

8.2 Deciduous Harvest Summaries

The total incidental deciduous volumes for each Run has been summarized in Table 8. An AAC forecast was not undertaken in this analysis for the deciduous harvest. The harvest was based on targeting coniferous stands with the deciduous volumes that were in the yield curves being merely reported on by period based on their ranking relative to operational harvesting priorities, harvest age and volume loss.

Table 8. Deciduous Harvest Summaries by Scenario

Scenario	Total AAC for the Planning Horizon (m^3)
Run 1 - Detailed Theoretical Long-Run Sustained Yield Average (LRSYA) Calculation	13,876,400
Run 2 - FMA Even Flow without Adjacency & Operational Harvest Sequencing	13,388,437
Run 3 - FMA Even Flow with Adjacency & Operational Harvest Sequencing using SLS Management Options	11,911,943
Run 4 - FMA Surge Cut with Adjacency & Operational Harvest Sequencing	12,014,526
Run 5 - North FMU Even Flow with Adjacency & Operational Harvest Sequencing	7,363,655
Run 6 - South FMU Even Flow with Adjacency & Operational Harvest Sequencing	4,485,138
Run 7 - South FMU Surge Cut with Adjacency & Operational Harvest Sequencing	4,498,426
Run 8 - North FMU Surge Cut with Adjacency & Operational Harvest Sequencing	7,266,909

Under the FMA agreement, 15,500m^3/yr had to come from the FMA area under the northern portion. Each scenario had met that obligation as shown in Table 9.

Table 9. Average Annual Deciduous Volume for the Northern FMU

	Average Annual Deciduous Volume North FMU (m3/year)				
Period	**Run 2**	**Run 3**	**Run 4**	**Run 5**	**Run 8**
2001-2006	28,616	28,616	34,759	28,619	28,619
2006-2011	38,890	31,979	37,179	32,568	35,592
2011-2016	20,707	31,470	32,728	34,826	34,638
2016-2021	34,499	27,378	29,830	29,959	36,556
2021-2026	37,279	35,747	39,305	36,089	32,976
2026-2031	38,343	31,126	32,720	29,877	28,156
2031-2038	40,983	45,136	44,754	37,035	38,730
2038-2048	34,081	29,151	28,491	38,354	37,048
2048-2058	39,100	36,987	31,563	38,089	37,013
2058-2068	27,477	36,668	40,614	40,177	39,895
2068-2078	58,536	24,666	22,271	40,447	39,140
2078-2088	40,200	40,709	43,489	38,142	37,491
2088-2098	67,521	42,611	43,971	45,030	43,527
2098-2108	47,130	34,497	36,830	41,189	41,033
2108-2118	46,267	40,537	36,042	36,128	35,955
2118-2128	28,105	35,707	37,266	40,687	39,883
2128-2138	35,127	37,116	39,041	37,890	37,356
2138-2148	35,463	40,245	40,026	31,225	30,845
2148-2158	40,371	38,173	33,860	36,788	37,950
2158-2168	27,748	38,597	38,228	36,668	33,888
2168-2178	51,265	36,048	37,468	35,663	34,896
2178-2188	47,391	34,180	33,091	41,220	37,639
2188-2198	53,912	41,422	44,358	36,775	37,751

