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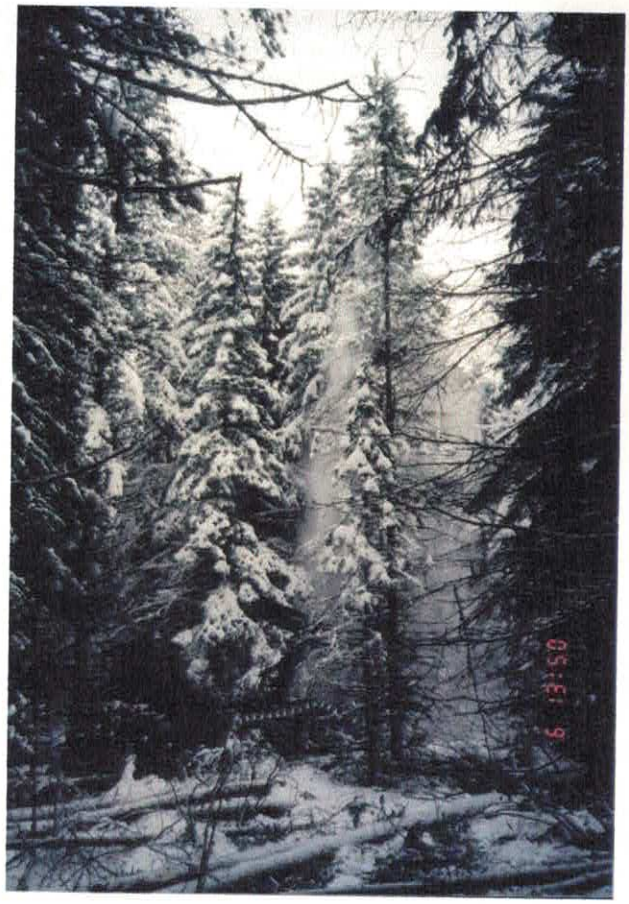
Commercial Thinning Experiment In the Horsefly Forest District



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Abstract

Since January of 1998, Riverside Forest Products Limited has been experimenting with commercial thinning in naturally regenerated and unmanaged forest stands South west of McKinley Lake in the Horsefly Forest District. The prescription was thinning from below to a target density of 625 stems per hectare using a single-grip harvester (Valmet 546H) and one of two forwarders (Valmet 546F and 892). Logs were processed at the stump and forwarded to the road side using designated trails.

In the two years Riverside has been experimenting with commercial thinning, examined were the following issues:

- Desired crop tree density and characteristics,
- Slash loading,
- Biodiversity,
- Hydrological stability,
- Scaling grade 6,
- Tree to Truck Appraisal implications,
- Windthrow and snow-damage,
- Machine productivity.

Based on these experiments, we believe that commercial thinning is an operationally viable alternative silviculture treatment that allows access to constrained timber while opening possibilities for forest attribute management including to developing higher valued forest stands .

Table of Contents

Table of Figures

List of Tables

Introduction

On January 23, 1996, the government of British Columbia designated the Cariboo-Chilcotin Land-Use Plan (CCLUP) a Higher Level Plan, giving it legal authority under the Forest Practices Code of British Columbia Act. Since then, all operational plans have to comform to this Higher Level Plan.

One of the main achievements of the land use plan was the establishment of three resource management zones across the Cariboo Forest Region. The three zones are the Special Resource Development (SRDZ), Integrated Resource Development (IRDZ), and Enhanced Resource Development (ERDZ). Each of these zones were assigned resource targets to be applied across the land base. The available timber target ranges from 70% to 84% access of the productive forest land base.

In the Horsefly Forest District 45% of the total area falls in the SRDZ designation (figure 1) of which half can be harvested with "modified harvest" techniques. The challenge for forest companies is to find new innovative ways to extract more timber out of a smaller landbase while working within the modified harvest targets and meeting non-timber objectives. Commercial thinning appears to be a viable option.

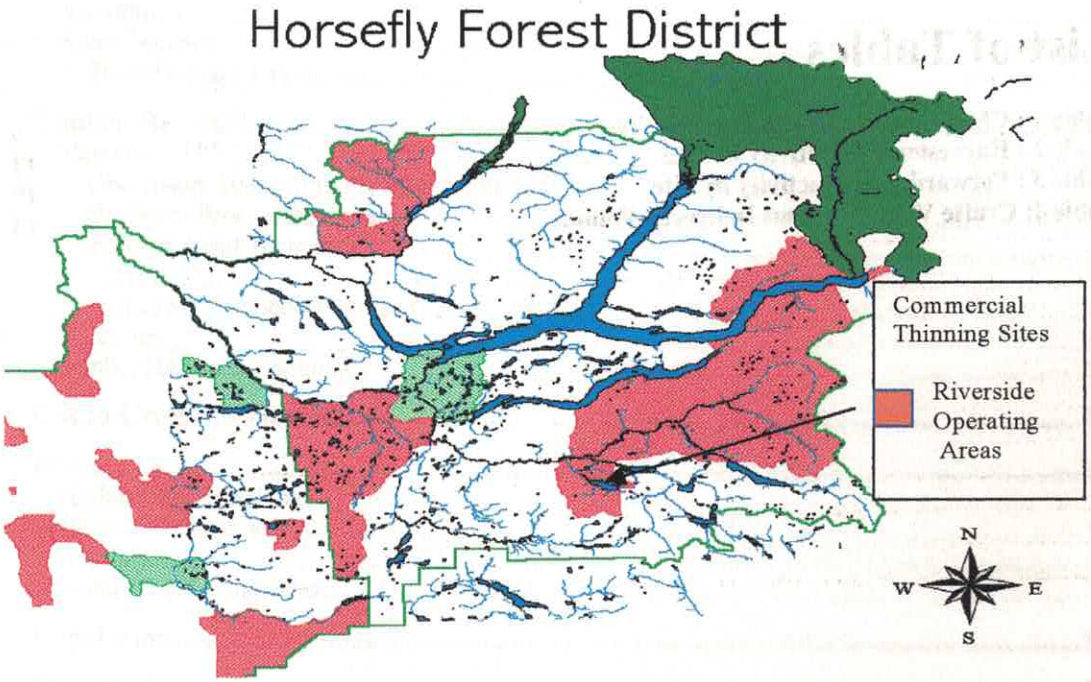

Figure 1: Horsefly Forest District

With approximately 45% of the timber harvesting in the Horsefly Forest District to be carried out in a manner which respects sensitive natural values, many issues developed. Across the Forest District Landscape Units were identified. Existing seral stages were identified and future harvest levels have been constrained in several of the Landscape Units in order to meet the desired seral stage levels set out in the Cariboo Regional Conservation Strategy (See Biodiversity section page 9). The main shortfall in many of the Landscape Units is the level of mature and old forests. In many of the Landscape Units stands greater than 120 years old are not available for harvesting.

Since only stands less than 120 years old are available in several of the Landscape Units, Riverside began identifying stands between 50 to 120 years old which had merchantable trees. Along with the biodiversity constraint imposed on harvesting, visuals, adjacency, and wildlife habitat concerns have also constrained levels of harvesting in many areas. Commercial thinning can address all of these issues.

In January of 1998, Riverside Forest Products began to experiment with commercial thinning in the Horsefly Forest District. The initial experiment was designed to harvest 5,000 m^3 in the winter and 5,000 m^3 in the summer. The experiment objectives were to determine the

costs, optimum piece sizes, appropriate equipment components, and limitations of ground based commercial thinning. The prescription was to thin from below the existing 60 year old stands. The spacing for all four sites thinned was set at 4 meter inter- tree distance with the objective to achieve 625 stems per hectare of healthy crop trees. Over 15,000 m^3 of timber was actually harvested from approximately 70 hectares of cutting permits (CP) 234 and 233. On all of the sites, the harvesting priority of the trees picked to be harvested were in the following order:

1. Deformed, damaged, scared or forked trees,
2. Lodgepole Pine
3. Balsam,
4. Spruce,
5. Cedar,
6. Douglas Fir.

One of the intents was to leave as many well-formed, well-spaced Douglas fir trees as possible in addition to maintain the 4 meter inter tree distance with the objective to retain 625 stems per hectare of healthy crop trees.

Site and Stand Description

The study sites were located in the Horsefly Forest District, in the Eastern part of the Williams Lake Timber Supply Area. All sites were located within 5 kilometres South West of McKinley Lake. The five sites were in stands regenerated naturally from wild fires and have been unmanaged until the commercial thinning commenced. (See Table 1)

Table 1 : Characteristics of the five trial sites

Site	234-1	233-1	233-3	233-4	233-11	Average
Area (ha)	10.1	17.6	36.3	9.1	4.0	
Net m^3/ha	323.2	291.8	300.3	450	292.7	332
Stems / ha merch	635	528	941	1170	992	853
Stems/ ha < 12.5 cm dbh	40	42	1556	100	1340	616
Total Stems / ha	674	570	2497	1270	2332	1470
Avg Dbh (cm)	29.4	30.2	22.7	24.8	22.8	26
Net vol / tree (m^3)	0.54	0.55	0.32	0.42	0.29	0.42
Tot Height (m)	24.7	22.8	24	25.3	22	23.8
% stud logs	40.4	37.2	65.6	50.2	66	51.6
% large logs	13.7	14.9	8.6	8.4	7.4	10.6
Avg LRF	193	190.8	175.5	181.5	175.7	183
Basal Area per ha (m^2/ha)	50	37.8	41	67.5	45	48

CP 234-1

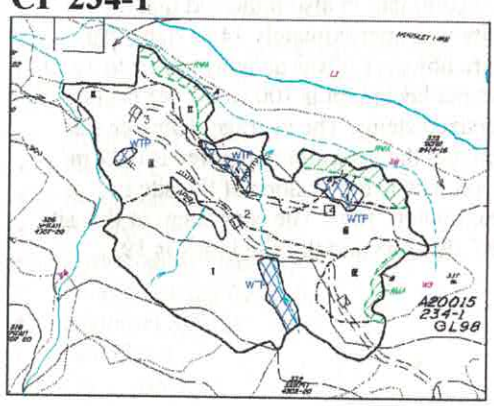

Figure 2: CP 234 block 1

Cutting permit 234 block 1 is a 23.6 hectare block that has a 10.1-hectare commercial thinning area (bottom third of block). The remaining area in the block was selectively harvested with the harvester and forwarder (top two-thirds of the block). The Commercial thinning portion was a 65-year-old white spruce, Douglas fir, Lodgepole pine type with a minor aspen and birch component. The average volume[1] of the stand was 323.2 m^3/ha. The average diameter at breast height (dbh) was 29.4 cm. The average tree height was 24.7 meters and the average piece size was 0.54 m^3 per tree. The density of the stand averaged 635 trees/hectare based on standard utilization and 40 stems under the utilization size. The average slope of the site is 15%. The ecosystem classification is ICH mk3 / 01. The site index is approximately 21[2].

[1] The volume is based on close utilization standards of pine trees of diameter at breast height greater than 12.5+ cm and all other coniferous species of greater than 17.5+ cm @ dbh.

[2] Site index 21 based on the 21-meter height of a 50 year old tree.

CP 233-1

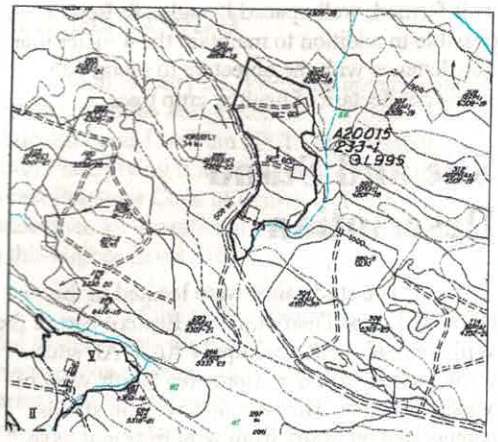

Figure 3: CP 233 block 1

Cutting Permit 233 block 1 is a 17.6 hectare block. The site is approximately 65 years old of white spruce, Douglas fir, Lodgepole pine and minor subalpine fir, and trembling aspen. The average volume was 291.8 m^3/ha. The average diameter was 30.2 cm. The tree height was 22.8 meters. The net piece size was 0.55 m^3 per tree. The average density was 528.4 stems per hectare plus 42 stems per hectare of undersized trees. The ecosystem classification for this site is SBS dw / 01. Generally, the site is open grown. The trees were quite branchy with many knots greater than two centimetres in size. The average slope of the site was 17%. The site index is approximately 19.

CP 233-3

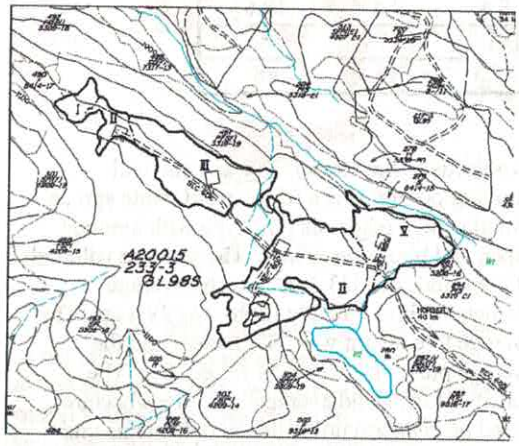

Figure 4: CP 233 block 3

Cutting permit 233 block 3 is a 36.3 hectare block. The site was approximately 60 years old of Lodgepole pine, Douglas fir, white spruce and a minor component of western red cedar, subalpine fir, cottonwood, white birch and aspen. The volume averaged at 300 m^3/ha. The average diameter was 22.7 cm. The density for the site was 941 stems per hectare plus 1556 stems per hectare of undersized trees. The tree height averaged 24 meters, and piece size averaged 0.32 m^3 per tree. The average slope of this site is 15%. The ecosystem is ICH mk3 / 01 with an 11.6 ha area of SBS dw1/05. The site index for this site is approximately 19. On this block there was approximately 23.6 hectares that were not harvested because during harvesting it was felt that the densities were too high (>3000 st/ha) and were prone to experience mortalities from blowdown or snow damage. These dense stands should be re-examined again in the future.

CP 233-4

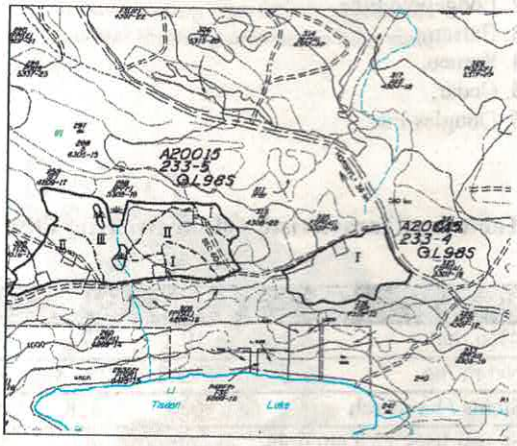

Figure 5: CP 233 block 4

Cutting permit 233 block 4 is a 9.1-hectare block. This stand is approximately 65 years old. The stand is mainly a Lodgepole pine, white spruce and minor Douglas fir and birch. The average volume of this stand was cruised to approximately 607 m^3/ha however, due to the cruise variation from the 4 plots established on this block, the actual volume per hectare is probably closer to 450 m^3, which is still quite high for the age of the stand. The cruise compilation also indicated that the density was approximately 1450 stems per hectare however it was actually closer to 1200 stems per hectare plus 100 stems per hectare of undersized stems. The average diameter was 25 cm and the net volume per tree is 0.42 m^3 per tree. The average slope of the site is approximately 10%. The ecosystem of this site is SBS dw1/ 05 and the site index is 19.

CP 233-11

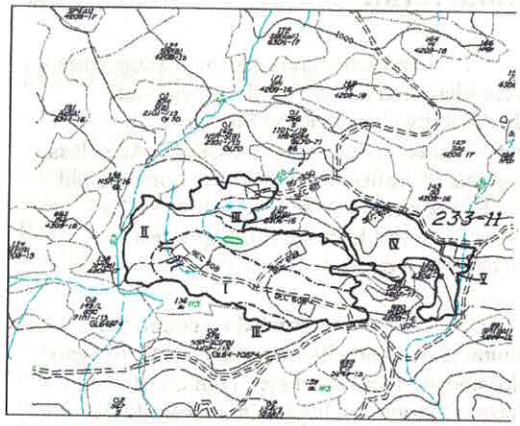

Figure 6: CP 233 block 11

Cutting permit 233 block 11 is a 39.7 hectare site. Only 4 hectares of this block has been harvested to date. This stand is a very dense (2000 to 3000 st/ha) 60-year-old stand of Lodgepole pine, white spruce, Douglas fir, subalpine fir with minor western red cedar. The net volume per hectare was approximately 292.7 m^3 / ha. The average diameter was 22.8 cm and the average volume per tree was approximately 0.29 m^3. The density of standard merchantable trees growing on the site was 992 stems per hectare; in addition, there are 1340 stems per hectare of undersized trees growing on the site. The 4 hectare area that was harvested was done in a strip fashion where a 5 meter wide trail was cut then 5 meters were lightly thinned then 10 meters was not harvested at all. This prescription was developed to determine the level of snow damage compared to a site that was commercially thinned from below on the other sites.

Issues

There are a number of issues that have been examined with the commercial thinning experiment:

- Crop Tree Density,
- Desired Crop Tree Characteristics,
- Slash Loading,
- Biodiversity,
- Hydrological Stability,
- Interior Scaling Grade 6,
- Appraisal System,
- Windthrow,
- Snow Damage.

Crop Tree Density

We were targeting to leave 625 stems per hectare of healthy crop trees. In some cases densities varied, we planned to retain 400 stems per hectare as the minimum. The stocking density of 400 was chosen because research has shown that stands with less than 350 trees have proven to blow down. Other parameters for choosing the minimum density are ice / snow damage, and reduced mean annual increment (MAI) per hectare. We want to harvest as many stems as possible without any future loss of volume, or by leaving sites unoccupied, or by leaving an undesired silviculture problem. A stand density diagram (SDD) was experimented with on these sites. We concluded that the SDD couldn't be solely relied on to determine target-stocking densities for these sites due to the complexity of natural un-managed stands. To date there are no SDD based on a mixed species stands. It is interesting to note however that the SDD that was used recommended that 430 stems per hectare should be retained. This issue should be re-examined again in the future.

The following was reported by Les Jozsa in the Forintek Special Publication SP-34 :

A foresters's choice of stand stocking density will significantly impact wood quality and final stand value. Widely spaced trees will grow faster than crowded ones. When this relationship is combined with the knowledge that rapid early growth results in a large core of juvenile wood, larger live crown, larger knots, and higher stem taper, it is easy to see how spacing of trees can affect wood properties. There is an optimal combination of stocking density and harvest age that will produce the highest value combination of volume and quality for each interaction of species and site. The specific prescription will depend on the desired end product.

Since we were operating on un-managed stands of timber it was challanging to determine the desired crop tree density. Densities and characteristics varies from dry site to moist sites. Ultimately the crop tree density should start when a site begins regeneration and managed through spacing, and pre-commercial thinning when the stand begins crown closure. This will all lead to the desire products and tree characteristics that we would hope to achieve at the time of final harvest.

Figure 7: Pine Stand planted in 1972 to 1600 stems per hectare. Note the branches on the trees

Desired Crop Tree Characteristics

The trees that were left as crop trees were healthy and of good form. The desired characteristics were trees having a live crown that is a minimum 20% of the height, minimum scars or forking, windfirm, and straight stems. The amount of scaring that is acceptable depends on the species of the tree. Pine is the most disease resistant tree on these sites. Alpine fir and spruce are the most susceptible species on these sites. Red cedar and Douglas fir are somewhere in the middle with regards to disease resistance on these sites. The current literature is not conclusive with regards to the effects of scaring and disease in thinned stands. We planned to remove all scarred spruce and balsam on these sites and exercised some tolerance with Lodgepole pine, Douglas fir, and Red cedar. The literature on partial cutting suggests that the minimum level of scaring that will incure is 5% of the stems but we expected 7% of the leave trees to be scared. To date the actual level of scaring has not been surveyed however it is felt by the Forest Service and by Riverside that the level that actually occurred was very low, probably due to careful harvesting by the experienced operators. The stage of harvesting that we experienced the most scarring was during the forwarding stage. See Appendix 5 for desired stand characteristics.

Slash Loading

Before we started this experiment, slash loading which could cause a fire hazard, was a concern. One year after harvesting more than 80% of the needles had fallen off the processed branches and a majority of the fines are mixed in with the duff layer of the soil. A fire hazard assessment has determined that slash loading is not a concern on this site because the moist microclimate and snow press that has decomposed the needles from the branches and tops within a period of one year.

Biodiversity

Landscape units and seral stage targets were identified in the "Cariboo Regional Biodiversity Conservation Strategy", an important component of the CCLUP. Age class analysis identified shortages of mature and old seral stages in some landscape units in the Horsefly Forest District, limiting forest management options.

The stands targeted by commercial thinning are generally immature (30 to 70 years old) and are in no short supply in the Horsefly Forest District. We hope to demonstrate that commercial thinning can be used to manipulate stand structures and promote mature forest attribute in younger stand by speeding up the natural stem exclusion phase by removing the suppressed, the intermediate, and some co-dominant stems. One of the challenges is to identify the mature stand attributes and to try reproducing them through silviculture. Specifically, more work is required around coarse woody debris, snags and stem density after treatment. Variable density commercial thinning, with wildlife tree patches around assisting snag pockets look like a promising alternative. Some lower quality trees could be felled and left as course woody debris or leave windthrow trees and limit salvage in some areas.

The stands for commercial thinning are immature by definition from the Biodiversity Guidebook. Future analysis should demonstrate that commercial thinning does not impact mature attributes and actually encourages an immature stand to develop mature attributes. To date, there is a lack of understanding by government agencies to the desired mature attributes that should be achieved.

A field trip to CP 233 block 1 by the Biodiversity Committee in the summer of 1999 concluded that the attribute management was very good however it was not agreed upon what the existing attributes would be classified on a chronological standard. Some individuals felt that once a site is thinned the attributes are adjusted as if the stand is clear-cut. Some individuals expressed that thinned stands should be classified as a 10 year old stand. The other side of this argument was that the attributes were improved because snags were created, the stand can be travelled by ungulates and fur-bearers on foot, and mature seral species will now be able to use the habitat. It was argued that the thinned sites should be classified as mature stands not immature. Although it was not agreed on the current biological classification for the thinned sites, it was agreed that the thinned sites would reach the characteristics of an "old" stand faster

than if the site were not thinned at all. These issues should be addressed in the future.

Hydrologic Stability

It is anticipated that the commercial thinned stands will maintain hydrologic stability since the stand essentially remains fully stocked. It is also anticipated that the tree interception of precipitation will increase as the crowns fill out the canopy from the healthy growing crop trees. More work is required in this area in the future. Currently, when a watershed is analysed for the level of Equivalent Clear Cut areas (ECA), a site is considered forested if it has an average stand height of 9 meters. There is no consideration for the age of the site or the stocking of the site.

Interior Scaling Grade 6

The interior log scaling grades were adopted from the inventory branch classification of stands suitable for harvest at a close utilisation standard to manufacture lumber and by-products. The inventory classification is used to determine annual allowable cuts (AAC). The interior log scaling grades are to determine the quantities and quality of each log for lumber manufacturing. The log grades assume that each log is processed in full tree length. In commercial thinning, trees are usually processed into 5-meter log lengths at the stump for easy extraction and protection of the remaining stems. It is common to process three logs (bolts) from each tree. Scaling classification of immature grade 6 trees are logs with a butt diameter of less than 15 cm for pine and 20 cm for all other species. If the logs meet these parameters then they are classified as a grade 6 log with a associated stumpage on this log set at \$0.25 / m^3. The average sawlog stumpage rate in the Horsefly Forest District is approximately \$10.00 / m^3. The determination of billable scale is extremely important.

The butt logs on most trees have a good chance of being scaled properly because they exhibit thick bark or have a pronounced taper. The top logs off a grade 6 tree are impossible for log scaler to determine from top logs off a sawlog tree, therefore logs are defaulted to a sawlog grade according to the scaling manual. In the Horsefly Forest District, there is approximately 5 m^3 per hectare of grade 6 top logs in the stands. Some other stands in the Horsefly area for commercial thinning can have up to 20m^3 per hectare of grade 6 top logs. This could give an overcharge of stumpage costs from \$50 to \$200 per hectare.

During the experiment, a new piece of equipment was tried on CP 233-1, 233-4 and 233-11. A painting device was installed on the harvesting head. When a tree met the grade 6 specification top lops from undersized stems were painted on the butt. With this done, it is then possible for a log scaler to determine a Grade 6 top log from a sawlog top log. A majority of the top logs went into a pulp sort. For the logs that were hand scaled it was determined that 33% of the pulp logs were from grade 6 top logs. The painting device that was installed was sold and serviced from Hultins out of Oregon. There were many problems with installing this device and to get it to work reliably. Part of the problem could be this device is very new and is a after market product that was not developed by the manufacturer of the harvesting head. It was concluded that there were too many problems with getting the device to work efficiently for the small amount of volume left on the experiment so it was discontinued.

The grade 6 scaling issue has the largest effect on spruce, Douglas fir, cedar and true firs because the utilization stump diameter is 20cm. The issue is not as dramatic for Lodgepole pine because the minimum stump diameter is 15cm. The issue may not be as dramatic for trees in the dry-belt of the interior because of the amount of taper that many trees have.

The grade 6 scaling issue is one of the major issues that should be resolved in order to maintain an incentive from commercial thinning. One of the ways to address this issue is to have cruise base permits where each cutblock is cruised before and after harvesting down to a 7.5 cm @ DBH. Another way is to have a scale based permit and use ocular estimates before and after the harvesting of each block to determine the grade 6 percentage. From the occular estimate the percentage of undersized stems could be determined. Once the logs are hauled to the sawmill it is important to ensure all the timber is tracked in its own log stratum and the percentage of undersized stems are adjusted on the scale stratum.