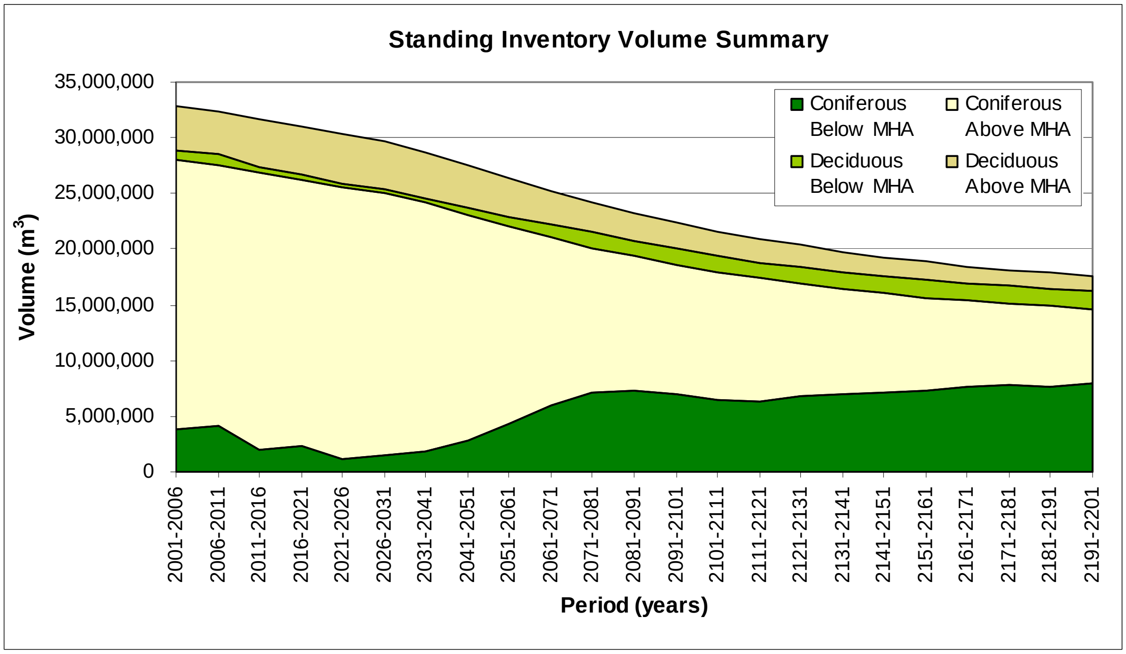
8.3 Standing Inventory Summaries

The annual standing inventory volume summary presented in Table 10 and Figure 5, shows the standing inventory volume of the Preferred Management Strategy, within the operable land base, both above and below Minimum Harvest Age (MHA) for each period. Graphs of the operable standing inventory can be found in the Appendices for all other scenarios. Graphs of the unoperable standing inventory can be found in Appendix 5, under the Run 4 summaries. No harvesting activities occur on the unoperable land base (area outside the net land base), therefore the land base only ages over time and does not change for each of the scenarios.

Table 10. Standing Inventory for the Preferred Management Option

	Volume (m^3)			
Period	**Coniferous Above MHA**	**Coniferous Below MHA**	**Deciduous Above MHA**	**Deciduous Below MHA**
2001-2006	24,179,337	3,782,138	3,964,489	957,849
2006-2011	23,265,975	4,204,743	3,841,856	1,044,283
2011-2016	24,811,989	2,027,790	4,369,379	467,708
2016-2021	23,836,570	2,356,547	4,257,951	537,807
2021-2026	24,536,003	1,082,629	4,444,531	284,642
2026-2031	23,603,198	1,442,695	4,332,176	362,843
2031-2038	22,415,407	1,797,628	4,138,169	410,081
2038-2048	20,170,962	2,899,474	3,857,667	603,727
2048-2058	17,718,661	4,269,439	3,504,336	854,382
2058-2068	15,019,748	5,990,342	2,984,460	1,157,901
2068-2078	12,959,813	7,174,300	2,632,485	1,382,650
2078-2088	12,010,156	7,359,710	2,489,815	1,399,716
2088-2098	11,729,621	6,914,415	2,297,752	1,415,459
2098-2108	11,501,415	6,488,910	2,174,768	1,384,507
2108-2118	11,098,883	6,319,430	2,117,119	1,385,849
2118-2128	10,012,500	6,880,827	2,000,579	1,438,216
2128-2138	9,434,812	6,969,272	1,842,353	1,497,142
2138-2148	8,890,119	7,122,560	1,697,931	1,564,812
2148-2158	8,319,657	7,346,968	1,703,648	1,523,029
2158-2168	7,700,299	7,652,357	1,531,005	1,588,955
2168-2178	7,333,635	7,760,265	1,427,662	1,616,281
2178-2188	7,151,164	7,694,955	1,459,848	1,584,873
2188-2198	6,649,311	7,928,513	1,333,253	1,609,586

Figure 5. Preferred Management Option's Standing Inventory Volume



8.4 Age Class Distribution Summaries

The age class distributions for the scenarios can be found in the appendices.

8.5 Harvest Block Size Distribution

The maximum block size for this analysis was generally 100 ha. There were a few instances where the block size was increased due to operational issues (maximum of 117 ha). The operational issues revolved around grouping stands that otherwise would have been isolated – if not combined into the adjacent block. If the block was already at 100 ha, then the block size was increased. The maximum block size that is in the dataset is 117 ha.

8.6 Other Values/Resources that Effect AAC & Cull Deductions

During this analysis, wildlife thresholds and targets were not developed. To account for this, SLS has provided guidance to make volume deductions (therefore harvesting less area) to the calculated harvest level to account for areas set aside for other values/resources within the FMA. The modeled Runs also did not consider volume deductions due to cull.

The rationale for the volume reductions to account for other resources/resource users was provided through historical operations data within the FMA while SLS was a quota holder.

Embodied within the Timber Supply Analysis is an allowance for traditional ground rule deletions such as streamside buffers, slopes over 45% and various merchantability criteria. This was part of the net land base process developed by Golder. The FMA area was reduced from a gross area of 337,447.29 ha to 222,759.26 ha, representing 34.0% drop in available area to be harvested within the FMA. This 34% of area can be used for other multiple uses as well. The Timber Supply Analysis also accommodates an allowance for green-up or adjacency constraints and a regeneration lag period. On top of the 34% of the area already deducted, a 13.3% reduction in volume had occurred due to application of adjacency. While this volume reduction does not transfer equally well to area, it provides rationale to ascertain that area is also reduced by an additional 5-13.3% due to adjacency.

Beyond the constraints modeled within the various timber supply runs there are risks of other management strategies, or accommodation of other resource values, which may have a further impact on sustainable harvest levels, refer to Table 11 for percentage reductions. Spray Lake Sawmills has proposed to manage this risk by subjectively reducing the AAC for a variety of possible eventualities.

Table 11. AAC Deductions due to Other Values/Resources

Subject Area Causing Possible Impact	% Reduction in Harvest Level
Rare ecosites or rare plants	1
Structural Retention	1
W/L - licks, travel corridors, etc	0.5
Buffering of unidentified drainages	0.5
DEM inaccuracies	1
Inaccessible stands (due to costs or impracticalities)	2
Historical resources or unique areas	0.5
Integration with non-commercial forest uses	0.5
Integration with other Commercial Forest Users	0.5
Total	**7.5**

The volume deductions to account for cull was assessed by Golder, within the Growth and Yield component of the analysis. The cull deductions to be applied were calculated as 3.07%. More details regarding the cull deductions can be found in the Growth and Yield report prepared by Golder.

The total reductions to account for cull and other resource users was 10.57%.