Appraisal System

Currently, the appraisal system does not recognise the cost of commercial thinning. The actual harvesting costs directly associated with commercial thinning are not reflective of the appraisal system tree to truck equation. This is a very crucial issue if commercial thinning will ever develop into an established operational system. Actual costs for commercial thinning average from \$22 / m^3 to \$50 / m^3 (tree to truck). For this experiment, the actual average tree to truck cost was \$27.82. Currently in the stumpage determination system, commercial thinning is treated the same as partial cutting. The average partial cutting appraisal tree to truck rate ranges from \$18.00 to \$24.00 / m^3. To date, the appraisal

system will only recognise approximately 50% to 75% of the actual tree to truck cost of commercial thinning. This is important when determining the fair and equitable stumpage charge for commercially thinned timber. Until this issue is resolved, the incentive to plan commercial thinning is economically weak. If the appraisal system is not adjusted to recognise commercial thinning, as a stand-alone harvesting cost (not lumped in with many other systems) then commercial thinning should be considered a specified operation and the estimated costs used.

Windthrow

Windthrow is a natural process and no forest will ever be immune from it because of the nature of wind storms. Certain sites are inherently more prone to windthrow, either because of greater topographic exposure to damaging winds, poor root anchorage, or a more susceptible stand structure and composition. Losses resulting from windthrow can be significantly reduced by recognising sites susceptible and using management strategies to minimise it's impact (Stathers R.J et al, 1994).

As a result of thinning, trees get bigger crowns and the wind velocity increases throughout the stand. The trees therefore have to resist greater forces by developing stronger roots. The root systems certainly develop to some extent by thinning, but not sufficiently to prevent windthrow in all cases. Current literature has documented that wind resistance is not certain. In many circumstances, heavily thinned sites are the hardest hit. The explanation for this may be that the trees in dense stands will, to some extent support each other and at the same time reduce the velocity of wind. How well a stand resists wind depends on the type and drainage of the soil which in turn influence rooting depth. The main reasons for increased windthrow following thinning appears to be a combination of increased wind penetration into the stand, reduced canopy closure which exposes more sail area, and loss of inter-crown contact to dampen tree swaying (Whitehead R.J. 1997). It is expected that wind throw will occur to a certain degree within a thinned stand during the first two years after harvesting.

To date, windthrow has occurred at a low incidence level on this commercial thinning experiment. CP 233-4 has experienced some windthrow following a storm, which passed through on September 15, 1999. As a result of the storm, approximately 50 trees blew down within a 4 hectare area. Upon investigation, the majority of the blowdown occurred on moist depressions where the rooting was approximately 30 cm. Initially, this site had approximately 1300 stems per hectare. It was thinned down to approximately 625 stems per hectare (675 stems were removed) or the percent removal equated to approximately 52% (a relatively high level of thinning). After reviewing the windthrow results and the density results, it could be that a lower level of thinning may reduce the amount of windthrow on sites with poor root development.

It is recommended that in areas of poor root development that the level of thinning should not exceed 30%. Susceptible areas are predictable and can be identified during silviculture prescription surveys, through careful consideration of terrain (exposure to damaging winds), and soil characteristics (texture, drainage and depth) in conjunction with stand conditions (density, live crown size, cover and exposure).

Snow Damage

Snow damage is a natural process and no forest will ever be immune from it. The winter of 1998-99 was not an average winter. It is normal for freeze-up to occur in the beginning of November. 1998-99 was subject to the "El-nino" weather phenomenon. In the Horsefly drainage, freeze- up to a significant degree did not occur until the third week of December. It was reported that frozen rain and heavy snow combined with wind gusts in adjacent 100 Mile House Forest District wreaked havoc with about 16,000 hectares of forest (The Williams Lake Tribune 1999). The McKinley Lake area generally experienced moderate levels of snow damage. The area around CP 233-3 however experienced high levels of ice / snow damage. A walk-through on the other cutblocks revealed that snow damage was low (<2%) and therefore not a concern.

Since CP 233-3 had visible levels of snow damage, it was investigated closer (Appendix 2). During the summer of 1999, a survey was conducted on the commercial thinning experiment areas to determine the level of snow breakage and interpret the causes. On CP 233-3, plots were established to randomly, sampling the trees within the block area. There were 34 plots established on a 100-meter grid pattern to randomly examine 93 trees. Of the trees sampled approximately 28 (30.1%) were damaged as a result of the ice / snow / wind damage. The 28 trees that were damaged were equivalent to 165 trees per hectare. On average, the damaged trees had a smaller stump diameter (15.1cm) than the healthy remaining trees (22.5cm). The damaged trees were found shorter in height and have smaller crown lengths (18.3 m ht. and 1.5 m crown) than the healthy trees (21.2m ht. and 2 m crown). The height to diameter (h/d) ratio was also a good indicator. The damaged trees had a h/d ratio of 1.08 or

greater. The healthy trees had a h/d ratio of 0.85. The live crown length as a percentage of tree height also indicated some variation from damaged to undamaged. The damaged trees had an average crown to height (c/h) percent of 39% versus 34% in the healthy trees. Since the results are similar, it is difficult to conclude what the impact of live crown is on rain/snow damage.

Snow Damage Discussion

The results obtained from the survey suggest that trees susceptible to snow damage were those with height to stump diameter ratios greater that 1.0. Snow damage was highest in the sites where the original density was approximately higher than 2500 stems per hectare. The sites with lower than 2000 stems per hectare did not seem to experience the same level of snow damage as the areas with higher densities. It is interesting to note that during the snow damage period the damage levels were much higher outside of the commercial thinning area compared to the area thinned. This may suggest that the density of crown canopy also play a factor in the degree of snow and ice damage (figure 8).

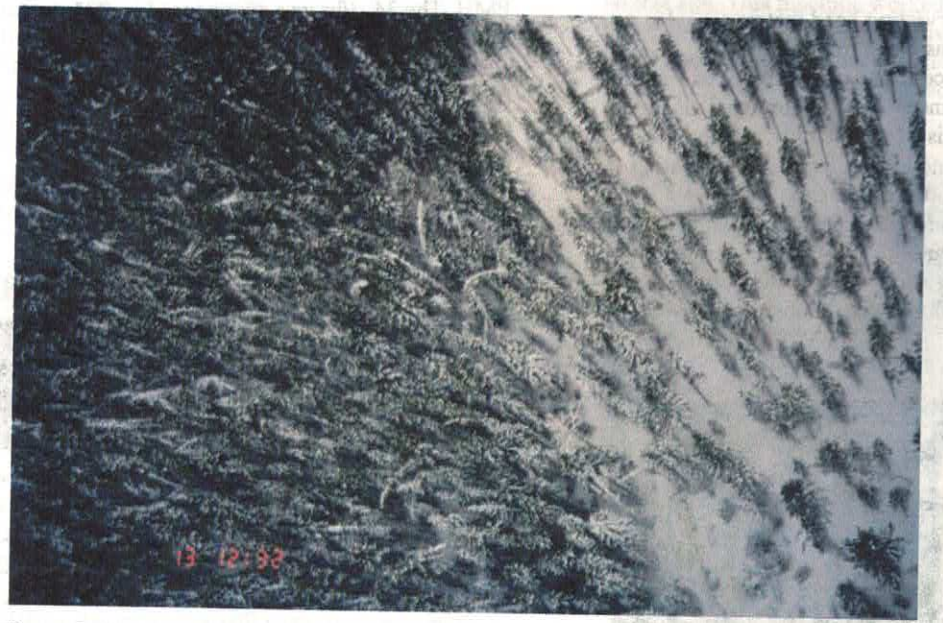

Figure 8: Snow damage on left side of photo, right half of photo was commercially thinned

Timber Harvesting

Figure 9: Valmet 546H harvester, and 546F forwarder

Harvester

All of the sites were felled and processed at the stump with a Valmet 546H harvester. This machine is a four-cylinder, turbocharged diesel 4.4 litre ford engine rated at 125 horsepower. The machine is 2.6 meters wide therefore can operate on a 3-meter wide trail. The harvester boom is mounted on the frame of the harvester directly in front of the operator. At all times, the boom is in full vision to the operator. The boom is a two-stage slide boom with a 9.75-meter reach. This boom can swing 300 degrees without moving the machine. The 125 hp motor seemed to supply enough power to the hydraulic system to harvest trees up to 45cm in diameter however seemed to have trouble processing the trees that were growing in the open and had many branches. The sound proof insulated cab has excellent visibility in all directions, and enables the operator to see the top of the tree that is harvested each time. Generally, this harvester worked well on the sites in this experiment.

Figure 10: Valmet 546 harvester in CP 233-3

The harvesting head that was used is a Valmet 942. It has chain roller arms for processing the trees. It has a capability to process stems with a diameter of 45 centimetres diameter. The cutting saw is a bar assembly, which is used to fell the trees and top the logs. The harvesting head counts the number of stems it harvests. This information is stored on the machine data logger. For the experiment, this information was compared to the scaled volumes delivered to the sawmill. The information was then analysed to determine productivity rates of the machinery.

Figure 11: Valmet 892 forwarder on trail in CP 233-3

Discussion: Harvesting Productivity by Site

Harvester Production Summary

On average the harvester fell 39 stems per productive machine hour (PMH) to equal an approximate volume production of 8.3 m^3 per hour based on an average 0.21 m^3 piece size. The production ranged from 34 stems to 60 stems per PMH. The 34 st/hr was experienced on 233-1. This stand was an open grown (550 stems / ha.) stand that had many large branches. The large branches reduced the processing productivity of each stem. The other issue with the open grown stand is that the operator had to move the machine from one stem to the next stem rather than harvest several stems form each site.

Table 2 : Harvester Productivity by Site

Cutting Permit	Trees PMH (per machine hour)	Volume m^3 PMH
233-1	34.35	9.18
233-3	48.88	7.52
233-4	48.54	13.92
233-11	60.9	10.98
Average	38.53	8.32

McNeel and Rutherford reported that moving accounts on average of 18% of the harvesting cycle and delimbing accounts for 34% of the cycle to total 52% of the cycle. It was estimated that the delimbing and moving phase was actually 60% to 70% of the time to move within the site. The piece size was 0.55 m^3 per tree, however the volume production was only 9 m^3 per PMH. There was approximately 40 cm of snow on the site at the time of harvest (see cover page of this report) and it slowed the machine.

The 60 stems PMH were on a dense stand of 2900 stems per hectare with the piece size of 0.17 m^3 per tree. The volume production was approximately 11 m^3 of PMH. The best production that was experienced was on CP 233-4 where 48.5 stems per hour were removed and the average piece size was 0.42 m^3.

After reviewing the harvesting on CP 233-11, it was determined that a smaller harvester could produce the same amount of stems per hour and yet have a lower cost per hour thus lowering the cost per m^3. In the future, there may be a requirement to have two different

commercial thinning crews, where one crew is designed for dense stands and another crew is designed for more open stands.

Harvesting Head Technology

One of the limitations of most harvesting heads is that they are challenged when cutting the tops of a sawlog when the rest of the stem is a pulplog. This function could be greatly improved if the harvesting head had a top saw which could cut the top of the log. This is also important for logs with broken tops.

Another limitation of most harvesting heads is that they can only process one stem at a time, making it unproductive in smaller stems. However, Timberjack has developed a single-grip head with multi-stem capability. This harvester head was examined by FERIC (TN-291). It's productivity ranged from 123 to 214 stems PMH. The volume PMH ranged from 11.1 to 15.2 m^3.

Forwarder

On CP 234-1, a Valmet 546F forwarder was used. This machine is a four-cylinder turbocharged diesel 4.0-litre ford engine rated at 103 horsepower that powers this 11-ton forwarder. It is 2.6 meters wide therefore, it can operate on a 3-meter wide trail. On undulating terrain, this machine requires a 4-meter wide trail because the top of the bunks will sway back and forth. On undulating trails narrower than 3.5 meters, the forwarder will sometimes scar crop trees with the top of the bunks. This can be avoided by placing tops and branches in the depressions to create a level forwarding trail. The crane has a reach of 5.4 meters for loading logs onto the forwarder.

Figure 12: Various log sorts processed at the stump

On CP 234-1, the month of February 1998 was mild with a snow pack of approximately 30 centimetres. Though the forwarder operated on a brush mat consisting of tops and branches, the operator had to be careful when operating over wet soft areas. The harvester can rut the ground if there is no adequate cover of tops and branches. When the forwarder travelled on the block road, it became rutted. In March, the road was too rutted for a pickup to travel on it. The road had to be graded with a small cat however once the rains started it was very difficult to maintain the road. It should be noted that though the forwarder is capable of working in soft ground, it must operate on a brush mat on wet soils or rutting definitely will occur. We were fortunate to have a low snow pack in 1998 however if we had a snow fall greater than 1 meter then the 546H forwarder would be limited in its ability to travel on this site. This machine worked well on the site however it must be noted that adverse forwarding was limited. This forwarder is challenged with forwarding full loads over 20% adverse grades.

Figure 13: Valmet 892 loading logs on CP 233-3

On the four blocks of CP 233, a Valmet 892 forwarder was used. This 16-ton forwarder is powered by a six-cylinder turbo Volvo engine rated at 178 horsepower. It is 2.9 meters wide therefore can operate on a 3.4-meter wide trail. The operator has a very clear view from the cab. The crane has a reach of 7.15 meters for loading onto the forwarder. This machine was capable of forwarding on adverse slopes to a maximum of 30%.

Forwarder Production Summary

The forwarder productivity was measured by loads PMH and volume PMH. (see Table 3). The forwarder averaged 0.8 loads PMH to average 10 m^3 per hour. The variations for forwarder loads were between 0.7 to 0.9 loads per hour. The variations for volume per hour ranged from 8.8 m^3 to 11.5 m^3 per hour. The main factors effecting forwarder productivity were number of sorts and length of forwarding distance.

Table 3 : Forwarder Productivity by Site

Cutting Permit	Loads PMH	M^3 PMH
233-1	0.88	11.51
233-3	0.8	9.31
233-4	0.86	11.33
233-11	0.73	8.78

The following point was discussed in Marvin Strimbold's report (see Appendix).

"When logging a clear-cut the forwarder would do long faces allowing forwarder to move up and down the face, forwarding specific species. In a CT, you may have one 20' long piece, one 16' log piece, one pulp and one species in each dimension between two trees in a tight area. The forwarder operator cannot go into this area six times as the chance of scaring those two standing trees as well as the entire trail will increase by six times. Therefore the operator pulls out the pieces and loads them and then sorts the load at the roadside. This operation slows production because the forwarder can only do one sort on either side of the road unless he moves up and down the road to each of the specific decks, sometimes even off loading wood to re-load instead of making too many trips up and down the decks. Where again in clear cut logging, other than the last load, the operator would unload all wood in one spot because of the sorting available in face logging by the harvester. In addition, in clear-cut logging the harvester is able to do a much better sort in the woods as space is not a problem and processed decks can be left in different directions."

Trucking

A self-loading short log truck was used (See Figure 14) It has a quad axle trailer, which has two bunks, and one bunk on the tractor with the loader attached to the tail-frame of the tractor. On average, this truck hauled 56,000-kg loads to average 50 m^3 loads. This truck was able to haul two trips per day thus was not able to keep up with the harvester and forwarder.

Figure 14: Self loading truck with Quad Axle trailer

On the trailer, the adjustable bunks are mobile with a hydraulic cylinder. This allows the operator to move the back bunks towards the loader for ease of loading then move the bunks to the back of the trailer to load the front of the trailer. Because of weight restrictions, it was common to see the bunks on the tractor with 30 cm or more stake showing.

Timber Harvesting Summary

The harvester operator handles the single most important phase of commercial thinning. The operator selects which trees should be removed and retained. The harvester operator will also choose the trails to be used by the forwarder. The 892 forwarder is 30 centimetres wider than the 546H. However since the engine of the 892 has more power it is capable of doing a better job than the 546H forwarding. It is very important to mention the requirement for experienced operators. Operator productivity is largely determined by the skill and experience of the operator. It is commonly accepted that it can take a harvester operator up to ten months of operation before they become efficient at harvesting. In some Scandinavian countries, this is acknowledged by having mandatory 6-week technical program for operators.

There have been many studies in the recent years on the productivity of the harvester and forwarder. Bulley reported in FERIC TN-292 that tree size, but not stand density, affected harvester productivity. Bulley also reported that the harvester productivity ranged from 4.3 to 22.5 m^3/PMH while the forwarder productivity ranged from11.8 to 23.2 m^3 PMH. Average productivity of the harvester and forwarder were 12.1 and 18.4 m^3 PMH, respectively.

For this experiment, the logs were sorted into five sorts: a white wood sort, a fir sort and a pulp sort. Each species was sorted into greater than 20-centimetre diameter or less than 20-centimetre diameter at the butt of the log. In small wood (less than 0.20 m^3 / tree) the harvester and forwarder have approximately the same productivity. In medium size wood (0.30 m^3 to 0.50 m^3) the forwarder is approximately 1.5 times more productive than the harvester. In large wood (greater than 0.5 m^3) the forwarder is twice as productive than the harvester.

Cut to Cruise Comparison

The volume harvested from the CT sites was tracked and compiled. One of the issues identified earlier was the Grade 6 logs. One way to solve this is to make the volume appraised based on a final cruise instead of estimating the volume removal and using this volume to value the stand and determine a stumpage rate. At the end of the harvesting, all of the sites on CP 233 were recruised. Each of the initial cruise plots was revisited and the trees harvested were noted. (see Table 4)

Table 4: Cruise Volume Versus Delivered Volume

	233-1	233-3	233-4	Total
Scale sawlog m^3	2,504	9,316	1,711	13,531
Scale pulp vol	116	1,062	139	1,317
Total vol	2,620	10,378	1,850	14,848
Cruise volume	1,933	9,866	3,019	14,818
Enhanced cruise[3]	1,969	12,693	3,365	16,056
Appraised vol	1,115	9,460	2,640	13,215

The volume of sawlog delivered over the scale was 13,351 m^3 whereas the cruise indicated that 14,818 m^3 should have been delivered, a difference of 10%. Once the pulp volume is included then the delivered volume is approximately the same as the cruise volume. When comparing the total volume delivered with the enhanced cruise[3] volume, the under cut is approximately 9%. From this analysis, it could be concluded that a cruise-based appraisal is not a equitable method to determine the value of the stand.

When the original appraisal was completed a percent reduction method was used whereas a percentage of each diameter class was removed to determine the cruise volume removal. Based on the stand table, the larger stems were retained and not included in the volume to remove from the stand. The target number to retain was 625 stems per hectare. It is interesting to note that the volume difference between the scale volume of sawlog is within 2% of the percent reduction method.

It could be concluded that the percent reduction method should be employed in the future to determine the volume of the stand that will be removed for appraisal purposes. The cruised -based appraisal method has been suggested as a way to account for the grade 6 scaling issue however the disadvantage of this is that the volume of the stand that will be removed may once again be 10% overestimated.

Issues

Higher Level Planning

The cut-to-length harvesting system is believed to be appropriate for removing trees in a partial cutting system where more than 100 stems per hectare are randomly distributed. It could be used in lakeshore management areas, commercial thinning, and areas with non-timber resource values. This harvesting system fits in with the spirit and intent of the Cariboo-Chilcotin Land Use Plan of "modified harvesting".

We anticipate that a major advantage to commercial thinning with this method will be an AAC offset. Thinning should allow fibre, which is to be available for the future (i.e. 35 to 70 year old stands) to be available in the present. This is very important in the Williams Lake TSA because of the age class imbalance that exists. An analysis on the AAC of the Williams Lake TSA conducted in Sept 1999 by Timberline concluded that commercial thinning could provide the most significant potential increases over the base case in the short-term harvest levels. Commercial thinning would allow the forest industry to shorten the technical rotation and alleviate impending wood supply shortages.

Density Management

Planting densities in the future should consider commercial thinning as a future stand management technique. In the past, tree-planting densities only targeted an average of 1600 stems per hectare. This has resulted in stems with large branches and poor form on many sites. We should be focusing on managing crops through pre-commercial thinning and planting at 2300 stems per hectare at age 30. Entry for commercial thinning 30% to 50% of the stems should occur once the trees have reached crown closure (approximately 35 to 45 years old). We should then commercial thin another 30% to 50% when the stand reaches crown closure again (approximately 50 to 60 years old). Stands in the

[3] The enhanced cruise is based on min DBH of 9.0, stump ht of 30cm, and top diameter of 6.4 cm and minimum length of 3.4 meters based on the minimum log specifications at the time of harvest.

interior should then be harvested once they have reached biological rotation.

Availability

A GIS query of forest inventory files into the amount of eligible commercial thinning stands in the Williams Lake TSA indicated that there is approximately 124,414 ha of 60 to 120 year old pine and fir leading stands available for harvesting with the commercial thinning method. On average a harvester and forwarder will be able to harvest 1 to 2 hectares per day (depending on piece size, volume removal etc) thus approximately 450 hectares per year per harvester and forwarder unit is feasible

Stand Density Diagrams

In developing prescriptions for the level or type of thinning to occur on each stand, many issues should be considered. It is not clear on what the thinning densities should be on each site. One tool that is commonly used to determine the level of thinning is a stand density diagrams (SDD). However, SDD's have been developed from single species stands using the tree and stand simulator (TASS). Mixed stand SDD's are needed for the Cariboo Forest Region. Mixed species plantations are very common in the Cariboo.

Conclusion

Commercial Thinning is an operationally feasible option in the Cariboo Forest Region. Commercial thinning will allow continuity of access to operable, merchantable stands from the Williams Lake TSA. The cost of commercial thinning is higher than conventional harvesting however if the actual costs are recognised in the stumpage appraisal system, then the delivered cost should be acceptable. Currently there are enough natural stands available for commercial thinning for at least one contractor on an annual basis. The major deterrents to begin operational commercial thinning are related to valuation issues.

With this experiment, we have determined that medium to large size equipment is the most appropriate for the timber stands in the Horsefly Forest District. In some stands, a smaller harvester may be appropriate. However, it will be limited to the stands with piece size less than 0. 20 m^3 per piece or less than 20cm diameter at the stump height. The 125 horse power harvester was challenged by the open growing stands with the large knot sizes. With equipment contribution to the success of a commercial thinning operation, enough cannot be said about the impact that an experienced operator would have. The larger 892 forwarder rated at 176 horsepower was the most practical forwarder for the sites thinned.

To date over 2,000 hectares have been identified for commercial thinning in the Horsefly Forest District in Riverside's Forest Development Plan. This is enough to sustain a harvester and forwarder unit for 5 years. GIS analysis in the W.L. TSA has indicated that approximately 125,000 hectares is potentially available for commercial thinning at this time. In the future many 35 to 45 year old plantations will be available for commercial thinning.

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Appendix 1

Harvesting Report by E.A. Strimbold Ltd.

E.A. Strimbold Ltd. ▲▼▲▼▲▼▲▼▲▼▲▼▲▼▲▼▲▼▲▼

Box 569 • Burns Lake, BC V0J 1E0 • Telephone 604-696-3607 • Fax 604-696-3607

Gord E. Chipman RPF
Area Supervisor, Horsefly Dist.
Riverside Forest Products
Williams Lake, BC

December 15, 1998

RE: Commercial Thinning - Horsefly Dist., Cutting Permit EG2233 - Block 03

[redacted] on behalf of E.A. Strimbold Ltd. viewed the above mentioned block and had derived an estimated production per productive hour, based on past experience. From cruise base we estimated that the wood being removed would average between .20 and .25 M3 per tree. Thus doing 50 trees per hour with our harvester would bring production to 12.5 M3 per productive machine hour. The rate per M3 for our harvester would be $14.80 (12.5M3 X $14.80 = $185.00\hr) and for the forwarder it would be $7.70 per M3(16.88M3 per Hour X $7.70 = $130.00\hr). To accomplish the 16.88 M3 per hour for our forwarder we estimated that to be 1.25 forwarder loads per hour. This is a combined machine rate for the system of $315.00 per hour.

With the above M3 rate per machine plus the cost of lowbedding, camp costs and sorts that involved under 6", over 6" and 3 species sorts and a pulp sort giving us 9 sorts, we came to an agreement of $24.81 per M3.

Please find attached a map with four high-lighted areas representing different sized wood, that I beleive was removed. Also please find attached another map indicating the time period that we worked on the above area's.

What we found in the open 1000-2000 stem stocking with .25 M3 per tree size, was that we were actually able to increase or maintain trees cut and processed per hour to within the 50-60 trees per PMH. The operators felt night shift was not too bad in these stands as the stands were healthier so that there was less chance of leaving poor quality trees because the visibility was much better in this less dense stand. In these stands the operator reported to have less fatigue, less damage to residual stands and overall there was higher productivity. I also feel these stands will be wind firm and have a much less chance of snow breakage.

So unit #1(map indicated), being an ideal commercial thinning block we found with close to our estimated productivity that the agreed upon logging price of $24.81 per M3 was a good price. However our forwarder productivity was down because of the number of sorts in this thinning area. This is the most sorts we have ever done in any of our commercial thinning experiences.

When logging a clear-cut the forwarder would do long faces allowing forwarder to move up and down face, forwarding specific species. In a thinning you may have one 20' long piece, one 16' log piece, one pulp and one specie in each dimension between two trees in a tight area. The forwarder operator cannot go into this area six times as the chance of scaring those two standing tree's as well as the entire trail will increase by six times. Therefore the operator pulls out the pieces and loads them and then sorts the load at the roadside. This operation slows production because he can only do one sort on either side of the road unless he moves up and down the road to each of the specific decks, sometimes even off loading wood to re-load instead of making too many trips up and down the decks. Where again in clear-cut logging , other than the last load, the operator would unload all wood in one spot because of the sorting available in face logging. Also in clear-cut logging the harvester is able to do a much better sort in the woods as space is not a problem and processed decks can be left in different directions.

As the wood piece size gets smaller the sorting of each log is slowed again by the number of bolts needed to make a M3 of wood. Cutting unit #2 (map indicated) was below our estimated production but I feel the quality of the remaining stand in both unit #2 and unit #3 will withstand high winds and snow press conditions. Unit #2 and #3 were very close in tree size, the only difference was under-story and specie mix. These sights seem to be predominantly pine, with varied densities between 2000-3500 stems per Hectare. So with these stands we tried to create a diverse height stand by periodically removing larger Pine and leaving smaller, younger Spruce and Fur. By doing this our production should have been up a little because the average piece size removed would be larger.

Within these area's our trees per PMH seem to stabilize to 50 tree's per PMH. But when the tree size is reduced from .25M3 to .15M3(6.5 trees\M3) the production went down to 7.5M3 per PMH instead of the 12.5M3 targeted production for our harvester. We thought maybe in tighter, high volume stands we would be able to harvest more tree's per PMH but because of height and density and fragile felling/processing we had to slow down our harvesting to avoid scaring residual stands. Therefore we were unable to increase our tree's cut per PMH. Space becomes a problem.

Unit #4(map indicated) was 2000-5000 stems per Ha. with very small piece sizes. In these stands our tree count went down because of having to go in and remove dry, unsalvageable pieces, and there were small unutilized pieces in areas within this timber type. At 48 tree's PMH and a .11 tree size we would only be producing 5.28M3 per PMH instead of the targeted harvester production of 12.5M3 per PMH. At this production of 5.28M3 we would be at harvester cost of $35.04 per M3 which is an extremely high price for the quality of wood recovered. Within the small, extremely tight stands, as long as the tree's are not too tall, it would be possible to use a smaller harvester and head which would increase the tree count. Using a smaller harvester and head would also reduce capital cost which would reduce M3 rate of $35.04 for the harvester but I feel this is something to explore at a later date once an efficient way to commercially thin the better quality stands has been established.

In unit #4 the silviculture side of things produces a concern. Because the stock diameter to height ratio and the fact that these tree's have been supported by each other for the last 30 years creates a concern that they may not be able to withstand high winds and heavy snow. As we know the first thing to grow is the crown before stem diameter and root establishment takes place. Therefore the residual stand becomes a high risk 5 years after thinning.

SUMMARY

The two harvester operators, [redacted] have been operating this type of equipment for 7 years and operate at 90-95 % efficiency of expected production. [redacted] and [redacted] both had approximately 6 months experience on the forwarder and ran about 70-75 % efficiency. With our operators and myself, I feel we run an efficient operation having alot of expertise. But I also realize from doing commercial thinning over the past 7 years, there are varied techniques, equipment, terrain and densities which all need to be explored further, on an on going bases to enable best possible silviculture treatments, productivity and cost efficiencies. I beleive the thinning cost as I stated with Gord, before we began, can run from as low as $24.81 per M3 to as high as $55.00 M3 depending on piece size, density, terrain and type of treatment.

We have had an enjoyable experience working with Gord Chipman, a dedicated forester that has the ability to look beyond today and is concerned for the future, making on the spot decisions and demanding quality workmanship. With that Gord, it has been a pleasure working with yourself and staff and MOF in Horsefly. I hope the enclosed information and our job performed will help yourself and MOF to make some commitments and that many commercial thinning contracts will be awarded in progress of our natural resources and future generations.

Thanks.

Sincerely,

[redacted]

per E.A. Strimbold Ltd

RIVERSIDE FOREST PRODUCTS
WILLIAMS LAKE DIVISION

RIVERSIDE FOREST PRODUCTS LIMITED

TENURE: F.L. A20015 | C.P.: 233 | BLOCK: 3

FOREST REGION: CARIBOO | FOREST DISTRICT: HORSEFLY | PHOTO NO.: 30BCC1009 109

LAND DISTRICT: CARIBOO | SUPPLY BLOCK: UPPER HORSEFLY | MAP SHEET REF.: 93A025, 026

UTM ZONE: 10 E: 635921 | N: 5791178

LATITUDE: 52° 15' | LONGITUDE: 121° 01' | GROSS AREA: 59.9

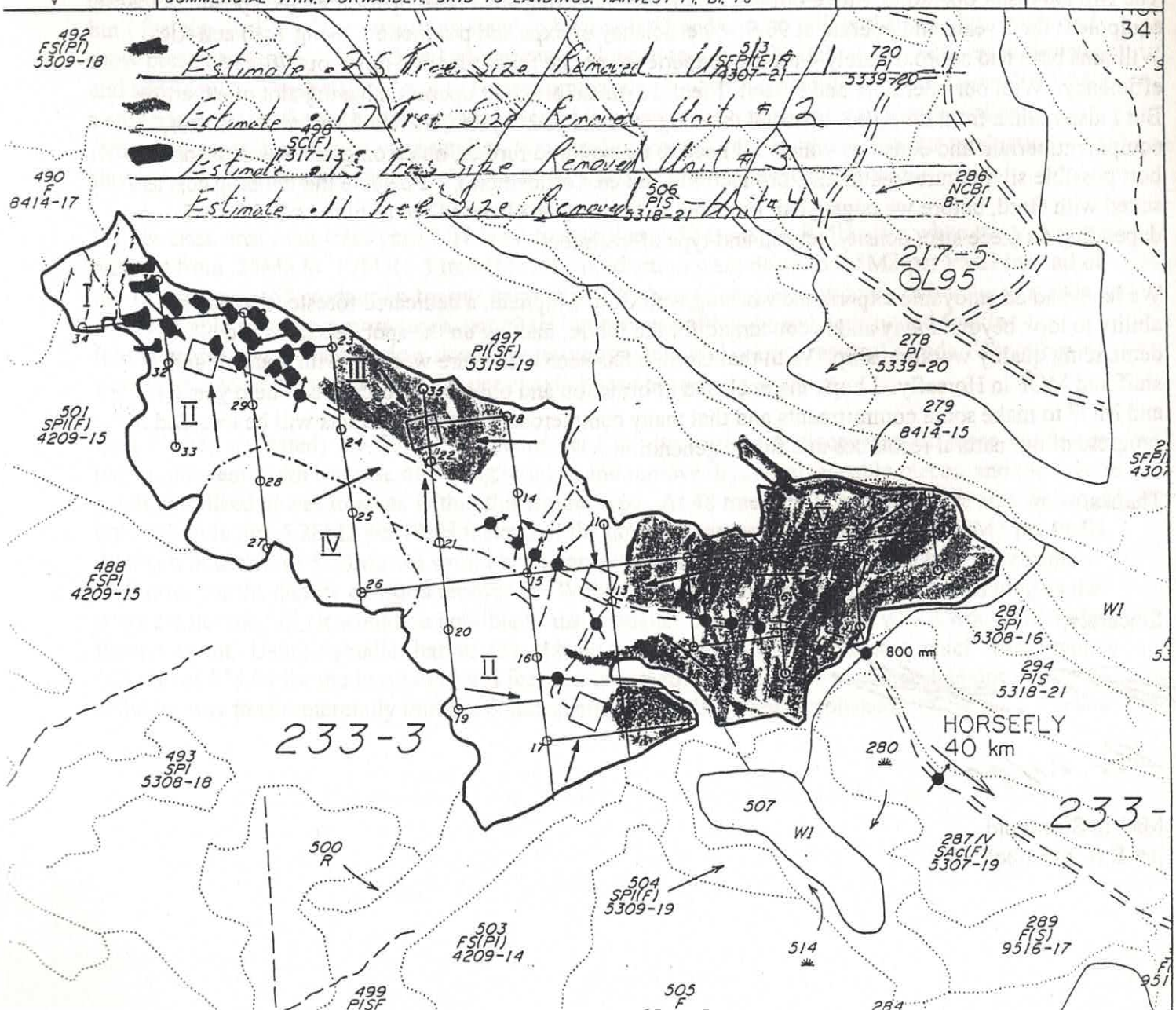
NET AREA: 57.3

LOCATION: TISDALL LAKE | DATE: 04/21/97

N

SCALE: 1:10000 1cm=100m

STANDARD UNIT	HARVEST SYSTEM	SOIL SENSITIVITY	% ALL. DIST.
I	FORWARDER, PROTECT ADVANCED REGENERATION, SKID TO LANDINGS		
II	COMMERCIAL THIN, FORWARDER, SKID TO LANDINGS, HARVEST Pl, Bl, Fd		
III	COMMERCIAL THIN, FORWARDER, SKID TO LANDINGS, HARVEST Pl, Bl, Fd		
IV	COMMERCIAL THIN, FORWARDER, SKID TO LANDINGS, HARVEST Sx, Fd		
V	COMMERCIAL THIN, FORWARDER, SKID TO LANDINGS, HARVEST Pl, Bl, Fd		



RIVERSIDE FOREST PRODUCTS
WILLIAMS LAKE DIVISION

RIVERSIDE FOREST PRODUCTS LIMITED

TENURE: F.L. A20015
FOREST REGION: CARIBOO
LAND DISTRICT: CARIBOO
UTM ZONE: 10 E: 635921
LATITUDE: 52° 15'

LOCATION: TISDALL LAKE

C.P.: 233
FOREST DISTRICT: HORSEFLY
SUPPLY BLOCK: UPPER HORSEFLY
N: 5791178
LONGITUDE: 121° 01'

BLOCK: 3
PHOTO NO.: 30BCC1009 109
MAP SHEET REF.: 93A025, 026

GROSS AREA: 59.9
NET AREA: 57.3
DATE: 04/21/97

N

SCALE:
1:10000
1cm=100m

STANDARD UNIT	HARVEST SYSTEM	SOIL SENSITIVITY	% ALL. DIST.
I	FORWARDER, PROTECT ADVANCED REGENERATION, SKID TO LANDINGS		
II	COMMERCIAL THIN, FORWARDER, SKID TO LANDINGS, HARVEST Pl, Bl, Fd		
III	COMMERCIAL THIN, FORWARDER, SKID TO LANDINGS, HARVEST Pl, Bl, Fd		
IV	COMMERCIAL THIN, FORWARDER, SKID TO LANDINGS, HARVEST Sx, Fd		
V	COMMERCIAL THIN, FORWARDER, SKID TO LANDINGS, HARVEST Pl, Bl, Fd		

August 1 to August 15 Double Shift
August 15 to Sept 15 Double Shift
Sept 15 to Oct 15 Single Shift
Oct 15 to Nov 13 Single Shift

492 FS(Pl) 5309-18
513 SFPl(E) 4307-21
720 Pl 5339-20
34
490 F 8414-17
506 PlS 5318-21
286 NCBl 8-111
217-5 OL95
278 Pl 5339-20
279 S 8414-15
497 Pl(SF) 5319-19
501 SPl(F) 4209-15
488 FSPl 4209-15
281 SPl 5308-16
800 mm
294 PlS 5318-21
233-3
HORSEFLY 40 km
280
493 SPl 5308-18
507
Wl
287/V SAc(F) 5307-19
500 R
504 SPl(F) 5309-19
503 FS(Pl) 4209-14
514
289 F(S) 9516-17
499 PlSF
505 F
233-

E.A. STRIMBOLD LTD.

Box 569, Burns Lake, BC V0J 1E0 Telephone & Fax: (250) 696-3607 [redacted]

December 10, 1997

Gord Chipman
Riverside Forest Products Ltd.
Williams Lake Division

Good day Gord:

Here is a breakdown of our price and cost per M3 on the Horsefly area thinning block, near McKinley Lake. We will begin Jan 5\98 and complete the block by Feb 27\98.

Price to roadside using a Single Grip Harvester\Forwarder System.

Combined Harvester\Forwarder Rate		$315.00 / 14M3	=	$22.50
Lowbed in and out	@	$4500.00 / 5500 M3	=	$ .82
Room and board 7 weeks	@	$4360.00 / 5500 M3	=	$ .79
Travel Time and set up\out 4 days x $1200.00	=	$4800.00 / 5500 M3	=	$ .87
Over head and supervision			=	$ 1.25
TOTAL COST TO RIVERSIDE PER M3				$26.23

This proposal is a non-replaceable contract and if the workmanship quality in the thinning is acceptable, we would like to have first opportunity for the other 5000 M3 of thinning in the summer of 1998. The rates would remain approximately the same if the block is similar.

Hope this is met with your approval. I look forward to hearing from you.

Sent Dec 11/97 1:31 p.m.

[redacted]

Agreed to a Rate of 24.81 m^3 on Dec. 15/97

Riverside Forest Products Ltd
Williams Lake, BC

Area Supervisor: Gordon E. Chipman RPF

E.A. STRIMBOLD LTD.
BLOCK REPORT

Location: Horsefly CP 233 - 03

Date 1998	Name Operator	Shift D\N	Machine	Shifts 546C	Shifts 892F	PMH 546C	PMH 892F	D\T Hrs	Oper Hrs	Tree Count	Forward Loads	Avail. Mach.	Est. M3 Harvest.	Est. M3 Forward	Est. M3 harv pmh	Est. M3 fwd pmh
July 30 + 31\98	Francis	D	546C	2		16		3	19	546		84.21%	91.00		5.69	
July 29,30,31\98	Steve	N	546C	3		24		10	30	863		80.00%	143.83		5.99	
Aug 1 - 15, 1998	Francis	D	546C	12		83		32	115	3610		72.17%	601.67		7.25	
Aug 1 - 15, 1998	Steve	N	546C	10		63.5		28	91.5	2940		69.40%	490.00		7.72	
Aug 1 - 15, 1998	Sang	D	892F		9		49.5	29.5	79		40	62.66%		520.00		10.51
Aug 1 - 15, 1998	Rick	N	892F		7		25.5	1.5	42.5		13	60.00%		169.00		6.63
Aug 16 - 31, 1998	Steve	D\N	546C	24		163.5		64	227.5	8296		71.87%	1382.67		8.46	
Aug 16 - 31, 1998	Francis	N\D	546C	26		215		57.5	272	10341		79.04%	1723.50		8.02	
Aug 16 - 31, 1998	Sang	D	892F		20		149.75	59.75	210		120.5	71.31%		1566.50		10.46
Aug 16 - 31, 1998	Rick	N	892F		16		121	22.5	143		83	84.62%		1079.00		8.92
Sept 1 - 15, 1998	Francis	D	546C	12		101.5		22	123.5	5556		82.19%	926.00	0.00	9.12	
Sept 1 - 15, 1998	Steve	N	546C	9		61		19.5	72	3276		84.72%	546.00	0.00	8.95	
Sept 1 - 15, 1998	Sang	D	892F		5		50.5	8	58.5		43.5	86.32%		565.50		11.20
Sept 1 - 15, 1998	Rick	N	892F		11		114.5	11	125.5		81.5	91.24%		1059.50		9.25
Sept 16 - 30, 1998	Francis	D	546C	13		122		29	147	6542		82.99%	1090.33		8.94	
Sept 16 - 30, 1998	Steve	D	546C	2		9		7	16	421		56.25%	70.17		7.80	
Sept 16 - 30, 1998	Sang	D	892F		9		90.5	14.5	105		78	86.19%		1014.00		11.20
Sept 16 - 30, 1998	Rick	D	892F		8		64.5	16	74.5		46	86.58%		598.00		9.27
Oct 1 - 15, 1998	Francis	D	546C	9		63.5		51.5	115	3238		55.22%	539.67		8.50	
Oct 1 - 15, 1998	Ken	N	546C	6		46.5		20	66.5	1646		69.92%	274.33		5.90	
Oct 1 - 15, 1998	Sang	D	892F		9		64	55.5	92		59.5	69.57%		773.50		12.09
Oct 1 - 15, 1998	Ken	N	892F		4		26.5	36.5	44.5		20	59.55%		260.00		9.81
Oct 16 - 31, 1998	Francis	D	546C	13		109		25	134	5429		81.34%	904.83		8.30	
Oct 16 - 31, 1998	Sang	D	892F		10		105	14.5	115.5		90.5	90.91%		1176.50		11.20
Oct 16 - 31, 1998	Ken	D	892F		4		26.5	36.5	44.5		20	59.55%		260.00		9.81
Oct 1 - 31, 1998	Ken	D	546C	6		46.5		20	66.5	1646		69.92%	274.33		5.90	
Nov 1 - 15, 1998	Francis	D	546C	11		90.5		19	114	5016		79.39%	836.00		9.24	
Nov 1 - 15, 1998	Sang	D	892F		11		92	21.5	123.5		88.5	74.49%		1150.50		12.51
TOTALS				158	123	1214.50	979.75	734.75	2867.5	59366	784		9894.33	10192.00	8.15	10.40

Estimated Volume: 6 Trees \ M3 & 13M3 per forwarder load

Block Summary: July 30 - November 15, 1998

Total M3 Harvested	9894.33
Total M3 Forwarded	10192.00
Total Tree's \ PMH Harv.	48.88
Total M3 \ PMH Harv.	8.15
Forwarder LOADS \ PMH	0.80
Total M3\PMH Forw.	10.40

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly

Harvester 546C - Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Tree Count	Tree's per PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Sept 01	9	2	11	81.82%	494	54.89	123.50	13.72	saw motor was not working
Sept 02	7	3	10	70.00%	419	59.86	104.75	14.96	busted feed roll hose 1 hr sharp chn
Sept 03	7	2	9	77.78%	404	57.71	101.00	14.43	trouble with saw bar return
Sept 04							0.00	ERR	1.5 hrs sharp chn 6.5hrs on forwarder
Sept 05	7	1	8	87.50%	371	53.00	92.75	13.25	
Sept 07	9	2	11	81.82%	590	65.56	147.50	16.39	bolts in feed wheels came loose
Sept 08	10.5	1.5	12	87.50%	615	58.57	153.75	14.64	auto button went chg hose
Sept 09	7	4	11	63.64%	417	59.57	104.25	14.89	chng hose fix leak on saw motor
Sept 10	9	2	11	81.82%	505	56.11	126.25	14.03	chng fuel pump chng oil
Sept 11	10	1	11	90.91%	379	37.90	94.75	9.48	prime chn oil tank - steep slope
Sept 12	8	1	9	88.89%	356	44.50	89.00	11.13	busted grapple hose
Sept 13							0.00	ERR	4 hrs chn sharpen, made sp hose etc
Sept 14	8	1.5	9.5	84.21%	439	54.88	109.75	13.72	forw .5 hr help and fix muffler on harv
Sept 15	10	1	11	90.91%	567	56.70	141.75	14.18	broke fitting on main hose
Sept 16	11	1	12	91.67%	605	55.00	151.25	13.75	sharpen chains and hauled fuel
Sept 17	6.5	2.5	9	72.22%	365	56.15	91.25	14.04	spring on measuring wheel , chng saw hose
Sept 18	9	3	12	75.00%	479	53.22	119.75	13.31	hose on boom and chng hose on head
Sept 19	6.5	0.5	7	92.86%	307	47.23	76.75	11.81	hauled fuel
Sept 20		4							helped with forwarder
Sept 21	9	4	13	69.23%	474	52.67	118.50	13.17	chng fuel pump and feed wh hose, shrp chn
Sept 22	11	1	12	91.67%	656	59.64	164.00	14.91	hauled fuel
Sept 23	11	2	13	84.62%	646	58.73	161.50	14.68	cable hose, tighten saw motor bolts, made step
Sept 24	11	2	13	84.62%	616	56.00	154.00	14.00	broke alt belt and pin come out of boom
Sept 25	10	2	12	83.33%	566	56.60	141.50	14.15	leak on top of boom
Sept 26	9	1	10	90.00%	471	52.33	117.75	13.08	broke fitting on chain oil hose
Sept 28	9	2	11	81.82%	459	51.00	114.75	12.75	lost bolt out of saw
Sept 29	9	2	11	81.82%	463	51.44	115.75	12.86	brk alta belt - town, hauled fuel
Sept 30	10	2	12	83.33%	435	43.50	108.75	10.88	brk wires on head , mech air conditioner
ALS	223.5	51	270.5	82.62%	12098	54.13	3024.50	13.53	

ated Volume: 4 Tree's per M3

Summary of Work Completed: Sept 1 - 30, 1998

Total PMH	223.5
Total M3	3024.5
Total Tree Counts	12098
Tree's per PMH	54.13
Tree's per Op Hr	44.72
M3 \ PMH	13.53
AVG Total M3 \ Shift	120.98

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly

Harvester 546C - Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Tree Count	Tree's per PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Sept 01	7.5	3	10.5	71.43%	449	59.87	112.25	14.97	pulled saw motor and did bolts
Sept 02	7	1	8	87.50%	400	57.14	100.00	14.29	3 hrs to go to twon for parts and fuel
Sept 03	6.5	4	10.5	61.90%	333	51.23	83.25	12.81	chng 3 valves on head - its working really good
Sept 04							0.00		2 hrs on saw and 2 hrs to travel home
Sept 08	3.5		3.5	100.00%	135	38.57	33.75	9.64	2 hrs travel
Sept 09	7	4	11	63.64%	450	64.29	112.50	16.07	blew main hose to vlave bank and fuel trouble
Sept 10	9.5	2	11.5	82.61%	513	54.00	128.25	13.50	lost saw cycle bolt walked to shop to get one
Sept 11	8	2.5	10.5	76.19%	463	57.88	115.75	14.47	1.5 hrs sharp chns weld on head help Sang
Sept 12							0.00		9 hrs worked on forwarder
Sept 13							0.00		9.5 hrs worked on forwarder
Sept 14	4	2.5	6.5	61.54%	200	50.00	50.00	12.50	7 hrs to pull forwarder engine
Sept 15	8	0.5		ERR	333	41.63	83.25	10.41	2 hrs getting fire wood
Sept 16	6	4	10	60.00%	309	51.50	77.25		saw bending, shrp chan and cut some fire wood
Sept 17	3	3	6	50.00%	112	37.33	28.00		2 hrs travel , and shrp chns
				ERR		ERR	0.00		
				ERR		ERR	0.00		
				ERR		ERR	0.00		
TOTALS	70	26.5	88	79.55%	3697	52.81	924.25	13.20	

Estimated Volume: 4 Trees per M3

Summary of Work Completed: Sept 1 - 17, 1998

Total PMH	70
Total M3	924.25
Total Tree Counts	3697
Tree's per PMH	52.81
Tree's per Op Hr	42.01
M3 \ PMH	13.20
AVG Total M3 \ Shift	84.02

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly

Forwarder 892F: Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Sept 01	8	4	12	66.67%	7.5	0.94	97.50	12.19	get fuel \ lots of shorting
Sept 02	11.5	0.5	12	95.83%	11	0.96	143.00	12.43	chng one hose
Sept 09	11	1	12	91.67%	9	0.82	117.00	10.64	put 2 clevises on chain \ add antifreeze
Sept 10	10.5	1	11.5	91.30%	9	0.86	117.00	11.14	help with harv .5 hr \ blew one hose on grapple
Sept 11	9.5	1.5	11	86.36%	7	0.74	91.00	9.58	blew out air filter
Sept 12				ERR		ERR	0.00	ERR	8 hrs wrenching on motor
Sept 13				ERR		ERR	0.00	ERR	put turbo on 892F
Sept 14				ERR		ERR	0.00	ERR	wrenching on 892fF - wngine is gone
Sept18				ERR		ERR	0.00	ERR	2 hrs travel time
Sept 19				ERR		ERR	0.00	ERR	9 hrs on forwardeer motor
Sept 20				ERR		ERR	0.00	ERR	6.5 hours on forwarder
Sept 21	6	6	12	50.00%	4	0.67	52.00	8.67	reseal compressor, joy stick, cut with harv for 1 hour
Sept 22	10.5	1.5	12	87.50%	10	0.95	130.00	12.38	ld trk .5 hrs, made hose and trouble with steering
Sept 23	8.25	3	11.25	73.33%	7	0.85	91.00	11.03	ld trk .75 hrs, help Marvin fix steering and heater
Sept 24	13.75	0.5	14.25	96.49%	13	0.95	169.00	12.29	ld trk .75 hours
Sept 25	10	2	12	83.33%	8	0.80	104.00	10.40	put light on machine
Sept 26	10		10	100.00%	8	0.80	104.00	10.40	
Sept 28	10.25	0.5	10.75	95.35%	9	0.88	117.00	11.41	ld trk .75 hrs
Sept 29	11.25	0.5	11.75	95.74%	10	0.89	130.00	11.56	ld trk .75 hrs
Sept 30	10.5	0.5	11	95.45%	9	0.86	117.00	11.14	ld trk 1 hr
TOTALS	99	21	120	82.50%	85.5	0.86	1111.50	11.23	

Estimated Volume: 13 M3 per load

Summary of Work Completed: Sept 1 - 30, 1998

Total PMH	99
Total M3	1111.5
Total Forw Loads	85.5
Loads per PMH	0.86
Loads per Op Hr	0.71
M3 \ PMH	11.23
AVG Total M3 \ Shift	79.39