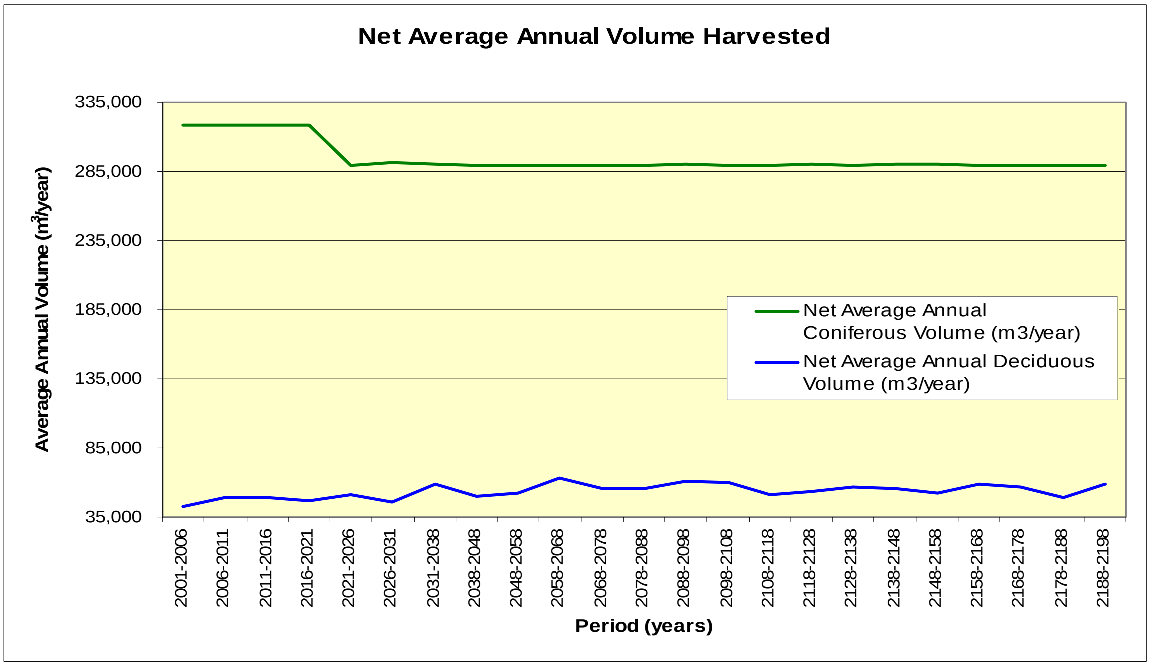
9.0 Summary/Conclusion

The net coniferous timber supply for the Preferred Management Strategy is depicted in Table 12 and Figure 6. During the next 20 years, the calculated annual coniferous harvest level is shown at 318,602 m^3/yr and then drops to 289,815 m^3/yr after 2021. The net annual deciduous volumes that would be generated from the harvest operations are also indicated. The 10.57% reduction attributable to cull and other uses/users are reflected in the volumes provided in Table 12 and Figure 6.

Table 12. Net Average Harvested Volumes from the Preferred Management Option

Period	Net Average Conifer Target Level (m^3/year)	Net Average Annual Deciduous Volume (m^3/year)	Calculated Conifer AAC (m3/year)
2001-2006	318,523	42,326	318,602
2006-2011	318,622	48,951	318,602
2011-2016	318,873	49,014	318,602
2016-2021	318,391	47,455	318,602
2021-2026	289,630	51,014	289,815
2026-2031	291,407	45,936	289,815
2031-2038	290,662	59,190	289,815
2038-2048	289,585	49,702	289,815
2048-2058	289,826	51,976	289,815
2058-2068	289,420	62,829	289,815
2068-2078	289,330	55,773	289,815
2078-2088	289,574	56,112	289,815
2088-2098	290,693	60,978	289,815
2098-2108	289,383	59,732	289,815
2108-2118	289,330	51,438	289,815
2118-2128	290,142	53,124	289,815
2128-2138	289,346	56,969	289,815
2138-2148	290,074	55,762	289,815
2148-2158	290,222	52,711	289,815
2158-2168	289,488	59,047	289,815
2168-2178	289,447	56,321	289,815
2178-2188	289,512	49,478	289,815
2188-2198	289,404	58,725	289,815

Figure 6. Net Average Harvested Volumes from the Preferred Management Option



A map outlining the spatial sequence for the first 15 years (2001-2016) of the plan is provided in Appendix 7. Refer to Appendix 5, to gain an understanding of the compartments where harvest operations will occur after 2016. Additional maps showing the 15 year harvest sequence within existing CTP holder areas is found in Appendix 8.

As with all analyses, the harvest levels are predicated on the accuracy of the data. There are a number of initiatives currently underway at SLS that will increase the accuracy of the data thereby providing better estimates of the sustainability of the forest resource for the next DFMP.

Part of the monitoring and stewardship reporting will include an assessment of actual losses in these various categories for both volume losses as well as on an area basis. Subsequent quadrants will then have a cut adjustment, up or down, in relation to the volume impacted outside of the 7.5 % allowance. The first stewardship reporting period is proposed for the end of the 2006 - 2011 timber quadrant. From the time the DFMP is expected to be approved the first reporting period would be 6 years instead of 5 however this will allow reporting to be synchronized with quadrant periods.

There are other management objectives and strategies which may have long term impacts on harvest levels, however, these are being dealt with through other mechanisms such as the company's growth and yield program, reporting of land base deletions, inventory updates, reforestation surveys or cut re-calculations as may be required as a consequence of fire or insect and disease losses.

The impacts of accommodating one resource value will not necessarily be exclusive of accommodating other values at the same time. As an example, buffering a mineral lick within a block may also be used to meet structural retention objectives or act to help improve a cut-block's aesthetics.

This approach to establishing and managing harvest levels is meant to add a degree of conservatism to the cut that will minimize possible risks in dealing with subject areas that have less than perfect knowledge.