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly

Forwarder 892F: Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Sept 01	10	2	12	83.33%	7	0.70	91.00	9.10	made a sp hose \ org shop \ fix light socket
Sept 02	12	2	14	85.71%	8.5	0.71	110.50	9.21	cab mount bolt fell out and head light fell off
Sept 03	10	1	11	90.91%	7	0.70	91.00	9.10	
Sept 04	14	1	15	93.33%	10	0.71	130.00	9.29	
Sept 05	10	0.5	10.5	95.24%	7	0.70	91.00	9.10	
Sept 06	11.5	1	12.5	92.00%	8.5	0.74	110.50	9.61	master switch shorted out
Sept 07	9.5	1	10.5	90.48%	7	0.74	91.00	9.58	2hrs to clean up deck
Sept 08	8	0.5	8.5	94.12%	6.5	0.81	84.50	10.56	
Sept 09	10	1	11	90.91%	7	0.70	91.00	9.10	fixed on trail .5 hr
Sept 10	10	0.5	10.5	95.24%	7	0.70	91.00	9.10	
Sept 11	9.5	0.5	10	95.00%	6	0.63	78.00	8.21	
Sept 21	5.5	0.5	6	91.67%	3	0.55	39.00	7.09	
Sept 22	7	2	9	77.78%	5	0.71	65.00	9.29	1 hour to help Max with Truck, complete service
Sept 23	10	1.5	11.5	86.96%	7	0.70	91.00	9.10	shrp chns , filled fluids, did windows
Sept 24	5.5	0.5	6	91.67%	4	0.73	52.00	9.45	went to town for fuel
Sept 25	10	2	12	83.33%	8	0.80	104.00	10.40	filled fluids, shrp chns, weld light on boom
Sept 27	9	1	10	90.00%	7	0.78	91.00	10.11	
Sept 28	9	1	10	90.00%	6	0.67	78.00	8.67	shrp chan, filled fluids, blew air filter
Sept 29		6		ERR		ERR	0.00	ERR	ran to town for fuel and oils
Sept30	8.5	1.5	10	85.00%	6	0.71	78.00	9.18	help francis fix wires on head
TOTALS	179	27	200	89.50%	127.5	0.71	1657.50	9.26	

Estimated Volume: 13 M3 per load

Summary of Work Completed: Sept 1 - 30, 1998

Total PMH	179
Total M3	1657.5
Total Forw Loads	127.5
Loads per PMH	0.71
Loads per Op Hr	0.64
M3 \ PMH	9.26
AVG Total M3 \ Shift	87.24

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly Block CP 233 - 03

Harvester 546C - Day \Night Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Tree Count	Tree's per PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
July 30	9.5	2.5	12	79.17%	313	32.95	78.25	8.24	Parking brk \ valve
July 31	6.5	0.5	7	92.86%	233	35.85	58.25	8.96	
Aug 01	8.5	1.5	10	85.00%	329	38.71	82.25	9.68	still slow \ chains
Aug 02		8	8	0.00%			0.00	ERR	wrkd on Harv \ chains
Aug 06	8	3	11	72.73%	366	45.75	91.50	11.44	lk on head \ wsh mach
Aug 07	7	2	9	77.78%	311	44.43	77.75	11.11	fan belt
Aug 08	8	1	9	88.89%	301	37.63	75.25	9.41	
Aug 09	8	1	9	88.89%	266	33.25	66.50	8.31	Hydralic
Aug 10	7	4	11	63.64%	304	43.43	76.00	10.86	fix alt
Aug 11	8	1	9	88.89%	355	44.38	88.75	11.09	feed wheel fitting
Aug 12	7	3	10	70.00%	334	47.71	83.50	11.93	hose and set pressure
Aug 13	6.5	4.5	11	59.09%	288	44.31	72.00	11.08	chn oil hose \ elec prb
Aug 14	7	2	9	77.78%	355	50.71	88.75	12.68	
Aug 15	8	1	9	88.89%	401	50.13	100.25	12.53	
Aug 16	8.5	1.5	10	85.00%	465	54.71	116.25	13.68	
Aug 17	9	1.5	10	90.00%	453	50.33	113.25	12.58	sharpened 6 chains 1 hr
Aug 18	9	2	11	81.82%	443	49.22	110.75	12.31	lst pin grapple
Aug 19	10.5	1.5	12	87.50%	516	49.14	129.00	12.29	
Aug 20	10	1	11	90.91%	563	56.30	140.75	14.08	lost bolt out of saw cyl
Aug 21	10	1	11	90.91%	585	58.50	146.25	14.63	1 hr sharpen chains
Aug 23	5	2	7	71.43%	245	49.00	61.25	12.25	1 hr for help with 892f
Aug 24	11	1	12	91.67%	601	54.64	150.25	13.66	
Aug 25	6	6	12	50.00%	371	61.83	92.75	15.46	saw motor bolt chg 3 hs
Aug 26	10.5	0.5	11	95.45%	566	53.90	141.50	13.48	
Aug 27	9	2	11	81.82%	505	56.11	126.25	14.03	busted cable hose
Aug 28	7	2	9	77.78%	368	52.57	92.00	13.14	serviced harvester
Aug 31	10.5	0.5	11	95.45%	504	48.00	126.00	12.00	
TOTALS	215	57.5	272	79.04%	10341	48.10	2585.25	12.02	

Estimated Volume: 4 Trees \ M3

Summary of Work Completed: JULY 30 - AUG 31, 1998

Total PMH	215
Total M3	2585.25
Total Tree Counts	10341
Tree's per PMH	48.10
Tree's per Op Hr	38.02
M3 \ PMH	12.02
AVG Total M3 \ Shift	99.43

PRODUCTION REPORT
EMPLOYEE [redacted]

Location: Horsefly Block CP 233 - 03

Harvester 546C - Night\Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Tree Count	Tree's per PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
July 29	6	4	10	60.00%	252	42.00	63	10.5	Park brake
July 30	8	3	11	72.73%	415	51.88	103.75	12.97	tilt valve \ park brk
July 31	6	3	9	66.67%	196	32.67	49	8.17	3 hrs to twn fuel
Aug 01	1	2	3	33.33%	20	20.00	5.00	5.00	2 hrs travel
Aug 05	7	2	9	77.78%	386	55.14	96.50	13.79	2 hrs travel
Aug 06	7.5	3	10.5	71.43%	353	47.07	88.25	11.77	brk hose \ fan belt
Aug 07	7	3	10	70.00%	361	51.57	90.25	12.89	bat on forw
Aug 08	6	3.5	9.5	63.16%	221	36.83	55.25	9.21	hoses and oil leaks
Aug 09	7	3	10	70.00%	341	48.71	85.25	12.18	center nut \ chains
Aug 10	7.5	2.5	10	75.00%	447	59.60	111.75	14.90	chain and bar repair
Aug 11	8	2	10	80.00%	366	45.75	91.50	11.44	
Aug 12	6	3.5	9.5	63.16%	215	35.83	53.75	8.96	grapple hose & wiring
Aug 13	6.5	3.5	10	65.00%	230	35.38	57.50	8.85	short in wiring
Aug 17	7	1	8	87.50%	391	55.86	97.75	13.96	2 Hrs travel time
Aug 18	10	1	11	90.91%	590	59.00	147.50	14.75	
Aug 19	8.5	2	10.5	80.95%	520	61.18	130.00	15.29	
Aug 20	6.5	3.5	10	65.00%	206	31.69	51.50	7.92	1 hr help Sang
Aug 21	7	3	10	70.00%	307	43.86	76.75	10.96	pull out broken bolts
Aug 22	6	2	8	75.00%	309	51.50	77.25	12.88	
Aug 24	8	2.5	10.5	76.19%	521	65.13	130.25	16.28	weld on forw\harv
Aug 25	8	1	9	88.89%	585	73.13	146.25	18.28	1.5 hrs chains
Aug 26	1		1	100.00%	39	39.00	9.75	9.75	went home
Aug 29	9	1	10	90.00%	525	58.33	131.25	14.58	
Aug 30		8	8	0.00%		ERR	0.00	ERR	chng feed rolls \ service
Aug 31	9	1	10	90.00%	500	55.56	125.00	13.89	
TOTALS	163.5	64	227.5	71.87%	8296	50.74	2074.00	12.69	

Estimated Volume: 4 Trees per M3

Summary of Work Completed: JULY 29 - AUG 31, 1998

Total PMH	163.5
Total M3	2074
Total Tree Counts	8296
Tree's per PMH	50.74
Tree's per Op Hr	36.47
M3 \ PMH	12.69
AVG Total M3 \ Shift	86.42

PRODUCTION REPORT
EMPLOYEE [redacted]

Location: Horsefly Block CP 233 - 03

Forwarder 892F: Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Aug 07	8	2	10	80.00%	6	0.75	78.00	9.75	cleaned landing
Aug 08	3	6	9	33.33%	2	0.67	26.00	8.67	W.L. get battery
Aug 09		2	2	0.00%	0		0.00		No charge on battery
Aug 10	2	9	11	18.18%	1	0.50	13.00	6.50	W.L. battery
Aug 11	8	1.5	9.5	84.21%	7	0.88	91.00	11.38	boggie bearing
Aug 12	5	5.5	10.5	47.62%	3	0.60	39.00	7.80	
Aug 13	7	2	9	77.78%	6	0.86	78.00	11.14	
Aug 14	8.5	0.5	9	94.44%	8	0.94	104.00	12.24	
Aug 15	8	1	9	88.89%	7	0.88	91.00	11.38	
Aug 16	5		5	100.00%	4	0.80	52.00	10.40	1.5 Hrs Fuel
Aug 17	12	0.5	12.5	96.00%	9	0.75	117.00	9.75	
Aug 18	8	0.5	8.5	94.12%	6.5	0.81	84.50	10.56	2.5 Hrs pulling Max
Aug 19		10	10	0.00%		ERR	0.00	ERR	10 Hrs Fibre gear
Aug 20		5	5	0.00%		ERR	0.00	ERR	5 Hrs Fibre gear
Aug 21	7.5	2.5	10	75.00%	6	0.80	78.00	10.40	lks add hyd oil
Aug 22	6.75	0.75	8	84.38%	5	0.74	65.00	9.63	clean up some piles on road
Aug 24	8.5	2.5	11	77.27%	7.5	0.88	97.50	11.47	lk for air lks \ put lght on bom
Aug 25	8	2	10	80.00%	6.5	0.81	84.50	10.56	blew out rad, fix air lks
Aug 26	10.5	1	11.5	91.30%	10.5	1.00	136.50	13.00	re\re hose
Aug 27	9	2	11	81.82%	7.5	0.83	97.50	10.83	oil chng, re bent pipe boom
Aug 28	8	2	10	80.00%	5.5	0.69	71.50	8.94	clean up pulp
Aug 29	7	0.5	7.5	93.33%	5	0.71	65.00	9.29	clean up landing
Aug 31	10	1	11	90.91%	7.5	0.75	97.50	9.75	
TOTALS	149.75	59.75	210	71.31%	120.5	0.80	1566.50	10.46	

Estimated Volume: 13M3 per Forwarder load

Summary of Work Completed: AUG 7 - AUG 31, 1998

Total PMH	149.75
Total M3	1566.5
Total Forw Loads	120.5
Loads per PMH	0.80
Loads per Op Hr	0.57
M3 \ PMH	10.46
AVG Total M3 \ Shift	78.33

PRODUCTION REPORT
EMPLOYEE [redacted]

Location: Horsefly Block CP 233 - 03

Forwarder 892F: Night Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds Per PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Aug 06				ERR			0.00	ERR	moved wood piles
Aug 07				ERR			0.00	ERR	moved wood piles
Aug 08				ERR			0.00		moved wood piles
Aug 10	8	1	9	88.89%	4	0.50	52.00	6.50	switch battery
Aug 11	2	0.5	2	100.00%	1	0.50	13.00	6.50	moved wood piles
Aug 12	8		8	100.00%	5	0.63	65.00	8.13	
Aug 13	7.5		7.5	100.00%	3	0.40	39.00	5.20	shelley est.
Aug 16	6	1	7	85.71%	4	0.67	52.00	8.67	3 Hrs sorting
Aug 17	8	1.5	9.5	84.21%	5	0.63	65.00	8.13	1 Hr walk mach
Aug 18				ERR		ERR	0.00	ERR	6 Hrs Sharpen 10 chns
Aug 20	6.5	4	10.5	61.90%	4.5	0.69	58.50	9.00	fix alt re rad fill hyd
Aug 21	8	3	11	72.73%	6	0.75	78.00	9.75	fix air lk clean machine
Aug 22	1.5	1.5	3	50.00%	1	0.67	13.00	8.67	lk on crane
Aug 23	7	3	10	70.00%	5	0.71	65.00	9.29	chng hoses and fill hyd oil
Aug 24	11	2	13	84.62%	10	0.91	130.00	11.82	cln shop & wire boom lite
Aug 25	11.5	2	13.5	85.19%	8	0.70	104.00	9.04	brk hse spray rad etc
Aug 26	11	0.5	11.5	95.65%	8	0.73	104.00	9.45	tape deck
Aug 27	10.5	1.5	12	87.50%	7.5	0.71	97.50	9.29	wrk on hoses \ tape deck
Aug 30	4	0.5	4.5	88.89%	3	0.75	39.00	9.75	filled hyd fluid
Aug 31	10.5	0.5	11	95.45%	8	0.76	104.00	9.90	
TOTALS	121	22.5	143	84.62%	83	0.69	1079.00	8.92	

Estimated Volume: 13 m3 per forwarder load

Summary of Work Completed: AUG 6 - AUG 31, 1998

Total PMH	121
Total M3	1079
Total Forw Loads	83
Loads per PMH	0.69
Loads per Op Hr	0.58
M3 \ PMH	8.92
AVG Total M3 \ Shift	67.44

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly

Harvester 546C - Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Tree Count	Tree's per PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
October 1	10.5	1.5	12	87.50%	505	48.10	101.00	9.62	hydr cooling pump 1.5 hr
October 3	1	8	9	11.11%	75	75.00	15.00	15.00	pump, turbo, electric cable 8 hrs
October 4	7		7	100.00%	330	47.14	66.00	9.43	
October 6		8	8						motor out of Hr.
October 8		8	8						motor out of Hr.
October 9		8	8						motor out of Hr.
October 10	5	6	11	45.45%	287	57.40	57.40	11.48	hydr cooling pump/trouble starting Hr.
October 11	7	1	8	87.50%	404	57.71	80.80	11.54	service .5 hr/ran out of fuel
October 12	10	2	12	83.33%	553	55.30	110.60	11.06	service .5/1 hr fitting/.5 hr help Sang
October 13	7	4	11	63.64%	336	48.00	67.20	9.60	service 1 hr/3 hr town for water hose
October 14	7	3	10	70.00%	303	43.29	60.60	8.66	service .5/2.5 hr electrical/radio/install tel.
October 15	9	2	11	81.82%	445	49.44	89.00	9.89	service 1 hr/1 hr valve bank
October 16	7	1	8	87.50%	337	48.14	67.40	9.63	water hose 1 hr
October 17	8	1	9	88.89%	467	58.38	93.40	11.68	hose on heads 1 hr
October 18	7	1	8	87.50%	329	47.00	65.80	9.40	broke frame of feed wheels 1 hr
October 19		6	6						town for parts 6 hrs
October 20	8	3	11	72.73%	396	49.50	79.20	9.90	service .5 / 2.5 hr repairs
October 21	8	2	10	80.00%	414	51.75	82.80	10.35	hydr cooling pump 2 hrs
October 22	10	1	11	90.91%	505	50.50	101.00	10.10	
October 23	8	2	10	80.00%	356	44.50	71.20	8.90	service .5/1.5 hr changed gear on pump
October 24	8		8	100.00%	425	53.13	85.00	10.63	
October 26	9	2	11	81.82%	479	53.22	95.80	10.64	service .5/1.5 hr wire on measuring/weld pin
October 27	9	2	11	81.82%	442	49.11	88.40	9.82	service 1 hr/1 hr lost bolt on saw bar
October 28	9	2	11	81.82%	455	50.56	91.00	10.11	service .5/1.5 hr fan belt/feed wheel/motor
October 29	8	2	10	80.00%	424	53.00	84.80	10.60	service .5/1.5 hr lost sprocket/changed button
October 30	10		10	100.00%	400	40.00	80.00	8.00	
TOTALS	172.5	76.5	249	69.28%	8667	50.24	1733.40	10.05	

Estimated Volume: 5 TREES PER M3

Summary of Work Completed: OCTOBER 1-31, 1998

Total PMH	172.5
Total M3	1733.4
Total Tree Counts	8667
Tree's per PMH	50.24
Tree's per Op Hr	34.81
M3 \ PMH	10.05
AVG Total M3 \ Shift	78.79

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: CP 233 BLK 3

Harvester 546C - Night Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Tree Count	Tree's per PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
October 13	7.5	3	10.5	71.43%	275	36.67	55.00	7.33	est. tree count/.5 hr serv/.5 hr sc/2hr repairs
October 23	9	2	11	81.82%	218	24.22	43.60	4.84	serv. .5 hr/1.5 hr sc & repair bar
October 26	6.5	4	10.5	61.90%	223	34.31	44.60	6.86	serv. .5hr/1.5 hr H.H./2 hr build & sc
October 27	9	3.5	12.5	72.00%	336	37.33	67.20	7.47	serv.1hr/.5 hr weld/.5hr clean shop/1.5 hr sc
October 28	7.5	4	11.5	65.22%	292	38.93	58.40	7.79	serv. 1hr/1hr walk blk/2hr town for bars
October 29	7	3.5	10.5	66.67%	302	43.14	60.40	8.63	serv. 1hr/.5hr sc/2hr fittings, saw bolt
TOTALS	46.5	20	66.5	69.92%	1646	35.40	329.20	7.08	

Estimated Volume:

Summary of Work Completed: OCTOBER 1-31, 1998

Total PMH	46.5
Total M3	329.2
Total Tree Counts	1646
Tree's per PMH	35.40
Tree's per Op Hr	24.75
M3 \ PMH	7.08
AVG Total M3 \ Shift	54.87

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: HORSEFLY

Forwarder 892F: Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
OCTOBER 1	5.5	6.5	12	45.83%	4.5	0.82	58.50	10.64	burnt 100amp breaker/welding/close block
OCTOBER 2		4					0.00		town for parts/Hr. & Fr.
OCTOBER 4	5	2	7	71.43%	4	0.80	52.00	10.40	put breaker on machine
OCTOBER 5	10.5	1.5	12	87.50%	11	1.05	143.00	13.62	1.5 hr help Max/move wood/Max stuck
OCTOBER 6	4	6.5	10.5	38.10%	4	1.00	52.00	13.00	6.5 hr motor out of Hr. to Finning
OCTOBER 7		6					0.00		6 hr. at finning
OCTOBER 8		8					0.00		8 hr town/put motor in Harv
OCTOBER 9		9.5					0.00		9.5 hr town/put motor in Harv
OCTOBER 10	7.5	4	11.5	65.22%	7	0.93	91.00	12.13	4 hr help Francis with motor
OCTOBER 11	7.5	0.5	8	93.75%	7	0.93	91.00	12.13	service .5 hr
OCTOBER 12	8.5	3.5	12	70.83%	8	0.94	104.00	12.24	2.5 hr blew hose/1 hr sharpen chains
OCTOBER 13	8	3	11	72.73%	8	1.00	104.00	13.00	2.5 hr Marvin weld/.75 hr checking of Faller
OCTOBER 14	7.5	0.5	8	93.75%	6	0.80	78.00	10.40	3 hrs bucking
OCTOBER 19		4					0.00		travel time
OCTOBER 20	6	4	10	60.00%	4	0.67	52.00	8.67	4 hr town
OCTOBER 21	12	1	13	92.31%	11	0.92	143.00	11.92	service .5 hr
OCTOBER 22	12	1	13	92.31%	11	0.92	143.00	11.92	service .5 hr
OCTOBER 23	11.5	1	12.5	92.00%	10	0.87			service .5hr / .5 hr blew hose
OCTOBER 24	8		8	100.00%	6	0.75			
OCTOBER 26	10.5	1	11.5	91.30%	8.5	0.81			service/.5 hr help Fran./finish below shop
OCTOBER 27	12	1	13	92.31%	11	0.92			service .5 hr/.5 hr cleanup Ken's mess
OCTOBER 28	12	0.5	12.5	96.00%	11	0.92			service .5 hr/moved load of wood
OCTOBER 29	11.5	1	12.5	92.00%	10	0.87			change lights .5 hr
OCTOBER 30	9.5		9.5	100.00%	8	0.84			
TOTALS	169	70	207.5	81.45%	150	0.89	1950.00	11.54	

Estimated Volume:

Summary of Work Completed: Oct 1-31 198

Total PMH	169
Total M3	1950
Total Forw Loads	150
Loads per PMH	0.89
Loads per Op Hr	0.72
M3 \ PMH	11.54
AVG Total M3 \ Shift	102.63

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: CP 233 BLK 3

Forwarder 892F: Night/Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
October 16	7	1	8	87.50%	5.5	0.79	71.50	10.21	service .5/.5 hr help Francis change hose
October 17	10.5	0.5	11	95.45%	7.5	0.71	97.50	9.29	service .5/ 2.5 loads clean up
October 18	4.5	5	9.5	47.37%	3	0.67	39.00	8.67	helped Francis 2.5 hr/1 hr sc/1.5 hr o'ring
October 20		8	8				0.00		service 1/1.5hr R&R pin/1hr chains/4.5 town
October 21		9.5					0.00		bucking 8hrs/ service .5hr/1 hr chains
October 22		9					0.00		bucking 2.5 hr/2hr town/4.5 hr travel
October 31	4.5	3.5	8	56.25%	4	0.89	52.00	11.56	1 cleanup load/1hr Max/.5 hr serv/1 hr H.H.
TOTALS	26.5	36.5	44.5	59.55%	20	0.75	260.00	9.81	

Estimated Volume:

Summary of Work Completed: OCTOBER 1-31, 1998

Total PMH	26.5
Total M3	260
Total Forw Loads	20
Loads per PMH	0.75
Loads per Op Hr	0.45
M3 \ PMH	9.81
AVG Total M3 \ Shift	65.00

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly

Harvester 546C - Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Tree Count	Tree's per PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Nov 1, 1998	4	1	5	80.00%	223	55.75	44.60	11.15	Changed oil \ lost saw sprockets
Nov 2, 1998	4	4	8	50.00%	239	59.75	47.80	11.95	2 hrs twn parts\ tigt saw housing\ brk cable
Nov 3, 1998	7	4	11	63.64%	358	51.14	71.60	10.23	chng cable\ chng packing in lift cylinder
Nov 4, 1998	10	1	11	90.91%	558	55.8	111.60	11.16	sharpen chains
Nov 5, 1998	10.5	1	12	87.50%	582	55.43	116.40	11.09	tigt bolts on saw motor\ .5 hrs help Sang
Nov 6, 1998	11	1	12	91.67%	570	51.82	114.00	10.36	
Nov 8, 1998	8.5	0.5	9	94.44%	494	58.12	98.80	11.62	
Nov 9, 1998	6	3	9	66.67%	303	50.50	60.60	10.10	brk peice fan - town and get another
Nov 10, 1998	8.5	2.5	11	77.27%	450	52.94	90.00	10.59	chng hose \ change fan
Nov 11, 1998	11		11	100.00%	645	58.64	129.00	11.73	
Nov 12, 1998	10	1	11	90.91%	594	59.40	118.80	11.88	
Nov 13, 1998			4	0.00%		ERR	0.00	ERR	load machine on lowbed\ washed Harv
				ERR		ERR	0.00	ERR	
				ERR		ERR	0.00	ERR	
				ERR		ERR	0.00	ERR	
				ERR		ERR	0.00	ERR	
				ERR		ERR	0.00	ERR	
TOTALS	90.5	19	114	79.39%	5016	55.43	1003.20	11.09	

Estimated Volume: 5 Trees per M3

Summary of Work Completed:

Total PMH	90.5
Total M3	1003.20
Total Tree Counts	5016
Tree's per PMH	55.43
Tree's per Op Hr	44
M3 \ PMH	11.09
AVG Total M3 \ Shift	91.20

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly

Forwarder 892F: Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Nov 1, 1998			5	0.00%			0.00		Cleanup
Nov 2, 1998	11	1	12	91.67%	10	0.91	130.00	11.82	
Nov 3, 1998	10.5	2	12.5	84.00%	11	1.05	143.00	13.62	worked on boom with Marvin
Nov 4, 1998	6.5	0.5	11	59.09%	6.5	1.00	84.50	13.00	spent most of day bucking - 4hrs
Nov 5, 1998	4	6	10	40.00%	4	1.00	52.00	13.00	took grapple to town to get weld
Nov 6, 1998	10	1	11	90.91%	9.5	0.95	123.50	12.35	blew hose on grapple
Nov 7, 1998	11	1	12	91.67%	9.5	0.86	123.50	11.23	broke one 90° fitting
Nov 9, 1998	9	1	10	90.00%	9	1.00	117.00	13.00	took pipe off boom to take to town
Nov 10, 1998	2	8	10	20.00%	2	1.00	26.00	13.00	put pipe on machine - twon to get pipe fixed
Nov 11, 1998	10.5	0.5	11	95.45%	12	1.14	156.00	14.86	
Nov 12, 1998	9.5	0.5	11	86.36%	9	0.95	117.00	12.32	bucking - 1hr
Nov 13, 1998	8		8	100.00%	6	0.75	78.00	9.75	
				ERR		ERR	0.00	ERR	
				ERR		ERR	0.00	ERR	
				ERR		ERR	0.00	ERR	
				ERR		ERR	0.00	ERR	
				ERR		ERR	0.00	ERR	
TOTALS	92	21.5	123.5	74.49%	88.5	0.96	1150.50	12.51	

Estimated Volume:13M3 per forwarder load

Summary of Work Completed:

Total PMH	92
Total M3	1150.5
Total Forw Loads	88.5
Loads per PMH	0.96
Loads per Op Hr	0.72
M3 \ PMH	12.51
AVG Total M3 \ Shift	104.59

Riverside Forest Products Ltd
Williams Lake, BC

Actual Volumes

E.A. STRIMBOLD LTD.
BLOCK REPORT

Area Supervisor: Gordon E. Chipman RPF

Location: Horsefly CP 233 - 03

Date 1998	Name Operator	Shift D\N	Machine	Shifts 546C	Shifts 892F	PMH 546C	PMH 892F	D\T Hrs	Oper Hrs	Tree Count	Forward Loads	Avail. Mach.	Est. M3 Harvest.	Est. M3 Forward	Est. M3 harv pmh	Est. M3 fwd pmh
July 30 + 31\98	Francis	D	546C	2		16		3	19	546 34		84.21%	80.89		5.06	
July 29,30,31\98	Steve	N	546C	3		24		10	30	863 36	14/hr m³/hr	80.00%	127.85		5.33	
Aug 1 - 15, 1998	Francis	D	546C	12		83		32	115	3610 43		72.17%	534.81		6.44	
Aug 1 - 15, 1998	Steve	N	546C	10		63.5		28	91.5	2940 46		69.40%	435.56		6.86	
Aug 1 - 15, 1998	Sang	D	892F		9		49.5	29.5	79		.81 40 9.1	62.66%	0.00	448.00		9.05
Aug 1 - 15, 1998	Rick	N	892F		7		25.5	1.5	42.5		.51 13 5.7	60.00%	0.00	145.60		5.71
Aug 16 - 31, 1998	Steve	D\N	546C	24		163.5		64	227.5	8296 50		71.87%	1229.04		7.52	
Aug 16 - 31, 1998	Francis	N\D	546C	26		215		57.5	272	10341 48		79.04%	1532.00		7.13	
Aug 16 - 31, 1998	Sang	D	892F		20		149.75	59.75	210		.86 120.5 9.0	71.31%	0.00	1349.60		9.01
Aug 16 - 31, 1998	Rick	N	892F		16		121	22.5	143		.60 83 7.7	84.62%	0.00	929.60		7.68
Sept 1 - 15, 1998	Francis	D	546C	12		101.5		22	123.5	5556 55		82.19%	823.11		8.11	
Sept 1 - 15, 1998	Steve	N	546C	9		61		19.5	72	3276 54		84.72%	485.33		7.96	
Sept 1 - 15, 1998	Sang	D	892F		5		50.5	8	58.5		43.5 9.6	86.32%		487.20		9.65
Sept 1 - 15, 1998	Rick	N	892F		11		114.5	11	125.5		.71 81.5 8.0	91.24%		912.80		7.97
Sept 16 - 30, 1998	Francis	D	546C	13		122		29	147	6542 54		82.99%	969.19		7.94	
Sept 16 - 30, 1998	Steve	D	546C	2		9		7	16	421 47		56.25%	62.37		6.93	
Sept 16 - 30, 1998	Sang	D	892F		9		90.5	14.5	105		.87 78 9.7	86.19%		873.60		9.65
Sept 16 - 30, 1998	Rick	D	892F		8		64.5	16	74.5		.71 46 8.0	86.58%		515.20		7.99
Oct 1 - 15, 1998	Francis	D	546C	9		63.5		51.5	115	3238 51		55.22%	479.70		7.55	
Oct 1 - 15, 1998	Ken	N	546C	6		46.5		20	66.5	1646 35		69.92%	243.85		5.24	
Oct 1 - 15, 1998	Sang	D	892F		9		64	55.5	92		.93 59.5 10.4	69.57%		666.40		10.41
Oct 1 - 15, 1998	Ken	N	892F		4		26.5	36.5	44.5		.76 20 8.5	59.55%		224.00		8.45
Oct 16 - 31, 1998	Francis	D	546C	13		109		25	134	5429 50		81.34%	804.30		7.38	
Oct 16 - 31, 1998	Sang	D	892F		10		105	14.5	115.5		.86 90.5 9.7	90.91%		1013.60		9.65
Oct 16 - 31, 1998	Ken	D	892F		4		26.5	36.5	44.5		.76 20 8.5	59.55%		224.00		8.45
Oct 1 - 31, 1998	Ken	D	546C	6		46.5		20	66.5	1646 35		69.92%	243.85		5.24	
Nov 1 - 15, 1998	Francis	D	546C	11		90.5		19	114	5016 55		79.39%	743.11		8.21	
Nov 1 - 15, 1998	Sang	D	892F		11		92	21.5	123.5		.96 88.5 10.7	74.49%		991.20		10.77
TOTALS				158	123	1214.50	979.75	734.75	2867.5	59366	784		8794.96	8780.80	7.244	8.96

H = 407.5
2194.25 hrs F = 327.25
= 48.9/hr 8/hr
H = 75%
F = 75%

Estimated Volume: 6 Trees \ M3 & 13M3 per forwarder load

actual trees per M3 — 6.75
11.2 M3 per forwarder load

8942

Block Summary: July 30 - November 15, 1998

Total M3 Harvested	8794.96
Total M3 Forwarded	8780.80
Total Tree's \ PMH Harv.	48.88
Total M3 \ PMH Harv.	7.244
Forwarder LOADS \ PMH	0.80
Total M3\PMH Forw.	8.96

Riverside Forest Products Ltd
Williams Lake, BC

Area Supervisor: Gordon E. Chipman RPF

E.A. STRIMBOLD LTD.
BLOCK REPORT

Location: Horsefly CP 233 - 03

Date 1998	Name Operator	Shift D\N	Machine	Shifts 546C	Shifts 892F	PMH 546C	PMH 892F	D\T Hrs	Oper Hrs	Tree Count	Forward Loads	Avail. Mach.	Est. M3 Harvest.	Est. M3 Forward	Est. M3 harv pmh	Est. M3 fwd pmh
July 30 - 31/98	Francis	D	546C	2		16		3	19	546		84.21%	84.00		5.25	
July 29,30,31/98	Steve	N	546C	3		24		10	30	863		80.00%	132.77		5.53	
Aug 1 - 15, 1998	Francis	D	546C	12		83		32	115	3610		72.17%	555.38		6.69	
Aug 1 - 15, 1998	Steve	N	546C	10		63.5		28	91.5	2940		69.40%	452.31		7.12	
Aug 1 - 15, 1998	Sang	D	892F		9		69.5	29.5	79		40	62.66%		465.20		9.40
Aug 1 - 15, 1998	Rick	N	892F		7		25.5	1.5	42.5		13	60.00%		151.19		5.93
Aug 16 - 31, 1998	Steve	D\N	546C	24		163.5		64	227.5	8296		71.87%	1276.31		7.81	
Aug 16 - 31, 1998	Francis	N\D	546C	26		215		57.5	272	10341		79.04%	1590.92		7.40	
Aug 16 - 31, 1998	Sang	D	892F		20		149.75	59.75	210		120.5	71.31%		1401.47		9.36
Aug 16 - 31, 1998	Rick	N	892F		16		121	22.5	143		83	84.62%		965.29		7.98
Sept 1 - 15, 1998	Francis	D	546C	12		101.5		22	123.5	5556		82.19%	854.77		8.42	
Sept 1 - 15, 1998	Steve	N	546C	9		61		19.5	72	3276		84.72%	504.00		8.26	
Sept 1 - 15, 1998	Sang	D	892F		5		50.5	8	58.5		43.5	86.32%		505.91		10.02
Sept 1 - 15, 1998	Rick	N	892F		11		114.5	11	125.5		81.5	91.24%		947.85		8.28
Sept 16 - 30, 1998	Francis	D	546C	13		122		29	147	6542		82.99%	1006.46		8.25	
Sept 16 - 30, 1998	Steve	D	546C	2		9		7	16	421		56.25%	64.77		7.20	
Sept 16 - 30, 1998	Sang	D	892F		9		90.5	14.5	105		78	86.19%		907.14		10.02
Sept 16 - 30, 1998	Rick	D	892F		8		64.5	16	74.5		46	86.58%		534.98		9.29
Oct 1 - 15, 1998	Francis	D	546C	9		63.5		51.5	115	3238		55.22%	498.15		7.84	
Oct 1 - 15, 1998	Ken	N	546C	6		46.5		20	66.5	1646		69.92%	253.23		5.45	
Oct 1 - 15, 1998	Sang	D	892F		9		64	25.5	92		59.5	69.57%		691.99		10.81
Oct 1 - 15, 1998	Ken	N	892F		4		26.5	36.5	44.5		20	59.55%		232.60		8.78
Oct 16 - 31, 1998	Francis	D	546C	13		109		25	134	5429		81.34%	885.23		7.66	
Oct 16 - 31, 1998	Sang	D	892F		10		105	14.5	115.5		90.5	90.91%		1052.52		10.02
Oct 16 - 31, 1998	Ken	D	892F		4		26.5	36.5	44.5		20	59.55%		232.60		8.78
Oct 1 - 31, 1998	Ken	D	546C	6		46.5		20	66.5	1646		69.92%	253.23		5.45	
Nov 1 - 15, 1998	Francis	D	546C	11		90.5		19	114	5016		79.39%	771.69		8.53	
Nov 1 - 15, 1998	Sang	D	892F		11		92	31.5	123.5		88.5	74.49%		1029.26		11.19
TOTALS				158	123	1214.50	979.75	734.75	2867.5	59356	784		9133.23	9117.92	7.52	9.31

Actual Volume: 6.5 Trees \ M3 & 11.63 M3 per forwarder load

actual trees per M3 – 6.5
11.63 M3 per forwarder load

Using Conversion Adjustments
Paid Volume 9,120 m^3

Block Summary: July 30 - November 15, 1998

Total M3 Harvested	**9133.23**
Total M3 Forwarded	**9117.92**
Total Tree's \ PMH Harv.	**48.88**
Total M3 \ PMH Harv.	**7.52**
Forwarder LOADS \ PMH	**0.80**
Total M3\PMH Forw.	**9.31**

Riverside Forest Products Ltd
Williams Lake, BC

E.A. STRIMBOLD LTD.
BLOCK REPORT CP233-01

Area Supervisor: Gordon E. Chipman RPF

Date 1999	Name Operator	Shift D\N	Shifts 546C	Shifts 892F	PMH/ Harv	PMH/ Forw	D\T Hrs	Oper Hrs	Tree Count	Forward Loads	Avail Machine	Est M3 Harvest	Est M3 Forward	Est M3 Har/pmh	Est M3 Fwd/pmh
Jan 1 - Jan 21	Francis	Day	18		123.5		28.5	161	4458		78%	1191		11.18	
Jan 4 - Jan 13	Steve	Night	9		78.5		15.00	93.50	2480		84%	663		9.78	
Jan 3 - Jan 14	Serge	Day		11		83	5.00	88.00		71	94%		923		11.12
Jan 4 - Jan 13	Rodney	Night		9		77.5	14.00	91.50		71	85%		923		11.91
Totals			27	20	202	161	62.5	434.00	6938	142		1854	1846	9.18	11.51

Actual trees per M3 - 3.74 or .27 peice size
Forwarder loads averaged - 12 M3

BLOCK SUMMARY: Jan 1 - Jan 13/1999

TOTAL M3 HARVESTED	**1854**
TOTAL M3 FORWARDED	**1846**
TOTAL TREES\PMH HARV.	**34.35**
TOTAL M3\PMH HARV.	**9.18**
FORWARDER LOADS\PMH	**0.88**
TOTAL M3\PMH FORW.	**11.51**

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly CP233 Block 01

Harvester 546C - Night Shift

Date	PMH Hrs	DT Serv	Oper Hrs	Machine Availability	Tree Count	Saw Log Bolts	Pulp Logs Bolts	Tree's per PMH	Estimated M3	Estimated M3 \ OPHR	Estimated M3 \ PMH	Comments
Jan 4, 1999	9	2	11	81.82%	191	323	116	21.22	51.07	4.64	5.67	service .5 hr/1.5 hr welded for Rocky
Jan 5, 1999	9.5	1.5	11	86.36%	271	363	125	28.53	72.46	54.20	5.71	service .5hr/1 hr go to last site for oil
Jan 6, 1999	7	2.5	9.5	73.68%	230	317	81	32.86	61.50	46.00	6.57	service .5hr/2 hr look for lost boom tip guard
Jan 7, 1999	10	1	11	90.91%	355	463	137	35.50	94.92	71.00	7.10	service .5hr/went to help Rocky-u-joint gone892
Jan 8, 1999	9	2	11	81.82%	365	479	111	40.56	97.59	73.00	8.11	service .5hr/.5hr feed roll hose/1hr alt belt
Jan 10, 1999	9	1	10	90.00%	203	429	127	22.56	54.28	40.60	4.51	service 1 hr
Jan 11, 1999	10	1	11	90.91%	365	584	129	36.50	97.59	73.00	7.30	service 1 hr
Jan 12, 1999	10	1	11	90.91%	295	386	117	29.50	78.88	59.00	5.90	service 1 hr
Jan 13, 1999	5	3	8	62.50%	205	317	71	41.00	54.81	41.00	8.20	finished cutting/3 hr hand falling
TOTALS	78.5	15	93.5	83.96%	2480	3641	1014	31.59	663.10	7.09	8.45	

Estimated Volume: 3.74 trees per M3

Summary of Work Completed:

Total PMH	78.5
Total M3	663.10
Total Tree Counts	2480
Tree's per PMH	31.59
Tree's per Op Hr	26.52
M3 \ PMH	8.45
AVG Total M3 \ Shift	73.68

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly CP233 Block 01

Harvester 546C - Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Tree Count	Saw Log Bolts	Pulp Logs Bolts	Tree's per PMH	Estimated M3	Estimated M3 \ OPHR	Estimated M3 \ PMH	Comments
Jan 1, 1999	5	3	8	62.50%	274	303	292	54.80	73.26	9.16	14.65	chain tightener/spring on measuring wheel
Jan 2, 1999	7.5	1.5	9	83.33%	384	661	241	51.20	102.67	11.41	13.69	go look for leak on FR
Jan 3, 1999	4	2	6	66.67%	120	235		30.00	32.09	5.35	8.32	helped move fuel trailer to new block
Jan 4, 1999	9	1	10	90.00%	262	404	152	29.11	70.05	7.01	7.78	big wood
Jan 5, 1999	9.5	0.5	10	95.00%	354	552	248	37.26	94.65	9.47	9.96	
Jan 6, 1999	10.5	0.5	11	95.45%	405	684	298	38.57	108.29	9.84	10.31	walked with Gord
Jan 7, 1999	3	7	10	30.00%	103	184	76	34.33	27.54	2.75	9.18	help Art make cover for tip of boom/wire on saw
Jan 8, 1999	9	1	10	90.00%	404			44.89	108.02	10.80	12.00	measuring wheel was loose
Jan 9, 1999	8.5	0.5	9	94.44%	320			37.65	85.56	9.51	10.07	tighten fitting of valve bank
Jan 11, 1999	6.5	0.5	7	92.86%	243	660		37.38	64.97	9.28	10.00	
Jan 12, 1999	9.5	0.5	10	95.00%	337	616		35.47	90.11	9.01	9.48	busted feed wheel hose
Jan 13, 1999	9.5	0.5	10	95.00%	307	718		32.32	82.09	8.21	8.64	
Jan 16, 1999	4	1	5	80.00%	113	296		28.25	30.21	6.04	7.55	ran out of fuel/fell trees with chain saw
Jan 17, 1999	4	3	7	57.14%	124	322		31.00	33.16	4.74	8.29	fell trees with chain saw
Jan 18, 1999	9	1	10	90.00%	263	840		29.22	70.32	7.03	7.81	service .5hr/.5hr trouble with saw bar
Jan 19, 1999	9	1	10	90.00%	271	728		30.11	72.46	7.25	8.05	sevice .5hr
Jan 20, 1999	6	4	10	60.00%	174	362		29.00	46.52	4.65	7.75	broke hose on top of boom/cut trees with ch saw
Jan 21, 1999			9									fix dismeter/pipe on boom/clean up
TOTALS	123.5	28.5	161	76.71%	4458	7565	1307	36.10	1191.98	7.40	9.65	

Estimated Volume: 3.74 trees per M3

Summary of Work Completed:

Total PMH	123.5
Total M3	1191.98
Total Tree Counts	4458
Tree's per PMH	36.10
Tree's per Op Hr	27.69
M3 \ PMH	9.65
AVG Total M3 \ Shift	66.22

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: HORSEFLY CP233 BLOCK 01

Forwarder 892F: Night Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Jan 4, 1999	8.5	2.5	11	77.27%	6	0.71	72.00	8.47	broke plate/welded
Jan 5, 1999	9	2	11	81.82%	9	1.00	117.00	13.00	worked on stick boom with Art/fixed hyd cap
Jan 6, 1999	8	1.5	9.5	84.21%	6	0.75	78.00	9.75	fixed seat
Jan 7, 1999	5.5	4.5	10	55.00%	4	0.73		9.45	univ broke/went got Art, went back and fixed
Jan 8, 1999	10.5	0.5	11	95.45%	12	1.14	52.00	ERR	
Jan 10, 1999	8	0.5	8.5	94.12%	7	0.88	91.00	11.38	put hose on
Jan 11, 1999	9.5	1.5	11	86.36%	8	0.84	104.00	10.95	grease/fix lines
Jan 12, 1999	9	0.5	9.5	94.74%	10	1.11	130.00	14.44	clean up
Jan 13, 1999	9.5	0.5	10	95.00%	9	0.95	117.00	12.32	Clean up middle area, landing
TOTALS	77.5	14	91.5	84.70%	71	0.92	923.00	11.91	

Estimated Volume: Based on 12 M3 per forwarder load

Summary of Work Completed:

Total PMH	**77.5**
Total M3	**923**
Total Forw Loads	**71**
Loads per PMH	**0.92**
Loads per Op Hr	**0.78**
M3 \ PMH	**11.91**
AVG Total M3 \ Shift	**102.56**

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly CP233 Block 1

Forwarder 892F: Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Jan 3, 1999	5.5	0.5	6	91.67%	5	0.91	60.00	10.91	first day on block 1
Jan 4, 1999	7.5	0.5	8	93.75%	6	0.80	78.00	10.40	
Jan 5, 1999	9.5	0.5	10	95.00%	7	0.74	91.00	9.58	
Jan 6, 1999	9.5	0.5	10	95.00%	8	0.84	104.00	10.95	
Jan 7, 1999	9.5	0.5	10	95.00%	8	0.84	104.00	10.95	
Jan 8, 1999	9.5	0.5	10	95.00%	6	0.63	78.00	8.21	
Jan 9, 1999	6.5	0.5	7	92.86%	7	1.08	91.00	14.00	
Jan 11, 1999	6.5	0.5	7	92.86%	5	0.77	65.00	10.00	
Jan 12, 1999	9.5	0.5	10	95.00%	10	1.05	130.00	13.68	
Jan 13, 1999	9.5	0.5	10	95.00%	9	0.95	117.00	12.32	
Jan 14, 1999	5		5	100.00%	4	0.80	52.00	10.40	finished block 01
TOTALS	83	5	88	94.32%	71	0.86	923.00	11.12	

Estimated Volume: Based on 12 M3 per forwarder load

Summary of Work Completed:

Total PMH	**83**
Total M3	**923**
Total Forw Loads	**71**
Loads per PMH	**0.86**
Loads per Op Hr	**0.81**
M3 \ PMH	**11.12**
AVG Total M3 \ Shift	**83.91**

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: HORSEFLY CP233 BLOCK 4

Harvester 546C - Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Tree Count	Saw Logs Bolts	Pulp Logs Bolts	Tree's per PMH	Estimated M3	Estimated M3 \ OP\HR	Estimated M3 \ PMH	Comments
Nov 24, 1998	7	5	12	58.33%	256	524	170	36.57	73.14	6.10	10.45	clean up blow down/tighten 1/2 tracks/chg hose
Nov 23, 1998	3	8	11	27.27%	122	255	62	40.67	34.86	3.17	11.62	worked on wiring/fixed track/clean up
Nov 25, 1998	11.5	0.5	12	95.83%	540	926	352	46.96	154.29	12.86	13.42	1/2 hr ser
Nov 26, 1998	11.5	5	12	95.83%	555	1012	330	48.26	158.57	13.21	13.79	1/2 hr ser
Nov 27, 1998	10	2	12	83.33%	494	940	238	49.40	141.14	11.76	14.11	changed saw hose/fuel trouble
Nov 28, 1998	7.5	3.5	11	68.18%	282	624	133	37.60	80.57	7.32	10.74	chg hose on boom/R&R fitting on saw motor
Nov 29, 1998	8	1	9	88.89%	405	882	186	50.63	115.71	12.86	14.46	1/2 hr ser/broke fitting for chain oil/go to shop
Nov 30, 1998	8	4	12	66.67%	404	802	177	50.50	115.43	9.62	14.43	1 hr ser/had to boost HR/worked on coloring
Dec 1, 1998	8.5	2.5	11	77.27%	431	978	236	50.71	123.14	11.19	14.49	1/2 hr ser/worked on paint system
Dec 2, 1998	11	1	12	91.67%	525	1020	228	47.73	150.00	12.50	13.64	1 hr ser
Dec 3, 1998	10.5	0.5	12	87.50%	506	1005	230	48.19	144.57	12.05	13.77	1/2 hr ser/Art weld fan/start cutting upper side
Dec 4, 1998	8	4	12	66.67%	402	751	192	50.25	114.86	9.57	14.36	chg electrical cable/touble with valve on saw
Dec 5, 1998	6	2	8	75.00%	286	584	177	47.67	81.71	10.21	13.62	town for tire repair on FR
Dec 6, 1998	9	1	10	90.00%	481	988	270	53.44	137.43	13.74	15.27	1/2 hr ser/help put tire on FR
Dec 7, 1998	10.5	1	11.5	91.30%	605	1250	384	57.62	172.86	15.03	16.46	1/2 hr ser/ broke blade on fan
Dec 8, 1998	4.5	1.5	6	75.00%	235	498	132	52.22	67.14	11.19	14.92	1/2 hr ser/took Rocky to wk
Dec 9, 1998		7	7						0.00	0.00		help Marvin with paint system
TOTALS	134.5	49.5	180.5	74.52%	6529	13039	3497	48.54	1865.43	10.33	13.87	

Estimated Volume: 3.5 TREES PER M3 actual trees per m3

Summary of Work Completed:

using actual volume

Total PMH	134.5
Total M3	1865.43
Total Tree Counts	6529
Tree's per PMH	48.54
Tree's per Op Hr	36.17
M3 \ PMH	13.87
AVG Total M3 \ Shift	109.73

Sawlogs Hauled 1548.23 m^3

13039 Bolts ÷ 1548.23 = 8.42 Bolts per m^3

Pulp Hauled 231.61 m^3 ? — 128 m^3 pulp.

3,407 Bolts ÷ 231.61 = 15.09 Bolts per m^3

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: HORSEFLY CP233 BLOCK 4

Harvester 548C - Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Tree Count	Tree's per PMH	Estimated M3	Estimated M3 \ OP\HR	Estimated M3 \ PMH	Comments
Nov 24, 1998	7	5	12	58.33%	256	36.57	73.14	6.10	10.45	clean up blow down/tighten 1/2 tracks/chg hose
Nov 25, 1998	11.5	0.5	12	95.83%	540	46.96	154.29	12.86	13.42	1/2 hr ser
Nov 26, 1998	11.5	5	12	95.83%	555	48.26	158.57	13.21	13.79	1/2 hr ser
Nov 27, 1998	10	2	12	83.33%	494	49.40	141.14	11.76	14.11	changed saw hose/fuel trouble
Nov 28, 1998	7.5	3.5	11		282	37.60	80.57	7.32	10.74	chg hose on boom/R&R fitting on saw motor
Nov 29, 1998	8	1	9		405	50.63	115.71	12.86	14.46	1/2 hr ser/broke fitting for chain oil/go to shop
Nov 30, 1998	8	4	12	66.67%	404	50.50	115.43	9.62	14.43	1 hr ser/had to boost HR/worked on coloring
Dec 1, 1998	8.5	2.5	11	77.27%	431.00	50.71	123.14	11.19	14.49	1/2 hr ser/worked on paint system
Dec 2, 1998	11	1	12	91.67%	525.00	47.73	150.00	12.50	13.64	1 hr ser
Dec 3, 1998	10.5	0.5	12	87.50%	506.00	48.19	144.57	12.05	13.77	1/2 hr ser/Art weld fan/start cutting upper side
Dec 4, 1998	8	4	12	66.67%	402.00	50.25	114.86	9.57	14.36	chg electrical cable/touble with valve on saw
Dec 5, 1998	6	2	8	75.00%	286.00	47.67	81.71	10.21	13.62	town for tire repair on FR
Dec 6, 1998	9	1	10	90.00%	481.00	53.44	137.43	13.74	15.27	1/2 hr ser/help put tire on FR
Dec 7, 1998	10.5	1	11.5	91.30%	605.00	57.62	172.86	15.03	16.46	1/2 hr ser/ broke blade on fan
Dec 8, 1998	4.5	1.5	6	75.00%	235.00	52.22	67.14	11.19	14.92	1/2 hr ser/took Rocky to wk
Dec 9, 1998		7	7	0.00%			0.00	0.00		help Marvin with paint system
TOTALS	131.5	41.5	169.5	77.58%	6407	48.72	1830.57	10.80	13.92	

Estimated Volume: 3.5 TREES PER M3 actual trees per m3

Summary of Work Completed: using actual volume

Total PMH	131.5
Total M3	1830.57
Total Tree Counts	6407
Tree's per PMH	48.72
Tree's per Op Hr	37.80
M3 \ PMH	13.92
AVG Total M3 \ Shift	114.41

[redacted]