10.0 Appendices

Appendix 1 – Harvest Units not in the ASRD Depletion Update

Appendix 2 – GIS and Access Data Processing Procedures

Appendix 3 – Time 0 Age Class Map

Appendix 4 – Model Run Input, Output and Summary Files (CD-ROM/DVD)

Appendix 5 – Model Run Summaries

Appendix 6 – Model Run Input, Output and Resultant Database Data Dictionary

Appendix 7 – 15 Year Harvest Sequence (FMA)

Appendix 8 – 15 Year Harvest Sequence (CTP Holders)

Appendix 1 – Harvest Units not in the ASRD Depletion Update

Appendix 3 – Time 0 Age Class Map

(contained in map folio)

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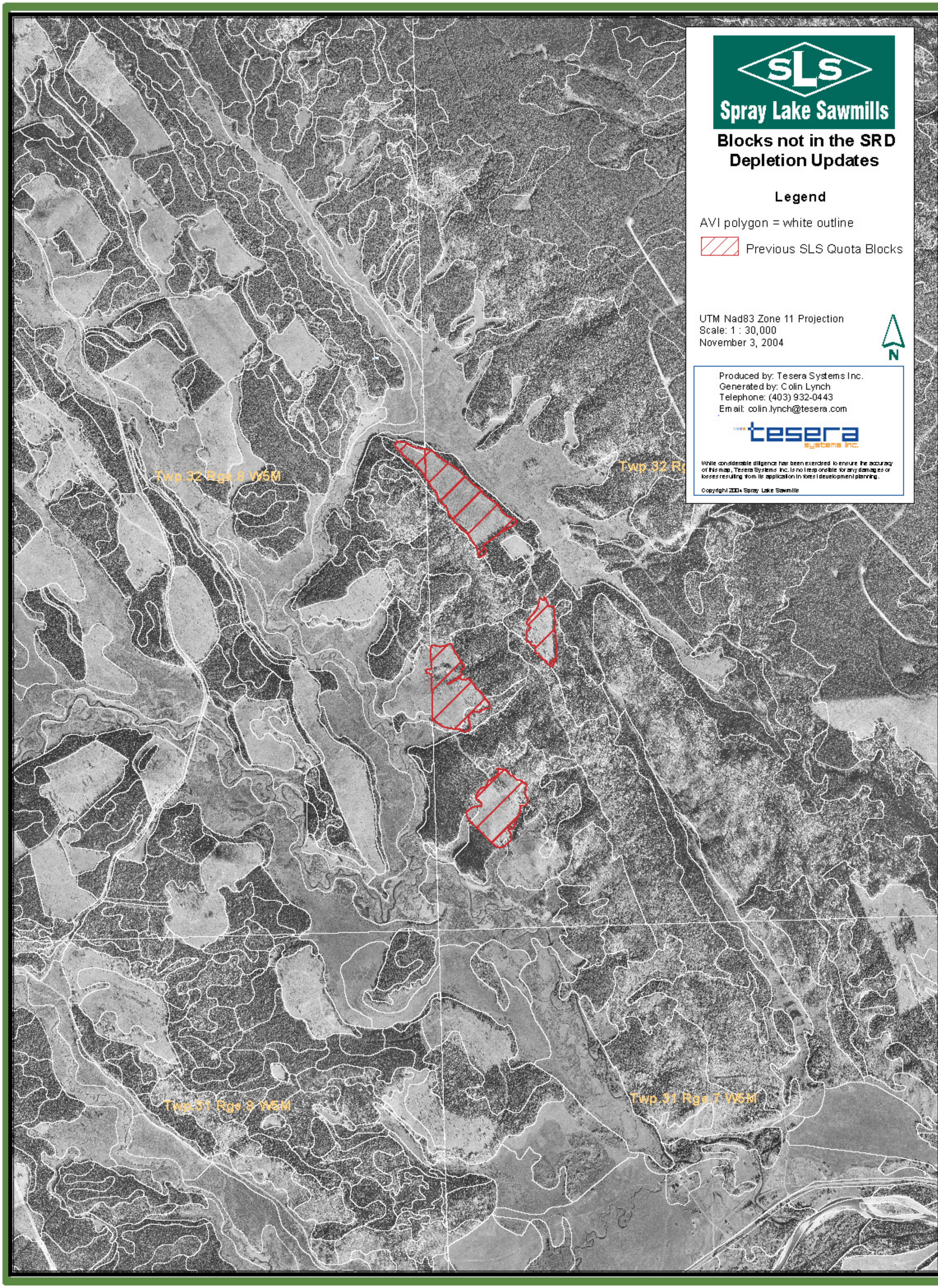
(contained in map folio)

Appendix 8 – 15 Year Harvest Sequence (CTP Holders)