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly CP233 Block 4

Forwarder 892F: Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Nov 30, 1998	10	2	12	83.33%	7	0.70	91.00	9.10	1/2 hr serv/took off stake/cleaned out machine
Dec 1, 1998	8	2	10	80.00%	8	1.00	104.00	13.00	Rad losing antifreeze
Dec 2, 1998	10	2	12	83.33%	10	1.00	130.00	13.00	1/2 hr ser/put hose on/tighten cab mounts
Dec 3, 1998	10.5	1.5	12	87.50%	10	0.95	130.00	12.38	1/2 hr ser/leaking hyd tank/new filter
Dec 4, 1998	10.5	1.5	12	87.50%	9	0.86	117.00	11.14	1/2 hr ser/new lights on/Art got new fittings
Dec 5, 1998	4	2.5	6.5	61.54%	3	0.75	39.00	9.75	Blew tire on FR-went to Kal Tire
Dec 6, 1998	8.5	1.5	10	85.00%	6	0.71	78.00	9.18	1/2 hr ser/put tire on/replaced elbow fitting
Dec 7, 1998	11	0.5	11.5	95.65%	13	1.18	169.00	15.36	1/2 hr ser/fan broke/hyd in tank/fuel up
Dec 8, 1998	10	1	11	90.91%	8	0.80	104.00	10.40	1/2 hr ser/leak on boom/added 1 bucket hyd oil
Dec 9, 1998	5	6.5	11.5	43.48%	3	0.60	39.00	7.80	fix cyl on boom/clean cab/wheel chain/fix cap
Dec 10, 1998	11	0.5	11.5	95.65%	9	0.82	117.00	10.64	1/2 hr ser/crossed line/finished other line
Dec 11, 1998	9.5	2.5	12	79.17%	8	0.84	104.00	10.95	fix steer cylinder/look for leaks
Dec 12, 1998	5.5	0.5	6	91.67%	4	0.73	52.00	9.45	1/2 hr ser/town for supplies for Marvin
Dec 13, 1998	8	1.5	9.5	84.21%	7	0.88	91.00	11.38	put new lights on/new track/check oil & rad
Dec 14, 1998	11	1	12	91.67%	10	0.91	130.00	11.82	put hyd oil in/got new plate for pad
Dec 15, 1998	10	2	12	83.33%	7	0.70	91.00	9.10	1/2 hr ser/clean up trails/fix leaks/new plate on
Dec 16, 1998	10	1.5	11.5	86.96%	8	0.80	104.00	10.40	1 1/2 hr ser-leak on cyl
Dec 17, 1998	10.5	0.5	11	95.45%	6	0.57	78.00	7.43	FINISHED BLOCK CP233 BLK 4
TOTALS	142.5	29	171.5	83.09%	122	0.86	1586.00	11.13	

Estimated Volume: Based on 13 M3 per Forwarder load

Summary of Work Completed:

Total PMH	142.5
Total M3	1586.00
Total Forw Loads	122.00
Loads per PMH	0.86
Loads per Op Hr	0.71
M3 \ PMH	11.13
AVG Total M3 \ Shift	88.11

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly CP233 Block 4

Forwarder 892F: Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Nov 24, 1998	2.5	10	12.5	20.00%	2	0.8	26.00	10.40	New Block
Nov 25, 1998	9	2.5	11.5	78.26%	9	1	117.00	13.00	out of fuel/changed fitting/throttle cable broke
Nov 26, 1998	7.5	4.5	12	62.50%	6	0.8	78.00	10.40	help Art with FR
Nov 27, 1998		4	4						Wrenching on FR
TOTALS	19	21	40	47.50%	17	0.89	221.00	11.63	

Estimated Volume: Based on 13 M3 per forwarder load

Summary of Work Completed:

Total PMH	19
Total M3	221
Total Forw Loads	17
Loads per PMH	0.89
Loads per Op Hr	0.43
M3 \ PMH	11.63
AVG Total M3 \ Shift	55.25

Riverside Forest Products Ltd
Williams Lake, BC

E.A. STRIMBOLD LTD.
BLOCK REPORT CP233-04

Area Supervisor: Gordon E. Chipman RPF

Date 1998	Name Operator	Shift D\N	Shifts 546C	Shifts 892F	PMH/ Harv	PMH/ Forw	D\T Hrs	Oper Hrs	Tree Count	Forward Loads	Avail Machine	Est M3 Harvest	Est M3 orwar	Est M3 Har/pmh	Est M3 Fwd/pmh
NOV 24-DEC 09	FRANCIS	DAY	16		131.5		41.50	169.50	6407		74%	1831		13.92	
NOV 24-NOV 27	SANG	DAY		4		19	21.00	40.00		17.00	48%		221		11.63
NOV 30-DEC 17	RODNEY	DAY		18		143	29.00	171.50		122.00	83%		1586		11.13
TOTALS			16	22	131.5	162	91.5	381.00	6407	139		1831	1807	13.92	11.33

Actual trees per M3 - 3.5 or .29 peice size
Forwarder loads averaged - 13.16 M3

BLOCK SUMMARY: NOV 24 - DEC 17/1998

TOTAL M3 HARVESTED	**1831**
TOTAL M3 FORWARDED	**1807**
TOTAL TREES\PMH HARV.	**48.54**
TOTAL M3\PMH HARV.	**13.92**
FORWARDER LOADS\PMH	**0.86**
TOTAL M3\PMH FORW.	**11.33**

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly CP233 Block 11

Harvester 546C - Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Tree Count	Saw Logs Bolts	Pulp Logs Bolts	Tree's per PMH	Estimated M3	Estimated M3 \ OP\HR	Estimated M3 \ PMH	Comments
Dec 11, 1998	6	5	11	54.55%	263.00	365.00	235.00	43.83	47.39	4.31	7.90	1/2 hr ser/clean up/change block/broke cable hs
Dec 12, 1998	6	1	7	85.71%	236.00	274.00	207.00	39.33	42.52	6.07	7.09	let Serge run HR/busted hose
Dec 13, 1998	7.5	1.5	9	83.33%	445.00	541.00	418.00	59.33	80.18	8.91	10.69	ran out of fuel/let Serge run HR for 1 hr
Dec 14, 1998	8	3	12	66.67%	495.00	606.00	488.00	61.88	89.19	7.43	11.15	1hr unacct for/brk hose/Art chg fuel pm/painted
Dec 15, 1998	7	3	10	70.00%	404.00	542.00	386.00	57.71	72.79	7.28	10.40	1/2 hr ser/chg hose/Hyd oil in/Art wk on paint sys
Dec 18, 1998	5	6	11	45.45%	236.00	224.00	195.00	47.20	42.52	3.87	8.50	town for gear/back to shop to get Art
Dec 19, 1998	9	1	10	90.00%	626.00	605.00	576.00	69.56	112.79	11.28	12.53	1/2 hr ser/trouble with parking brake
Dec 20, 1998	6	2	8	75.00%	336.00	324.00	277.00	56.00	60.54	7.57	10.09	1/2 hr ser/broke fitting saw motor
Dec 21, 1998	10	1	11	90.91%	606.00	594.00	572.00	60.60	109.19	9.93	10.92	1/2 hr ser/spool on saw spin was sticking
Dec 22, 1998	7	2	9	77.78%	414.00	390.00	376.00	59.14	74.59	8.29	10.66	walk 508 blk with Marvin/work on paint system
Dec 29, 1998		10	10	0.00%					0.00			changed slides in boom/helped Ray on cooling pu
Dec 30, 1998		3	9	0.00%	307.00	291.00	286.00		55.32	6.15		went to shop to look for fitting/fix leak
Dec 31, 1998	6	3	9	66.67%	355.00	318.00	307.00	59.17	63.96	7.11	10.66	shop to get bolt/cab bolt on/town for fuel
TOTALS	77.5	41.5	126	61.51%	4723	5074	4323	60.94	850.99	6.75	10.98	

Estimated Volume: 5.55 trees per M3

Summary of Work Completed:

Total PMH	77.5
Total M3	850.99
Total Tree Counts	4723
Tree's per PMH	60.94
Tree's per Op Hr	37.48
M3 \ PMH	10.98
AVG Total M3 \ Shift	65.46

Blk #11 Sawlogs Hauled 684.04
5074 Bolts ÷ 684.04 m^3 = 7.42 Bolts per m^3
Pulp Hauled 166.44 m^3
4323 ÷ 166.44 m^3 = 25.97 Bolts per m^3

Gord.

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: HORSEFLY CP233 BLOCK 11

Forwarder 892F: Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
DEC 23, 1998	7.5	0.5	8	93.75%	5	0.67	65.00	8.67	
DEC 24, 1998	4.5	0.5	5	90.00%	3	0.67	39.00	8.67	
DEC 28, 1998	7.5	0.5	8	93.75%	5	0.67	65.00	8.67	
DEC 29, 1998	9.5	0.5	10	95.00%	6	0.63	78.00	8.21	
DEC 30, 1998	8.5	0.5	9	94.44%	7	0.82	91.00	10.71	
DEC 31, 1998	7.5	0.5	8	93.75%	5	0.67	65.00	8.67	
JAN 1, 1998	8.5	0.5	9	94.44%	7	0.82	91.00	10.71	
JAN 2, 1998	8.5	0.5	9	94.44%	7	0.82	91.00	10.71	
TOTALS	62	4	66	93.94%	45	0.73	585.00	9.44	

Estimated Volume: Based on 13 M3 per forwarder load

Summary of Work Completed:

Total PMH	62
Total M3	585
Total Forw Loads	45
Loads per PMH	0.73
Loads per Op Hr	0.68
M3 \ PMH	9.44
AVG Total M3 \ Shift	73.13

Gord

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: Horsefly CP233 Block 11

Forwarder 892F: Day Shift

Date	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Dec 18, 1998	7.5	4	11.5	65.22%	5	0.67	65.00	8.67	NEW BLOCK/new hose on cyl/new filter
Dec 19, 1998	8	2	10	80.00%	5	0.63	65.00	8.13	new hose/change oil/unload and reload
Dec 21, 1998	10	1	11	90.91%	8	0.80	104.00	10.40	1 hr service
Dec 22, 1998	9.5	1	10.5	90.48%	8	0.84	104.00	10.95	went with Serge
TOTALS	35	8	43	81.40%	26	0.74	338.00	9.66	

Estimated Volume: Based on 13 M3 per Forwarder load

Summary of Work Completed:

Total PMH	35.00
Total M3	338.00
Total Forw Loads	26.00
Loads per PMH	0.74
Loads per Op Hr	0.60
M3 \ PMH	9.66
AVG Total M3 \ Shift	84.50

Gord.

Riverside Forest Products Ltd
Williams Lake, BC

E.A. STRIMBOLD LTD.
BLOCK REPORT CP233-11

Area Supervisor: Gordon E. Chipman RPF

Date	Name	Shift	Shifts	Shifts	PMH/	PMH/	D\T	Oper	Tree	Forward	Avail	Est M3	Est M3	Est M3	Est M3
	Operator	D\N	546C	892F	Harv	Forw	Hrs	Hrs	Count	Loads	Machine	Harvest	Forward	Har/pmh	Fwd/pmh
Dec 11 - Dec 31	Francis	Day	13		77.5		41.5	126	4723		62%	851		10.98	
Dec 18 - Dec 22	Rodney	Day		4		35	8.00	43		26	81%		312		8.91
Dec 23/98 - Jan 2/99	Serge	Day		8		62	4.00	66		45	94%		540		8.71
Totals			13	12	77.5	97	53.5	235	4723	71		851	852	10.98	8.78

Actual trees per M3 - 5.55 or .18 peice size.
Forwarder loads averaged - 12 M3

BLOCK SUMMARY: Dec 11/98 - Jan 2/1999

TOTAL M3 HARVESTED	**851**
TOTAL M3 FORWARDED	**852**
TOTAL TREES\PMH HARV.	**60.9**
TOTAL M3\PMH HARV.	**10.98**
FORWARDER LOADS\PMH	**0.73**
TOTAL M3\PMH FORW.	**8.78**

E.A. STRIMBOLD LTD.

Box 569, Burns Lake, BC V0J 1E0 Telephone & Fax: (250) 696-3607 [redacted]

Facsimile Transmission Header

To: Gord Chipman Riverside, Williams Lake From: [redacted]

Date: April 16/99. Subject: CTL.

Total Pages (Including This Page): 9

Good Morning Gord.

Here is the Block Reports on Pughead 98L4 and my write up on how I thought the Blocks went. Also a Note on E62002-98L4 the Harvester and Forwarder have different features that is because we had a skidder and feller for 9 Days skidding tough area's and Processing Big Wood and Just a Feller for another 11 days felling oversize etc.

Have a good day and hope to hear from you soon or [redacted] with what is going to happen in the future.

[redacted]

E.A. Strimbold Ltd.
Box 569 • Burns Lake, BC V0J 1E0 • Telephone 604-696-3607 • Fax 604-696-3607

Gord E. Chipman RPF
Area Supervisor, Horsefly Dist.
Riverside Forest Products
Williams Lake, B.C.

April 14, 1999

RE: Commercial Thinning CP , EG233-blks 04, 11, 01

The following is a summary of the above mentioned blocks with problems and benefits each of them had. After completing block 03 we went block 04 along the 500 road at 510km. This block out of all the area's we have done was the most economical and productive as far as cubic meters per hour harvested and forwarded. I beleive the three main reasons for this was stand density and the piece size that was to be removed, the terrain was easy, and the timber type was predominately pine and spruce being removed thus leaving a lot less sorting for both forwarder and harvester. The tree size was 3.5 trees per m3 or .29 of a cubic m3, making the wood size optimum for a feller processor (single grip harvester) in a thinning or clear-cut and with 201 m3 per ha. being removed the delimbing is made very easy as well because of the tight stand not allowing rough limbs to be created. The feller processor operator really enjoyed working in this stand as not only did he have good production but also a good quality job in the spacing and tree selection making it easier and at the end of a 10 hour shift did not feel he had been put through the ringer. At our current pricing I feel that this would be a economical type of a block, for ourselves , Riverside, and Ministry of Forest. After viewing what took place on the opposite side of the road during the heavy snows shortly after our completion of the thinning block one can only say it works, seeing how snow and mother natures thins, I would say that we did a much better job and we also recovered 200m3 per ha. and created some employment.

Block 11 was done next which is of much poorer quality wood for commercial thinning as densities were very high and the piece size very low, with a lot of unmerchanable stems. Gord and Ourselves thought that maybe we could do strip logging and that this would help production, which it did but not as much as we thought due to still having to fall into the thick standing timber trying to protect remaining stems. One idea that maybe would really speed things up would be to have no sorts , or maybe one, that being the very best of sawlogs and pulp the rest as being in dense stand and small pieces space became a real problem . This would

increase production in both the forwarder and the harvester and eliminate some of the frustrations of the operators, as they felt fatigued and our availability of the harvester shows that those unmerchanable stems created some mechanical difficulty too. We tried to get our paint system working on this block and block 04 and by the end of this block I felt the operators were getting very frustrated with that as well.

Block 01 was the final block of thinning and two factors that made this block a little slower than expected was, one the amount of snow that fell close to two feet or better in the first week and this with slopes of 20-35% made maneuverable very difficult. A lot less volume per ha. was removed as a great deal of the block was naturally spaced. Volume per Ha. removed was half of block 04, it was at 105 m3 per Ha. This low density lead to difficult trees to process due to heavy limbs, and a lot of ground to cover in difficult snow conditions. The block was easy to space as there was next to no slash and with the low density one could do a good quality job as there was room to move and quite easy to make tree selection and good trail choices.

Thanks

[redacted]

E.A. Strimbold Ltd

E.A. Strimbold Ltd. ▲▼▲▼▲▼▲▼▲▼▲▼▲▼▲▼▲▼▲▼
Box 569 • Burns Lake, BC V0J 1E0 • Telephone 604-696-3607 • Fax 604-696-3607

Gord E. Chipman RPF
[redacted] **RPF**
Riverside Forest Products
Williams Lake, B.C.

April 14,1999

RE: Bug Wood, Likely Area EG2002-98L4 Using CTL

In this particular block we were hampered by heavy snowfalls and quite a large accumulation prior to start up. Along with the heavy snow fall the wood size was on average a little too big especially when you have lots of snow in the trees to start it makes falling difficult. In this type of a stand and snow condition we pobably could of paid a feller buncher to come in and bunch and still come out ahead with less downtime and more production especially for the harvester but also for the forwarder as well. Our falling productivity was down to 30 trees per hour plus we had the expense of paying handfallers in which a buncher could of fell 50% of that wood. The Thinning portions of this block was slow as it was difficult to get to the trees due to snow depth, then when there we had to leave the best ones and take a couple smaller ones out or rough limy pine trees. The terrain on the top end of the block was a little more demanding as we could not go up with out return trails created by the cat. The forwarding distance was not a problem. The biggest factor was the snow depth and I thought maybe we could get through it using limbs and tops, but was just a little too much. Our forwarding Production is not all that accurate as it had to wait for our harvester and help the harvester get around so our production should of been around 15+ m3 per hour in this type of wood. Thanks for the work and hopefully this information can be of use, and we'll be able to do more of this type of work with yourselves in the future. Any further questions or concerns please feel free to give me a call.

Thanks

Sincerely

[redacted]

E.A. Strimbold Ltd

Riverside Forest Products Ltd
Williams Lake, BC

E.A. STRIMBOLD LTD.
BLOCK REPORT EG 2002-98LA

Area Supervisor: [redacted]

Date 1999	Name Operator	Shift D\N	Shifts 546C	Shifts 892F	PMH/ Harv	PMH/ Forw	D\T Hrs	Oper Hrs	Tree Count	Forward Loads	Avail Machine	Est M3 Harvest	Est M3 orwar	Est M3 Har/pmh	Est M3 Fwd/pmh
JAN 27 - FEB 22	STEVE	N	19		153.5		36.50	220.00	4362		69%	1913		12.46	
JAN 26 - FEB 26	FRANCIS	D	26		179		73.00	256.00	5611		70%	2460		13.75	
JAN 27 - MAR 5	RODNEY	N		22		177	38.50	229.50		175.50	77%		2369		13.39
JAN 17 - MAR 4	SERGE	D		32		251	42.00	301.00		185.00	83%		2498		9.95
TOTALS			45	54	332.50	428	190	1006.50	9973	360.50		4373	4867	13.15	11.37

Actual trees per M3 - 2.28 or .44 peice size
Forwarder loads averaged - 13.5 M3

BLOCK SUMMARY: JAN264 - MAR 5, 1999

TOTAL M3 HARVESTED	**4373**
TOTAL M3 FORWARDED	**4867**
TOTAL TREES\PMH HARV.	**30**
TOTAL M3\PMH HARV.	**13.15**
FORWARDER LOADS\PMH	**0.84**
TOTAL M3\PMH FORW.	**11.37**

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: EG 2002 - 98L4

Forwarder 892F: Day Shift

Date 1999	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Jan 26	1.5	7.5	9	16.67%	2	1.33	27.00	18.00	
Jan 27	11.5	0.5	12	95.83%	8	0.70	108.00	9.39	hard going in snow/tow processor up hill
Jan 28	9.5	0.5	10	95.00%		0.00			tow processor twice
Jan 29	9.5	0.5	10	95.00%	5	0.53	67.50	7.11	broke fitting/Art replaced/lost 4 pails oil
Jan 30	2	4	6	33.33%	1	0.50	13.50	6.75	moved saw logs/worked on door/chg oil/grease
Jan 31	9.5	0.5	10	95.00%	8.5	0.89	114.75	12.08	
Feb 1	9.5	0.5	10	95.00%	6	0.63	81.00	8.53	broke a fitting
Feb 2	4.5	0.5	5	90.00%	4	0.89	54.00	12.00	broke a fitting
Feb 3	3		3	100.00%	0.5	0.17	6.75	2.25	help Francis with machine
Feb 4	8.5	0.5	9	94.44%		0.00			
Feb 5	9.5	0.5	10	95.00%	7	0.74	94.50	9.95	
Feb 6	10.5	0.5	11	95.45%	9	0.86	121.50	11.57	
Feb 7	6	6	12	50.00%	5	0.83	67.50	11.25	busted a hose
Feb 8	9.5	0.5	10	95.00%	3.5	0.37	47.25	4.97	pull Francis with machine/had hard time with HR
Feb 9	8	2	10	80.00%	9	1.13	121.50	15.19	Art welded/still leaking
Feb 10	8	2	10	80.00%	8.5	1.06	114.75	14.34	help Francis-stuck
Feb 11	7		7	100.00%	2	0.29	27.00	3.86	help Art and Fancis
Feb 15	7	3	10	70.00%	7	1.00	94.50	13.50	fitting still leaking
Feb 16	9.5	0.5	10	95.00%	7	0.74	94.50	9.95	throttle cable/pulled Francis Truck
Feb 17	3	5	8	62.50%	4	0.80	54.00	10.80	worked on #12/fitting leaking
Feb 18	5	4	9	55.56%	3.5	0.70	47.25	9.45	welding on grapple/moved fuel tank
Feb 19	9.5	0.5	10	95.00%	7	0.74	94.50	9.95	
Feb 21	9.5	0.5	10	95.00%	8	0.84	108.00	11.37	
Feb 22	10.5	0.5	11	95.45%	10	0.95	135.00	12.86	
Feb 23	7.5	0.5	8	93.75%	4	0.53	54.00	7.20	broke grapple
Feb 24	2		2	100.00%	2	1.00	27.00	13.50	put grapple on machine
Feb 25	12	1	13	92.31%	13	1.08	175.50	14.63	problem with the turbo
Feb 26			0						clean saw and skidder
Feb 27	3		3	100.00%	3	1.00	40.50	13.50	worked with chain saw for 7 hours
Mar 1	10.5	0.5	11	95.45%	9	0.86	121.50	11.57	loaded slash wood
Mar 2	10.5	0.5	11	95.45%	11.5	1.10	155.25	14.79	
Mar 3	10.5	0.5	11	95.45%	9	0.86	121.50	11.57	
Mar 4	11.5	0.5	12	95.83%	8	0.70	108.00	9.39	last day forwarding
TOTALS	251	42	301	83.39%	185	0.74	2497.50	9.95	

Estimated Volume: Based on 13.5 M3 per forwarder load

Summary of Work Completed:

Total PMH	**251**
Total M3	**2497.5**
Total Forw Loads	**185**
Loads per PMH	**0.74**
Loads per Op Hr	**0.61**
M3 \ PMH	**9.95**
AVG Total M3 \ Shift	**78.05**

Gord.

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: EG 2002 - 98L4

Forwarder 892F: Day\night Shift

Date 1999	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Forwarder Loads	Forwarder Lds PMH	Estimated M3 \ Shift	Estimated M3 \ PMH	Comments
Jan 27	5	3	8	62.50%	4.5	0.90	60.75	12.15	
Jan 28	10	1	11	90.91%	9.5	0.95	128.25	12.83	got stuck - Art came to help .5 hr
Jan 29	5	4	9	55.56%	4	0.80	54.00	10.80	processor wouldn't work
Jan 30	11	0.5	11.5	95.65%	11	1.00	148.50	13.50	
Jan 31	8	0.5	8.5	94.12%	7	0.88	94.50	11.81	
Feb 1	6.5	0.5	7	92.86%	5	0.77	67.50	10.38	HR broke down/chg oil in 892
Feb 2	10	1	11	90.91%	9.5	0.95	128.25	12.83	grease,fuel, full hyd,muffler fell off
Feb 7	7.5	0.5	8	93.75%	11	1.47	148.50	19.80	1 pulp, 10 logs
Feb 8	11	1	12	91.67%	11	1.00	148.50	13.50	1 pulp, 10 logs/Steve broke down
Feb 9	8	3	11	72.73%	8	1.00	108.00	13.50	1 pulp, 7 logs/fix fuel line/fix leaking fitting
Feb 10	8	3	11	72.73%	11	1.38	148.50	18.56	1 pulp, 10 logs/fix fitting
Feb 11	9	2	11	81.82%	14	1.56	189.00	21.00	Steve broke down/.5 pulp, 13.5 logs
Feb 12			6						worked on HR
Feb 13			8						golfer service
Feb 14	9	0.5	9.5	94.74%	9	1.00	121.50	13.50	moved decks of logs/cleaned up some pulp
Feb 15	10.5	0.5	11	95.45%	11	1.05	148.50	14.14	stuck in mud
Feb 16	10	1	11	90.91%	11	1.10	148.50	14.85	fixed light/took fuel to Steve/fixed grill/move logs
Feb 17	8	3	11	72.73%	9	1.13	121.50	15.19	Art fixed pipe 4 times
Feb 18	10.5	0.5	11	95.45%	12	1.14	162.00	15.43	service .5 hr
Feb 19	8.5	2.5	11	77.27%	9	1.06	121.50	14.29	helm Steve change boom hose
Feb 20	3	2	5	60.00%	3	1.00	40.50	13.50	Steve blew boom hose/look for rad break
Feb 21	8.5	1.5	10	85.00%	6	0.71	81.00	9.53	steep ground-slow
Mar 4	7	7	14	50.00%	9	1.29	121.50		help Art skid - 7 hours
Mar 5	3		3	100.00%					clean up
TOTALS	177	38.5	229.5	77.12%	175.5	0.99	2369.25	13.39	

Estimated Volume: Based on13.5 M3 per forwarder load

Summary of Work Completed:

Total PMH	**177**
Total M3	**2369.25**
Total Forw Loads	**175.5**
Loads per PMH	**0.99**
Loads per Op Hr	**0.6**
M3 \ PMH	**13.38**
AVG Total M3 \ Shift	**98.72**

(Dark

PAGE 08

EA STRIMBOLD

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04/16/1999 06:44

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: EG 2002 - 98L4

Harvester 546C - Day Shift

Date 1999	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Tree Count	Saw Log Bolts	Pulp Logs Bolts	Tree's per PMH	Estimated M3	Estimated M3 \ OPHR	Estimated M3 \ PMH	Comments
Jan 26	3	5	8	37.50%	170	340		56.67	74.56	9.32	24.85	helped Art shim boom/took telephone out of HR
Jan 27	10	2	12	83.33%	290	740		29.00	127.19	10.60	12.72	trouble with saw/hard going in snow
Jan 28	6.5	3.5	10	65.00%	139	465		21.38	60.96	6.10	9.38	stuck twice/hard going in snow
Jan 29	7	4	11	63.64%	213	544		30.43	93.42	8.49	13.35	stuck/trouble with HR/went to town
Jan 30	1	5	6	16.67%							0.00	worked on machine all day
Jan 31	9	1	10	90.00%	305	696		33.89	133.77	13.38	14.86	parking brake not releasing
Feb 1	7	3	10	70.00%	163	414		23.29	71.49	7.15	10.21	trouble with left valve bank
Feb 2	3	7	10	30.00%	96			32.00	42.11	4.21	14.04	boom broke/electrical trouble/soon chain saw wood
Feb 3	1	7	3	33.33%								hyd pump went
Feb 5	8	2	10	80.00%	341	795		42.63	149.56	14.96	18.70	pump back on/busted hose on head
Feb 6	10	1	11	90.91%	317	715		31.70	139.04	12.64	13.90	busted hose on boom/broke knife on head
Feb 7	9.5	2.5	12	79.17%	319	756		33.58		0.00	0.00	weld pin/saw sensor trouble/change 2 hoses
Feb 8	5	5	10	50.00%	161	360		32.20	70.61	7.06	14.12	Art welding on head/still having trouble with saw
Feb 9	9.5	0.5	10	95.00%	338	860		35.58	148.25	14.82	15.60	
Feb 10	8	2	10	80.00%	262	618		32.75	114.91	11.49	14.36	sharpened chains/leak on saw motor/stuck
Feb 11	1	6	7	14.29%	57			57.00	25.00	3.57	25.00	valve bank/measuring wheel/leaks
Feb 14	6	3	9	66.67%	183			30.50	80.26	8.92	13.38	help Art put valve bank back on
Feb 15	8.5	1.5	10	85.00%	254	590		29.88	111.40	11.14	13.11	broke fitting on saw/HR was heating
Feb 16	6	4	10	60.00%	156			26.00	68.42	6.84	11.40	went to town to get hose for transmission
Feb 18	8	1	9	88.89%	271	780		33.88	118.86	13.21	14.86	lost cover for saw sensor
Feb 19	7	3	10	70.00%	215	540		30.71	94.30	9.43	13.47	busted hose on grapple/electrical problems
Feb 20	8	2	10	80.00%	215	722		26.88	94.30	9.43	11.79	trouble with measuring-loose wire on boom
Feb 22	9	2	11	81.82%	253	642		28.11	110.96	10.09	12.33	busted hose-Art had to go to shop twice
Feb 23	8	3	11	72.73%	214	571		26.75	93.86	8.53	11.73	clean up/ran chain saw for 3 hours
Feb 24	9.5	0.5	10	95.00%	315			33.16	138.16	13.82	14.54	busted feed wheel hose/loose fitting
Feb 25	10.5	0.5	11	95.45%	364	827		34.67	159.65	14.51	15.20	service..5 hrs
Feb 26		1	5									busted hose/drove HR out to low bed 4 hrs
TOTALS	179	73	256	69.92%	5611	11975		31.35	2460.96	9.61	13.75	

Estimated Volume: 2.28 Trees per M3

Summary of Work Completed:

Total PMH	179
Total M3	2460.96
Total Tree Counts	5611
Tree's per PMH	31.35
Tree's per Op Hr	21.92
M3 \ PMH	13.75
AVG Total M3 \ Shift	91.15

PRODUCTION REPORT
EMPLOYEE - [redacted]

Location: EG 2002 - 86L4

Harvester 546C - Day Shift

Date 1999	PMH Hrs	D/T Serv	Oper Hrs	Machine Availability	Tree Count	Saw Log Bolts	Pulp Logs Bolts	Tree's per PMH	Estimated M3	Estimated M3 \ OP\HR	Estimated M3 \ PMH	Comments
Jan 27	4	2.5	6.5	61.54%	118							service .5hr/ 2 hr unaccounted for
Jan 28	10	1	11	90.91%	274	611	41	27.40	120.18	10.93	1.09	
Jan 29	2	7	9	22.22%	72				31.58	3.51		worked on feed roll pressures
Jan 30	10	1.5	11.5	86.96%	393	776	116	39.30	172.37	14.99	1.50	having trouble with park brake
Jan 31	8	0.5	8.5	94.12%	151	217	61	18.88	66.23	7.79	0.97	
Feb 1	6.5	0.5	7	92.86%	165	339	60	25.38	72.37	10.34	1.59	broke cassette
Feb 2	10	2.5	12.5	80.00%	285	564	87	28.50	125.80	10.00	1.00	helped with HR for 2 hrs
Feb 3			2									travel 2 hr
Feb 7	8	2.5	10.5	76.19%	253	519	61	31.63	110.96	10.57	1.32	travel 2 hr
Feb 8			11									worked on hr all day/town
Feb 9	10	1	11	90.91%	265	570	61	26.50	116.23	10.57	1.06	
Feb 10	10	1	11	90.91%	263	511	61	26.30	115.35	10.49	1.05	
Feb 11			11									Helped Art work on valve bank
Feb 12			6									finally found crack in valve block
Feb 14	9	0.5	9.5	94.74%	242	511	60	26.89	106.14	11.17	1.24	covered lots of ground-scattered wood
Feb 15	8	3	11	72.73%	202	447	74	25.25	88.60	8.05	1.01	blew hose/shop/hyd oil and trans oil added
Feb 16	8	3	11	72.73%	286	519	85		125.44	11.40	1.43	re-wired elec cable on boom tip
Feb 17	9.5	1.5	11	86.36%	310	500			135.96	12.36		processed hand fell wood/blew hose
Feb 18	9	2	11	81.82%	179	439	61		78.51	7.14	0.79	processed hand fell wood /blew 2 hoses
Feb 19	8.5	2.5	11	77.27%	202	525	34		88.60	8.05	0.95	blew big boom hose
Feb 20	4		4	100.00%	96	209	21		42.11	10.53	2.63	blew another boom hose
Feb 21	9	2	11	81.82%	303	619	91		132.89	12.08	1.34	opened up boundary back to above landing
Feb 22	10	2	12	83.33%	303			30.30	132.89	11.07	1.11	broke spring on measuring wheel
TOTALS	153.5	36.5	220	69.77%	4362	7976	974	28.42	1913.16	8.70	12.46	

Estimated Volume: 2.28 trees per M3 (.44 piece size)

Summary of Work Completed:

Total PMH	153.5
Total M3	1913.16
Total Tree Counts	4362
Tree's per PMH	28.42
Tree's per Op Hr	19.83
M3 \ PMH	12.46
AVG Total M3 \ Shift	83.18

Appendix 2

Commercial Thinning Snowbreakage Survey

COMMERCIAL THINNING SNOWBREAKAGE SURVEY

CP 233 BLOCK 3

CREW: [redacted]

OVERVIEW

The purpose of this survey was to measure the extent of snow damage on trees following commercial thinning. The survey was conducted in the Horsefly (Black Creek) Forest District on cutting permit 233 block 3 located west of the town of Horsefly, off the 500 road (Appendix A).

A 100 m X 100 m grid was developed to allow 34, 3.99 m radius plots to be randomly placed throughout the block (Appendix B). The information collected included:

- total number of trees/ plot,
- species,
- stump diameter (cm),
- diameter at breast height (cm),
- total tree height of all trees in each plot,
- crown length of all trees in each plot, and
- an indication as to whether a tree was damaged or not.

A tree was considered to have been damaged by winter snowfall if it was broken, bent or fallen. Trees suspected to have been damaged or killed by wind or other causal agents were not considered as a 'damaged tree' in this survey. A summary of the information collected from all 34 plots is available in Appendix C.

RESULTS

Table 1 shows that the total area sampled was 0.17 ha creating a 0.47 % cruise of the 36.30 ha block. This allowed for a total of 93 trees to be sampled, equivalent to 546.9 trees/ha (Table 2).

Table 1: Summary of Snow Breakage Survey Information

# of Plots	Plot Radius (m)	Area/Plot (m2)	Total Area Sampled (ha)	Net Area of Block (ha)	Cruise %
34	3.99	50.01	0.17	36.30	0.47

Table 2: Summary of Trees Sampled

# of Trees Sampled	Area Sampled	Trees/ha
93	0.17	546.90

Table 3 identifies that of the 93 trees sampled 28 were damaged due to winter snowfall. The majority of the trees sampled were Douglas Fir. The 28 trees that were considered to be damaged were equivalent to 164.6 trees/ha or 30.1% of the total density of the block (Table 4).

Table 3: Summary of Trees Surveyed

Count of Broken (Y/N)	Species				
Broken (Y/N)	Cw	Fd	Pl	Sx	Grand Total
N	6	35	19	5	65
Y		18	8	2	28
Grand Total	6	53	27	7	93

Table 4: Damaged Trees Sampled

Total # of Damaged Trees Sampled	Area Sampled	Damaged Trees/ha	Percentage of Total
28	0.17	164.66	30.11

Table 5 summarizes the maximum, minimum and average stump diameter and Dbh for healthy (N) and broken (Y) trees. On average the broken trees had a smaller stump diameter and Dbh than the healthy trees. The maximum and minimum stump diameters (30.6 cm and 10.5 cm respectively) of the broken trees indicates a relatively large variation between sampled trees. However, this variation is, for the most part, smaller than the variation demonstrated by the healthy trees (max. = 55.8 cm, min. = 10.3 cm).

Table 5: Summary of Stump Diameter and Dbh.

		Broken (Y/N)		
Species	Data	N	Y	Grand Total
Cw	Max of Dbh	32.9		32.9
	Min of Dbh	8.4		8.4
	Average of Dbh	17.3		17.3
	Max of Stump Dia. (cm)	40.0		40.0
	Min of Stump Dia. (cm)	10.3		10.3
	Average of Stump Dia. (cm)	20.1		20.1
Fd	Max of Dbh	48.7	24.7	48.7
	Min of Dbh	8.7	8.6	8.6
	Average of Dbh	22.4	14.5	19.7
	Max of Stump Dia. (cm)	55.8	30.6	55.8
	Min of Stump Dia. (cm)	10.7	10.5	10.5
	Average of Stump Dia. (cm)	26.2	16.9	23.1
Pl	Max of Dbh	34.4	24.0	34.4
	Min of Dbh	11.4	10.4	10.4
	Average of Dbh	23.0	16.4	21.1
	Max of Stump Dia. (cm)	42.3	27.7	42.3
	Min of Stump Dia. (cm)	13.0	10.9	10.9
	Average of Stump Dia. (cm)	27.7	18.8	25.0
Sx	Max of Dbh	35.3	19.0	35.3
	Min of Dbh	17.6	10.5	10.5
	Average of Dbh	27.4	14.8	23.8
	Max of Stump Dia. (cm)	40.5	22.3	40.5
	Min of Stump Dia. (cm)	21.4	12.7	12.7
	Average of Stump Dia. (cm)	32.3	17.5	28.1
Total Max of Dbh		48.7	24.7	48.7
Total Min of Dbh		8.4	8.6	8.4
Total Average of Dbh		**22.5**	**15.1**	**20.3**
Total Max of Stump Dia. (cm)		55.8	30.6	55.8
Total Min of Stump Dia. (cm)		10.3	10.5	10.3
Total Average of Stump Dia. (cm)		**26.6**	**17.5**	**23.8**

Table 6 summarizes the maximum, minimum and average tree height and crown length for healthy and broken trees sampled. On average trees found to be broken were of shorter height and smaller crown length. The variation in tree height and crown length was found to be relatively close to the average.

Table 6: Summary of Height and Crown Length

		Broken (Y/N)		
Species	Data	N	Y	Grand Total
Cw	Max of Height (m)	20.4		20.4
	Min of Height (m)	6.4		6.4
	Average of Height (m)	12.0		12.0
	Max of Crown Length (m)	9.0		9.0
	Min of Crown Length (m)	3.6		3.6
	Average of Crown Length (m)	5.9		5.9
Fd	Max of Height (m)	32.0	27.0	32.0
	Min of Height (m)	11.2	11.7	11.2
	Average of Height (m)	21.3	17.5	20.0
	Max of Crown Length (m)	23.6	18.8	23.6
	Min of Crown Length (m)	2.0	3.0	2.0
	Average of Crown Length (m)	8.7	7.0	8.1
Pl	Max of Height (m)	27.4	28.0	28.0
	Min of Height (m)	15.0	10.6	10.6
	Average of Height (m)	23.8	19.9	22.6
	Max of Crown Length (m)	11.0	6.6	11.0
	Min of Crown Length (m)	2.0	1.5	1.5
	Average of Crown Length (m)	6.8	4.5	6.1
Sx	Max of Height (m)	25.6	22.5	25.6
	Min of Height (m)	16.8	15.5	15.5
	Average of Height (m)	21.5	19.0	20.8
	Max of Crown Length (m)	18.8	7.9	18.8
	Min of Crown Length (m)	9.0	6.5	6.5
	Average of Crown Length (m)	12.5	7.2	11.0
Total Max of Height (m)		32.0	28.0	32.0
Total Min of Height (m)		6.4	10.6	6.4
Total Average of Height (m)		**21.2**	**18.3**	**20.3**
Total Max of Crown Length (m)		23.6	18.8	23.6
Total Min of Crown Length (m)		2.0	1.5	1.5
Total Average of Crown Length (m)		**8.2**	**6.3**	**7.6**

Table 7 illustrates the calculated tree height to stump diameter ratio determined for both healthy and broken trees. It was found that on average the broken trees sampled demonstrated a ratio greater than 1 (1.08) and larger than the ratio demonstrated by healthy trees. Furthermore, both the maximum and minimum ratios for the broken trees were higher than those of the healthy trees.

Table 7: Summary of Tree Height to Stump Diameter Ratios.

		Broken (Y/N)		
Species	Data	N	Y	Grand Total
Cw	Max of Height/Stump Dia. (m/cm)	0.82		0.82
	Min of Height/Stump Dia. (m/cm)	0.39		0.39
	Average of Height/Stump Dia. (m/cm)	**0.66**		**0.66**
Fd	Max of Height/Stump Dia. (m/cm)	1.32	1.36	1.36
	Min of Height/Stump Dia. (m/cm)	0.52	0.65	0.52
	Average of Height/Stump Dia. (m/cm)	**0.88**	**1.07**	**0.95**
Pl	Max of Height/Stump Dia. (m/cm)	1.50	1.54	1.54
	Min of Height/Stump Dia. (m/cm)	0.63	0.79	0.63
	Average of Height/Stump Dia. (m/cm)	**0.91**	**1.07**	**0.96**
Sx	Max of Height/Stump Dia. (m/cm)	0.79	1.22	1.22
	Min of Height/Stump Dia. (m/cm)	0.63	1.01	0.63
	Average of Height/Stump Dia. (m/cm)	**0.68**	**1.11**	**0.80**
Total Max of Height/Stump Dia. (m/cm)		1.50	1.54	1.54
Total Min of Height/Stump Dia. (m/cm)		0.39	0.65	0.39
Total Average of Height/Stump Dia. (m/cm)		**0.85**	**1.08**	**0.92**

Table 8 summarises the crown lengths calculated as a percentage of tree height for healthy and broken trees. It was determined that on average damaged trees demonstrated a smaller percentage of crown length than healthy trees. However, the variation in percentages was relatively large and closely approximated that of the healthy trees.

Table 8: Summary of Crown Length as a Percentage of Tree Height

		Broken (Y/N)		
Species	Data	N	Y	Grand Total
Cw	Max of Crown/Height (%)	78.1		78.1
	Min of Crown/Height (%)	27.2		27.2
	Average of Crown/Height (%)	**53.4**		**53.4**
Fd	Max of Crown/Height (%)	73.8	87.0	87.0
	Min of Crown/Height (%)	14.7	23.8	14.7
	Average of Crown/Height (%)	**39.8**	**39.2**	**39.6**
Pl	Max of Crown/Height (%)	42.3	34.9	42.3
	Min of Crown/Height (%)	8.5	11.5	8.5
	Average of Crown/Height (%)	**27.9**	**23.0**	**26.4**
Sx	Max of Crown/Height (%)	87.0	51.0	87.0
	Min of Crown/Height (%)	39.7	28.9	28.9
	Average of Crown/Height (%)	**58.2**	**39.9**	**53.0**
Total Max of Crown/Height (%)		87.0	87.0	87.0
Total Min of Crown/Height (%)		8.5	11.5	8.5
Total Average of Crown/Height (%)		**39.0**	**34.6**	**37.7**

DISCUSSION

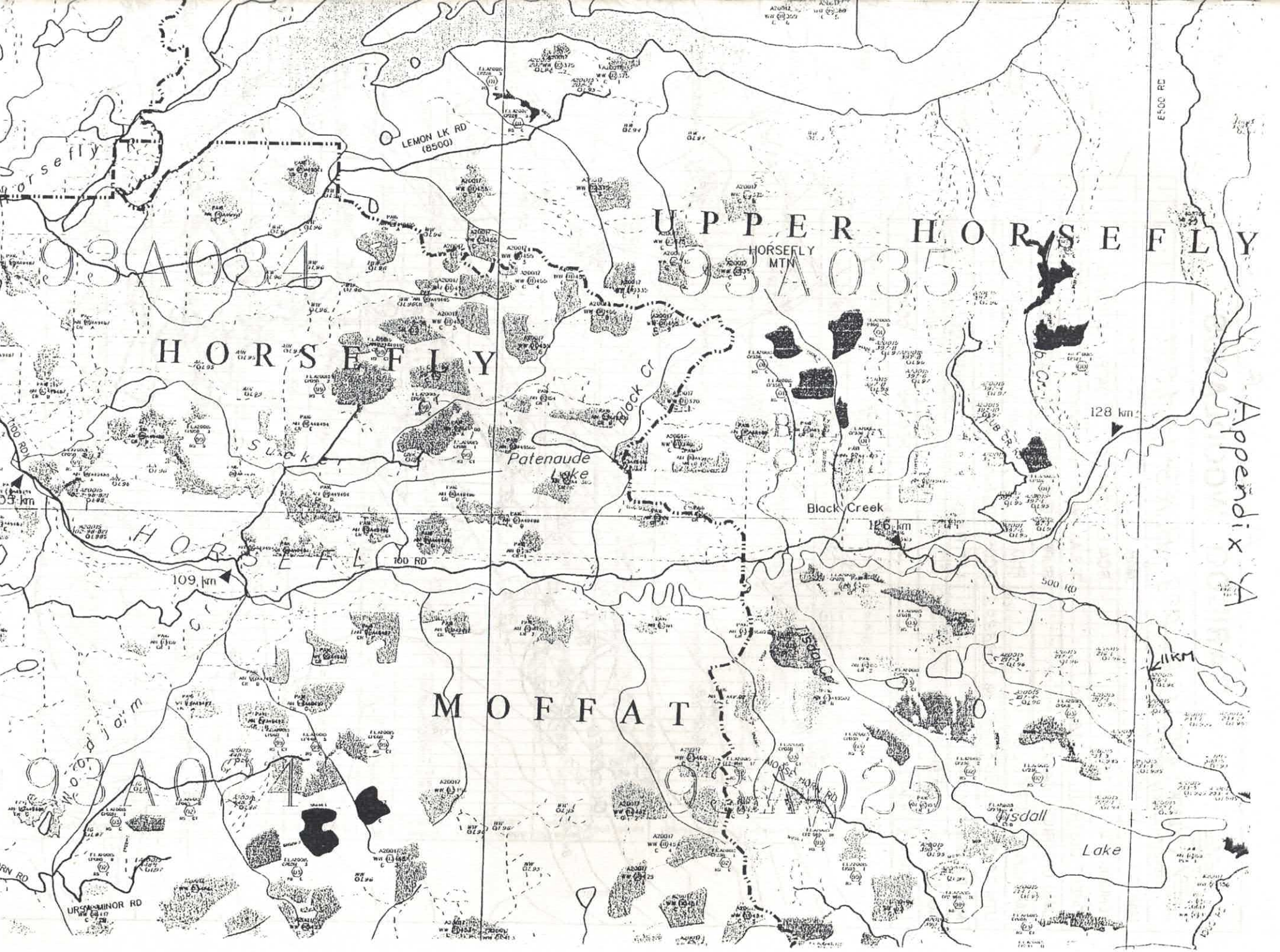
The results obtained from the survey suggest that trees susceptible to snow damage were those with height to stump diameter ratios greater than 1 (small stump diameter relative to tree height) and with a smaller percentage of live crown relative to

total tree height. An explanation for this may be that stands of higher density often have trees that are subject to greater competition. These trees focus energy on tree height and little energy on girth and canopy depth in order to out-compete surrounding trees for sunlight. When these dense stands are thinned, trees with characteristics such as a height to stump diameter greater than 1 and small crowns become more susceptible to damage due to snow loading.

It was felt that any conclusions made regarding individual species would be based on speculation. This is because certain species were selected for when commercially thinned. As a result individual species would be poorly represented by the sample.

Appendix D stratifies the observed snow damage, commercial thinning quality and approximate residual densities. This stratification suggests that the extent of snow damage may be proportional to the residual density (i.e. more damage where more trees were left). If this is the case than it would be of interest to compare this stratification to the original stand structure (i.e. density and stump diameters) prior to commercial thinning.

Overall, it is believed that the survey was a good representation of what was observed by the data collectors. Difficulty in ensuring that a sufficient number of plots were obtained became a problem due to plots randomly falling on roads, immature patches and block boundary. A larger plot radius may rectify this problem while increasing the cruise to 1%.


LEMON LK RD
(8500)
UPPER HORSEFLY
HORSEFLY MTN
93A034
93A035
HORSEFLY
Black Cr
Patenaude Lake
Black Creek
128 km
126 km
100 RD
109 km
500 RD
MOFFAT
93A041
93A025
Lisdall Lake
11KM
Appendix A

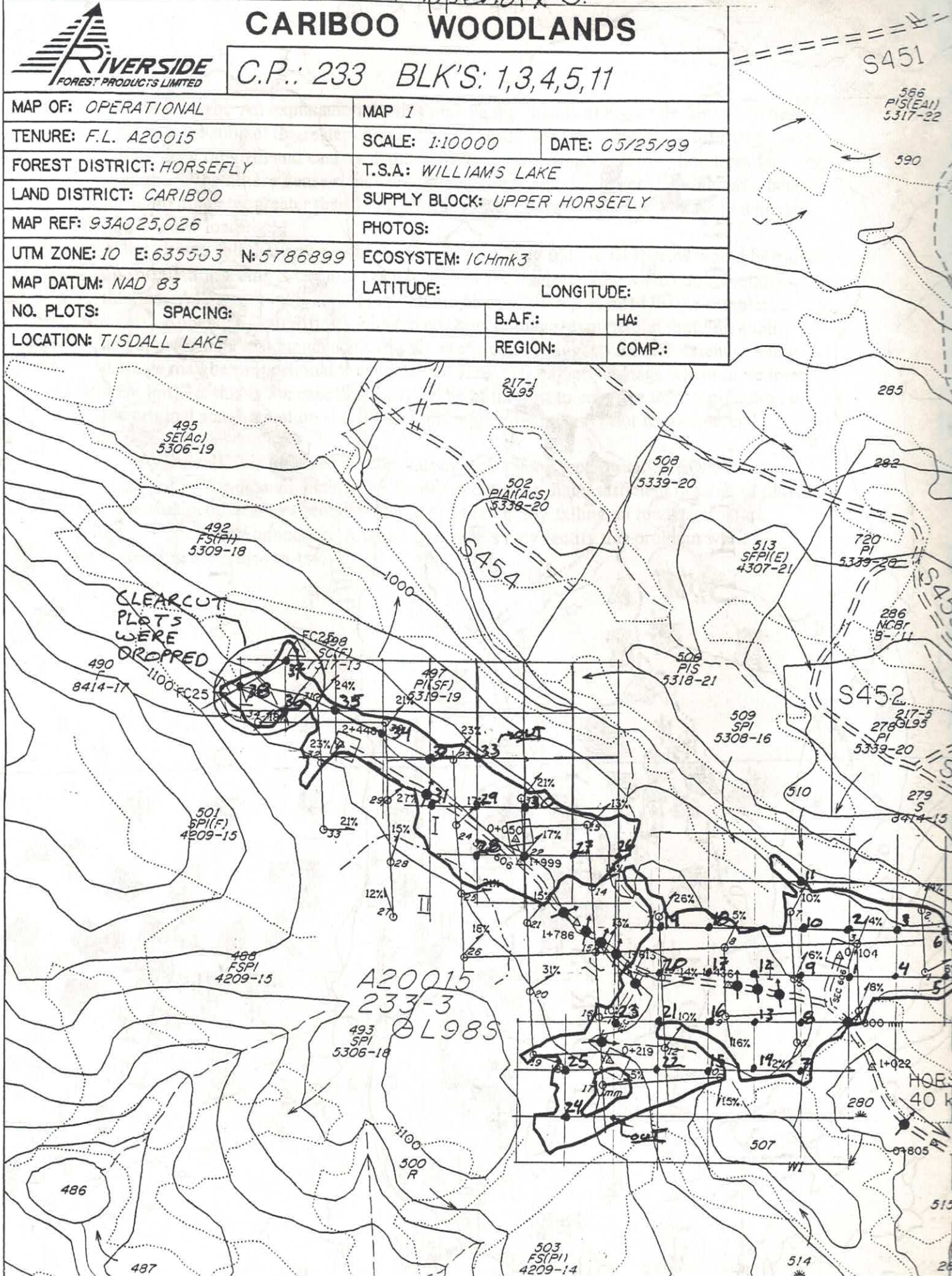
Appendix B.