Spray Lake Sawmills
Blocks not in the SRD Depletion Updates
Legend
AVI polygon = white outline
Previous SLS Quota Blocks
UTM Nad83 Zone 11 Projection
Scale: 1 : 30,000
November 3, 2004
N
Produced by: Tesera Systems Inc.
Generated by: Colin Lynch
Telephone: (403) 932-0443
Email: colin.lynch@tesera.com
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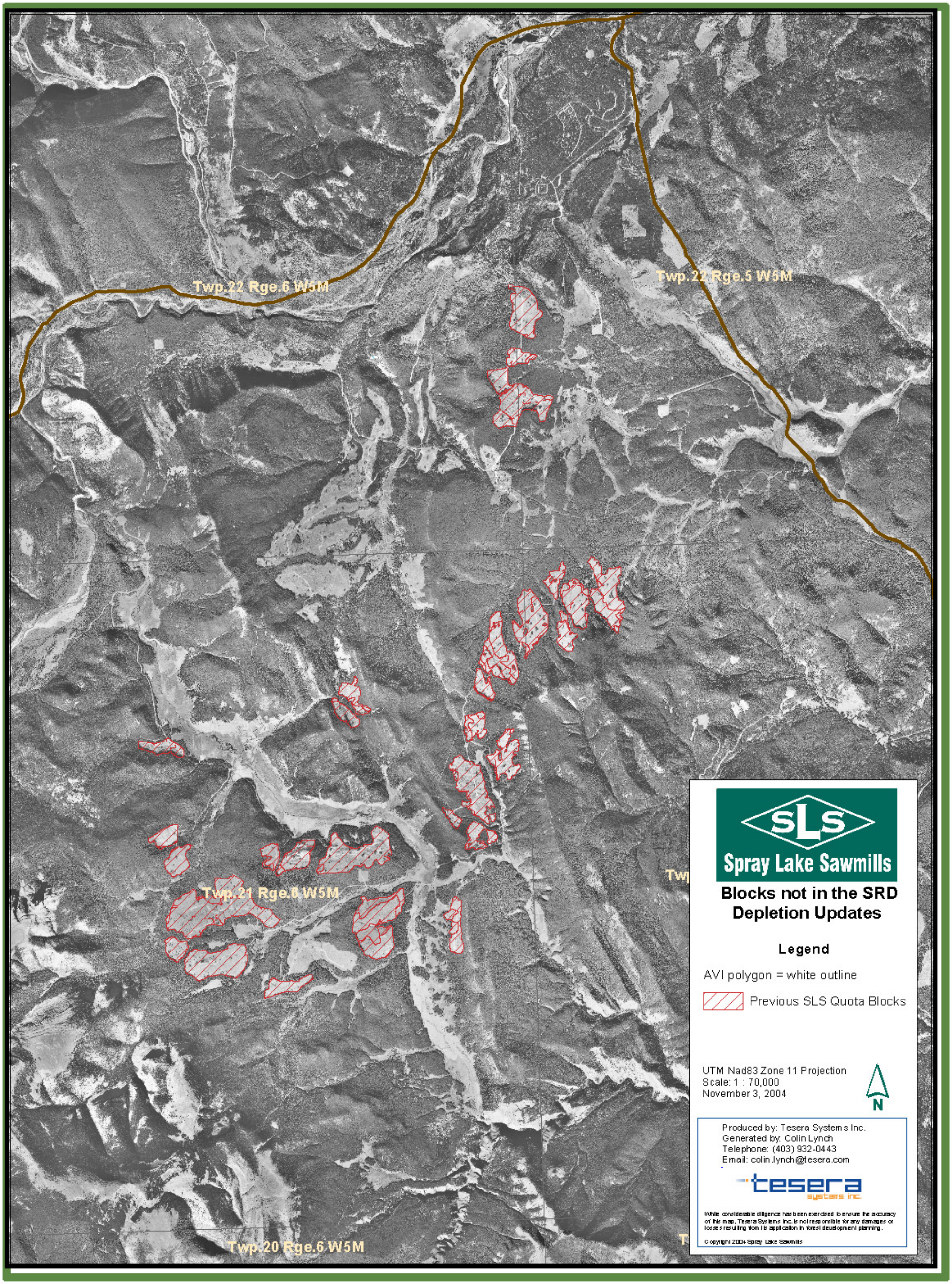
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Twp.20 Rge.6 W5M
SLS
Spray Lake Sawmills
Blocks not in the SRD Depletion Updates
Legend
AVI polygon = white outline
Previous SLS Quota Blocks
UTM Nad83 Zone 11 Projection
Scale: 1 : 70,000
November 3, 2004
N
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