CARIBOO WOODLANDS

RIVERSIDE FOREST PRODUCTS LIMITED

C.P.: 233 BLK'S: 1,3,4,5,11

MAP OF: OPERATIONAL	MAP 1	
TENURE: F.L. A20015	SCALE: 1:10000	DATE: 05/25/99
FOREST DISTRICT: HORSEFLY	T.S.A.: WILLIAMS LAKE	
LAND DISTRICT: CARIBOO	SUPPLY BLOCK: UPPER HORSEFLY	
MAP REF: 93A025,026	PHOTOS:	
UTM ZONE: 10 E: 635503 N: 5786899	ECOSYSTEM: ICHmk3	
MAP DATUM: NAD 83	LATITUDE: LONGITUDE:	
NO. PLOTS: SPACING:	B.A.F.:	HA:
LOCATION: TISDALL LAKE	REGION:	COMP.:



Appendix C

Plot #		Tree #	Species	Stump Dia. (cm)	Height (%)		Distance (m)	Add to Height	Height (m)	Crown (%) Bottom	Add to Crown Length (m)	Crown Length (m)	Dbh (cm)	Broken (Y/N)	Comments	Height/Stump Dia. (m/cm)	Crown/Height (%)
					Bottom	Top											
1		1	Pl	25.2	-15	100	20	0	23	70	0	6	21.8	N		0.91	26.09
2		1	Pl	34	-10	126	20	0	27.2	84	0	8.4	31.1	N		0.80	30.88
3		1	Sx	21.4	-10	74	20	0	16.8	26	0	9.6	17.6	N		0.79	57.14
4		1	Fd	19.8	-15	88	20	0	20.6	30	0	11.6	17.7	N		1.04	56.31
5		1	Fd	21	0	0	20	0	19.6	0	0	7.6	15.7	Y		0.93	38.78
		2	Sx	31	-5	100	20	0	21	45	0	11	28	N		0.68	52.38
		3	Fd	18	-5	80	20	0	17	50	0	6	16.3	N		0.94	35.29
6		1	Sx	40.5	-8	120	20	0	25.6	50	0	14	35.3	N		0.63	54.69
7		1	Fd	34.9	-5	122	20		25.4	45	0	15.4	31	N		0.73	60.63
		2	Fd	20.5	-4	44	20	12	21.6	0	0	6.5	18.7	Y		1.05	30.09
		3	Fd	21.4	-2	45	20	9.9	19.3	0	0	7.6	19.4	Y		0.90	39.38
8		1	Fd	22.7	-10	92	20	0	20.4	55	0	7.4	20	N		0.90	36.27
		2	Fd	32.4	-4	102	20	0	21.2	60	0	8.4	26.8	N		0.65	39.62
9		1	Pl	30.9	-10	116	20	0	25.2	75	0	8.2	26.2	N		0.82	32.54
		2	Pl	41.1	-10	120	20	0	26	65	0	11	31.2	N		0.63	42.31
10		1	Pl	32.2	-8	116	20	0	24.8	76	0	8	26	N		0.77	32.26
		2	Pl	19.8	-8	112	20	0	24	82	0	6	14.7	N		1.21	25.00
		3	Pl	25.8	-10	80	20	6.3	24.3	0	0	4.5	24	Y		0.94	18.52
		4	Pl	25.5	-8	110	20	0	23.6	100	0	2	21.2	N		0.93	8.47
11	No Trees	0															
12		1	Fd	24.5	-5	112	20	0	23.4	80	0	6.4	21.1	N		0.96	27.35
		2	Fd	36.3	-4	128	20	0	26.4	88	0	8	31.8	N		0.73	30.30
		3	Fd	23.6	-3	100	20	0	20.6	63	0	7.4	20.2	N		0.87	35.92
		4	Fd	13	-3	65	20	0	13.6	55	0	2	11.1	N		1.05	14.71
		5	Cw	10.8	-2	30	20	0	6.4	5	0	5	8.4	N		0.59	78.13
		6	Fd	24	-2	108	20	0	22	65	0	8.6	21.5	N		0.92	39.09
13		1	Fd	17	-8	10	20	13.9	17.5	0	0	6.2	13.6	Y		1.03	35.43
		2	Fd	16.7	-8	12	20	14.6	18.6	0	0	5.3	14.5	Y		1.11	28.49
		3	Fd	21.4	-8	100	20	0	21.6	6	0	18.8	19.2	Y	Bent	1.01	87.04
		4	Sx	34.2	-8	100	20	0	21.6	6	0	18.8	26.5	N		0.63	87.04
14		1	Fd	10.7	-15	45	20	0	12	20	0	5	8.7	N		1.12	41.67
		2	Fd	31.7	-15	100	20	0	23	58	0	8.4	27.2	N		0.73	36.52
		3	Fd	34.9	-15	96	20	0	22.2	62	0	6.8	28.6	N		0.64	30.63
15		1	Fd	42	-10	120	20	0	26	70	0	10	31.7	N		0.62	38.46
16		1	Fd	15.3	-5	76	20	2.3	18.5	55	2.3	6.5	13.7	Y		1.21	35.14
		2	Fd	16.5	0	0	0	0	17	0	0	6.9	13.8	Y		1.03	40.59
17		1	Cw	10.3	-1	38	20	0	7.8	20		3.6	9.2	N		0.76	46.15
18		1	Fd	20	-10	82	20	0	18.4	34		9.6	17.4	N		0.92	52.17
19		1	Fd	11.8	0	0	0	0	16	0		4.2	10.7	Y	Bent	1.36	26.25
		2	Fd	12	0	0	0	0	16.1	0		7.6	11.7	Y		1.34	47.20
		3	Pl	29.8	-13	102	20	0	23	75		5.4	25	N		0.77	23.48
		4	Pl	13.5	-11	90	20	0	20.2	75		3	11.4	N		1.50	14.85
		5	Pl	21.1	-12	90	20	0	20.4	70		4	17.4	N		0.97	19.61
		6	Sx	12.7	0	0	0	0	15.5	0		7.9	10.5	Y		1.22	50.97
20		1	Cw	10.4	-15	25	20	0	8	-2		5.4	10	N		0.77	67.50
		2	Fd	33.9	-15	112	20	0	25.4	64		9.6	27	N		0.75	37.80
		3	Fd	40	-10	108	20	0	23.6	70		7.6	32.7	N		0.59	32.20
		4	Pl	25.1	-15	104	20	0	23.8	66		7.6	21.5	N		0.95	31.93
		5	Pl	15.5	0	0	0	0	12.3	0		2.6	12.5	Y		0.79	21.14
21		1	Sx	22.3	0	102	20	2.1	22.5	80	2.1	6.5	19	Y		1.01	28.89
		2	Fd	34.5	-2	158	20	0	32	40		23.6	30.4	N		0.93	73.75
		3	Fd	46.7	0	136	20	0	27.2	60		15.2	38.5	N		0.58	55.88

Plot #		Tree #	Species	Stump Dia. (cm)	Height (%)		Distance (m)	Add to Height	Height (m)	Crown (%)	Add to Crown	Crown	Dbh	Broken (Y/N)	Comments	Stump Dia./Height	Crown/Height (%)
					Bottom	Top				Bottom	Length (m)	Length (m)	(cm)			(cm/m)	
22		1	Pl	29.9	-24	110	20	0	26.8	72	0	7.6	25.6	N		0.90	28.36
23		1	Fd	30.6	-5	75	15	15	27	0	0	12.5	24.7	Y		0.88	46.30
		2	Fd	23.9	4	148	15		21.6	94	0	8.1	21	N		0.90	37.50
		3	Fd	55.8	5	122	25		29.25	50	0	18	48.7	N		0.52	61.54
24		1	Cw	17	10	80	20	0	14	40	0	8	14.5	N		0.82	57.14
		2	Fd	11	9	65	20	0	11.2	40	0	5	9.9	N		1.02	44.64
25		1	Cw	40	-5	98	15	0	15.45	70		4.2	29	N		0.39	27.18
		2	Fd	15.5	-7	110	15	0	17.55	70		6	13.7	N		1.13	34.19
		3	Fd	12.2	-5	102	15	0	16.05	72		4.5	10	N		1.32	28.04
		4	Fd	12.5	-4	90	15	0	14.1	65		3.75	11.5	N		1.13	26.60
		5	Pl	18.2	-4	116	15	10	28	85	1	5.65	15.8	Y		1.54	20.18
		6	Cw	31.8	-4	132	15	0	20.4	72		9	32.9	N		0.64	44.12
		7	Sx	34.5	-1	150	15	0	22.65	90		9	29.8	N		0.66	39.74
26		1	Fd	27.7	7	121	20	0	22.8	60		12.2	24	N		0.82	53.51
		2	Fd	38	6	140	20	0	26.8	80		12	34	N		0.71	44.78
		3	Fd	14	0	0	0	0	16.1	0		7.6	11.4	Y		1.15	47.20
27		1	Fd	10.5	0	0	0	0	11.7	0		6.1	8.6	Y		1.11	52.14
		2	Fd	21	-10	100	20	0	22	63		7.4	18	N		1.05	33.64
		3	Pl	30.3	-5	115	20	0	24	75		8	23.2	N		0.79	33.33
		4	Pl	13	-11	64	20	0	15	50		2.8	11.6	N		1.15	18.67
		5	Pl	26.9	-10	108	20	0	23.6	60		9.6	22.4	N		0.88	40.68
28		1	Fd	22.1	10	120	20	0	22	90		6	19.4	N		1.00	27.27
		2	Fd	12.2	0	0	0	0	16	0		5	10.5	Y		1.31	31.25
		3	Fd	18.9	11	108	20	0	19.4	80		5.6	16	N		1.03	28.87
		4	Pl	42.3	9	146	20	0	27.4	100		9.2	34.4	N		0.65	33.58
29		1	Fd	22.4	-10	101	20	0	22.2	72		5.8	19.3	N		0.99	26.13
		2	Fd	12.7	-16	44	20	0	12	20		4.8	10.7	N		0.94	40.00
		3	Pl	27.8	-10	122	20	0	26.4	86		7.2	25.1	N		0.95	27.27
30		1	Pl	23.7	-5	100	20	0	21	68		6.4	20.2	N		0.89	30.48
		2	Fd	33.9	-2	130	20	0	26.4	76		10.8	30.3	N		0.78	40.91
31		1	Fd	24.3	10	68	15	7	15.7	0		6.6	20.7	Y		0.65	42.04
		2	Fd	14.6	6	132	15	0	18.9	102		4.5	12.4	Y	Bent	1.29	23.81
		3	Pl	33.5	12	144	20	0	26.4	104		8	27.8	N		0.79	30.30
32		1	Pl	19.6	-25	14	21	16.1	24.29	0		6.4	16.7	Y		1.24	26.35
34		1	Fd	31.9	-10	110	20	0	24	60		10	25.8	N		0.75	41.67
		2	Fd	15.3	-3	112	15	0	17.25	55		8.55	12.8	N		1.13	49.57
		3	Pl	10.9	-1	45	15	3.7	10.6	0		3.7	10.5	Y		0.97	34.91
		4	Pl	27.7	4	30	20	17.9	23.1	0		6.6	23	Y		0.83	28.57
35		1	Pl	21.2	-4	49	20	12.8	23.4	0		5.3	18.3	Y		1.10	22.65
		2	Pl	11.4	0	0	0	0	13.1	0		1.5	10.4	Y		1.15	11.45
		3	Fd	12.4	0	0	0	0	12	0		3	10.9	Y		0.97	25.00
		4	Fd	12.5	0	0	0	0	12	0		3.5	10.5	Y		0.96	29.17

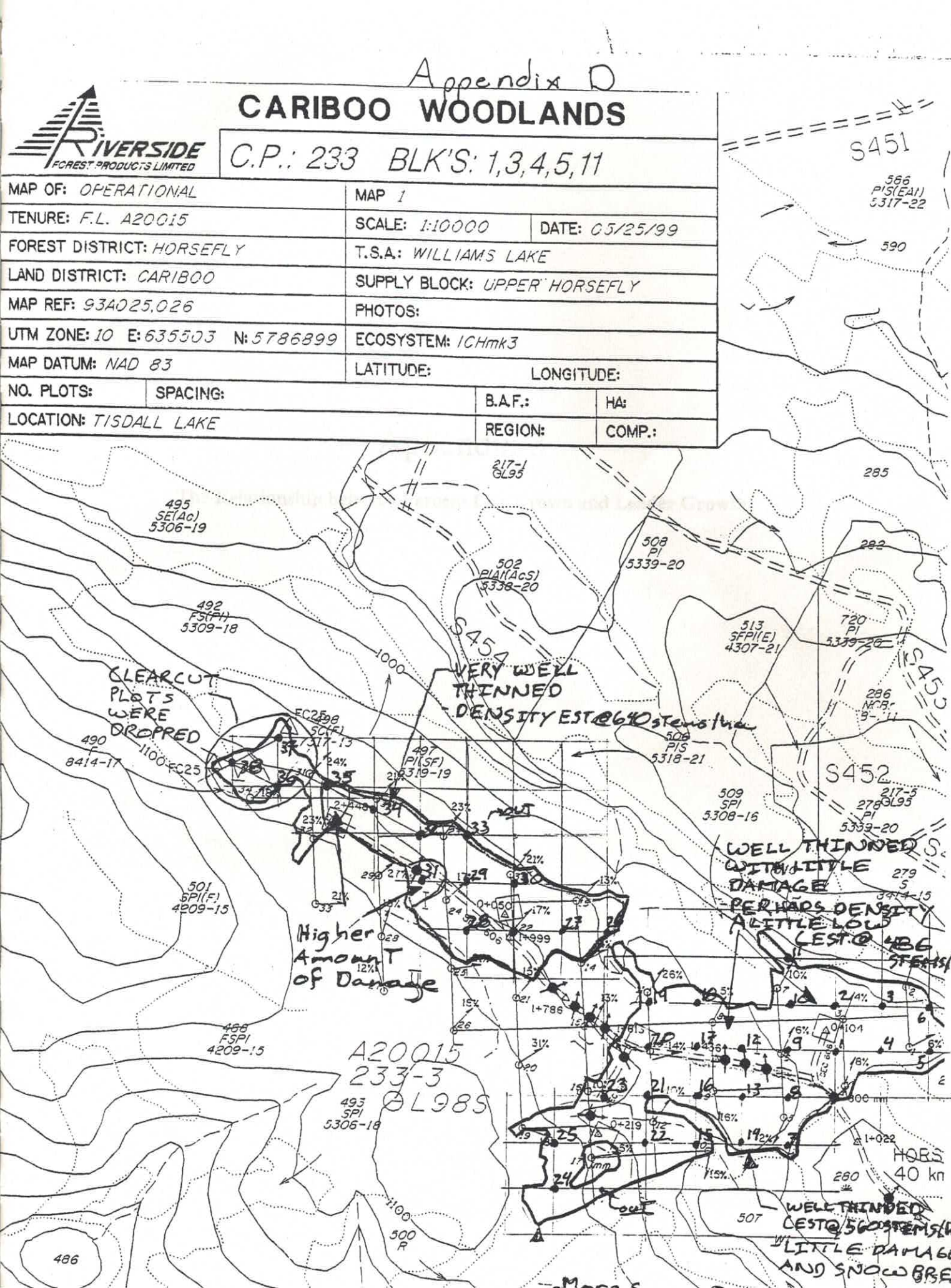
Appendix D

CARIBOO WOODLANDS

RIVERSIDE FOREST PRODUCTS LIMITED

C.P.: 233 BLK'S: 1,3,4,5,11

MAP OF: OPERATIONAL	MAP 1		
TENURE: F.L. A20015	SCALE: 1:10000	DATE: 05/25/99	
FOREST DISTRICT: HORSEFLY	T.S.A.: WILLIAMS LAKE		
LAND DISTRICT: CARIBOO	SUPPLY BLOCK: UPPER HORSEFLY		
MAP REF: 93A025,026	PHOTOS:		
UTM ZONE: 10 E: 635503 N: 5786899	ECOSYSTEM: ICHmk3		
MAP DATUM: NAD 83	LATITUDE:	LONGITUDE:	
NO. PLOTS:	SPACING:	B.A.F.:	HA:
LOCATION: TISDALL LAKE		REGION:	COMP.:



Appendix 3

The Relationship between Percent Live Crown and Leader Growth

COMMERCIAL THINNING SURVEY: THE RELATIONSHIP BETWEEN PERCENT CROWN AND LEADER GROWTH

by

C. Bruce Hopper

December 9, 1999

PURPOSE

To determine if the ratio of live crown to tree height (i.e. percent crown) found for Spruce, Douglas Fir and Lodgepole Pine trees in commercially thinned blocks had an effect on leader growth.

PROCEDURE

The following cutting permits and associated blocks in the Horsefly Forest District were chosen as the study area: 233-1, 233-3, 233-4 and 234-1. Only the commercially thinned standard units (SU) within each block were sampled. A total of 90 trees from each block (30 Spruce, 30 Lodgepole Pine and 30 Douglas Fir) were sampled for two basic characteristics. Total height was the first and was easily measured using a clinometer and measuring tape. The second characteristic, leader growth, was more subjective however. To make the estimation less subjective leader growth was estimated based on 5 cm length classes (i.e. 0 to 5, 6 to 10, 11 to 15, 16 to 20, 21 to 25, 26 to 30 and 31 to 35 cm classes). Percent Crown was calculated using Formula 1.

Formula 1: Percent Crown

$$\textit{Percent Crown} = \textit{Crown Length (m)} / \textit{Total Height (m)}$$

An analysis of variance (ANOVA) for each individual block was performed to test for the following null hypothesis: *The treatment means are equal or not significantly different from one another*. The *treatment means* being the mean percent crown by 5 cm leader class. If these means proved to be equal or not significantly different (based on alpha = 0.05) then we would *not* reject the null hypothesis. Thus, indicating that percent crown did *not* appear to have a potential effect on leader growth. If, on the other hand, the treatment means prove to be significantly different from one another then percent crown would appear to have had a potential effect on leader growth.

RESULTS

It was assumed that a sample of 30 trees from each of the three species (Spruce, Fir and Pine) per block would accurately represent the effect that percent crown had on leader growth. Figure 1 illustrates the actual sampling percent realized from each block. Out of all four blocks 233-3 was the only one of concern. The sampling intensity of this block was low (i.e. less than 1%) due to the large commercially thinned area and high post-harvest density. This was considered when analyzing the results.

Figure 1: Sampling Percent Summary

Cutting Permit #	Block #	Post-Thinning Density (stems/ha)	Total Commercial Thinned Area (ha)	Total # of Stems	Total # of Stems Sampled	Sampling Percent
233	1	420	16.60	6972	90	1.29%
233	3	750	32.00	24000	90	0.38%
233	4	810	9.00	7290	90	1.23%
234	1	480	9.70	4656	90	1.93%

Figures 2 through 5 show a 'Summary' and 'ANOVA' for CP 233-1, 233-3, 233-4 and 234-1 respectively. Each of the 'Summaries' shows the 'Count' of stems sampled, 'Average' crown percent and 'Variance' of crown percent. Note that Figure 2 identifies a total of 86 stems sampled in block 233-1 as opposed to the 90 stems actually sampled. This discrepancy was due to the fact that any leader growth class containing less than three trees was excluded from the ANOVA process.

As illustrated in Figures 2 through 5 each ANOVA determined an 'F-crit' (F critical) value. If the F critical value was greater than the $F_{0.05}$ value then the null hypothesis would be rejected. It was determined that none of the ANOVA's produced an F critical value that exceeded their associated $F_{0.05}$ value and thus not rejecting the proposed null hypothesis. The $F_{0.05}$ value for all blocks however, did not exceed the F critical values by a large margin.

Figure 2: Summary and Analysis of Variance for CP 233-1

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
10	18	10.66	0.59	0.02
15	17	9.00	0.53	0.02
20	16	8.91	0.56	0.02
25	15	10.02	0.67	0.01
30	20	13.71	0.69	0.02
Total	86	52.30	0.61	0.02

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*	$F_{0.05}$
Between Groups	0.33	4	0.08	4.51	0.00	2.48	2.50
Within Groups	1.46	81	0.02				
Total	1.78	85					

Figure 3: Summary and Analysis of Variance for CP 233-3

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
5	7	1.69	0.24	0.00
10	34	12.23	0.36	0.01
15	26	8.65	0.33	0.01
20	9	3.85	0.43	0.01
25	4	1.59	0.40	0.02
30	10	4.35	0.44	0.01
Total	90	32.37	0.36	0.01

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*	$F_{0.05}$
Between Groups	0.22	5	0.04	4.11	0.00	2.32	2.33
Within Groups	0.90	84	0.01				
Total	1.12	89					

Figure 4: Summary and Analysis of Variance for CP 233-4

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
5	4	1.73	0.43	0.02
10	26	11.62	0.45	0.02
15	27	13.44	0.50	0.02
20	11	7.06	0.64	0.02
25	14	8.43	0.60	0.02
30	8	5.16	0.65	0.02
Total	90	47.44	0.53	0.03

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*	$F_{0.05}$
Between Groups	0.56	5	0.11	5.34	0.00	2.32	2.33
Within Groups	1.77	84	0.02				
Total	2.33	89					

Figure 5: Summary and Analysis of Variance for CP 234-1

Summary

Groups	*Count*	*Sum*	*Average*	*Variance*
5	14	7.77	0.56	0.02
10	25	12.78	0.51	0.02
15	15	7.42	0.49	0.02
20	17	6.26	0.37	0.02
25	3	0.77	0.26	0.03
30	11	3.34	0.30	0.01
35	5	1.33	0.27	0.01
Total	90	39.68	0.44	0.03

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*	$F_{0.05}$
Between Groups	0.90	6	0.15	7.03	0.00	2.21	2.22
Within Groups	1.77	83	0.02				
Total	2.67	89					

In response to the above results further ANOVA's were performed on the data. These additional ANOVA's separated individual block data even further. Instead of producing one ANOVA for each block three ANOVA's, one representing each species, were produced. Figure 6 summarizes these results.

Figure 6: Summary of Analysis of Variance by Block by Species

Cutting Permit #	Block #	Species	F crit	$F_{0.05}$
233	1	Fd	2.64	3.05
		Pl	1.473	3.39
		Sx	1.123	2.8
233	3	Fd	4.779	3.01
		Pl	0.3038	3.4
		Sx	0.4869	3.01
233	4	Fd	1.605	2.76
		Pl	2.222	3.37
		Sx	1.77	2.8
234	1	Fd	2.45	2.78
		Pl	1.438	2.98
		Sx	1.765	2.82

Cutting permit 233-3 was the only block to produce an F critical value that exceeded the $F_{0.05}$ value. This indicated that the treatment means for Douglas Fir demonstrated a significant difference.

Discussion and Conclusions

As none of the blocks demonstrated a significant difference between treatment means the null hypothesis was not rejected. This would suggest that percent crown *did*

not have a potential effect on leader growth. The values leading to this conclusion were very close to one another (Figures 2 through 5) thus it was believed that by combining the three species together in the initial ANOVA might have masked a potential effect. However, after performing an ANOVA that isolated species from one another it was determined that there was no significant difference between treatment means (Figure 6). Cutting permit 233-3 however, did show a significant difference in percent crown for Douglas Fir (Figure 6). Due to the fact that no other blocks demonstrated similar results and the fact that 233-3 was of such a low sampling intensity (Figure 1) it was believed that this was erroneous or coincidental. Over all there was no decisive evidence to conclude that percent crown had an effect on leader growth.

RECOMMENDATIONS

There were a few ideas for future studies that arose while out in the field. One suggests that there may be a possible correlation between tree dominance and leader growth. This developed after noticing that some trees of greater dominance within the post-harvested stand demonstrated remarkable growth regardless of percent crown. Other recommendation suggested that leader growth may not be the most optimum estimation of growth. Rather an attempt to correlate characteristics such as age, mean annual increment, current annual increment, tree height, percent crown, pre-harvest density, post-harvest density and many others would be better.

Appendix 4

Cruise Based Removal

Cruise Comparison

		Standard Utilization 30 cm stump, 10 cm top dia, 15 cm dia pine butt dia, 20 cm butt other species																	
		Initial Cruise						Cruise Cut						Cruise Leave					
Cutting Permit	Area	Merch Height	Avg. D.B.H.	m3 per tree	Basal Area	Trees Per Hectare	Net Vol/ha.	Merch Height	Avg. D.B.H.	m3 per tree	Basal Area	Trees Per Hectare	Net Vol/ha.	Merch Height	Avg. D.B.H.	m3 per tree	Basal Area	Trees Per Hectare	Net Vol/ha.
233-1	17.6	17.8	30.2	0.55	37.8	528	291.8	18.4	29.7	0.57	13.5	181.1	110	22.4	30.4	0.54	24.3	311.3	182
233-3	36.3	18.1	22.7	0.32	41	941	300.3	17.2	21.7	0.3	29.4	714.1	238	19.2	25.9	0.41	11.6	224.1	104
233-4	9.1	19.3	24.8	0.42	67.5	1445	607.5	18.3	23.5	0.38	36	870	332	20.5	26.6	0.49	31.5	559.1	276

		Enhanced Utilization 10 cm stump, 2.5 cm top dia, 9 cm butt dia all species																	
		Initial Cruise						Cruise Cut						Cruise Leave					
Cutting Permit	Area	Merch Height	Avg. D.B.H.	m3 per tree	Basal Area	Trees Per Hectare	Net Vol/ha.	Merch Height	Avg. D.B.H.	m3 per tree	Basal Area	Trees Per Hectare	Net Vol/ha.	Merch Height	Avg. D.B.H.	m3 per tree	Basal Area	Trees Per Hectare	Net Vol/ha.
233-1	17.6	21.4	26.6	0.44	38.7	715.2	310	20.4	29.7	0.58	13.5	181.1	112	19.1	29.2	0.51	25.2	350.5	191
233-3	36.3	20.8	16.6	0.17	53.2	2507	418	18	17	0.17	39.4	1593	314	20.3	22.3	0.3	13.8	345.4	120
233-4	9.1	23	19	0.42	74.2	2876	693	20.3	21.3	0.31	40.5	1191.1	370	22	22.8	0.35	33.7	821	294

Appendix 5

Desired Crop Tree Characteristics for Commercial Thinning

Commercial Thinning

Specifications:

- Density - >500 stems/ha < 2500 stems/ha
- Height/Diameter Ratio - >1.00
- Live crown - >30%
- Tree Characteristics (no large branches)
- Terminal Growth (good leader growth, not stunted)
- Spacing - 4m (Leaves approximately 450-500 Stems/ha)
- Age - > 35 years < 80 years (70 years old maximum age for Pine)
- Age Class - 3 – 4 (Age Class 5 Pine stands and 7 for all other species are not commercial thinning, it is a Partial Cut)
- Piece Size – At minimum must be able to cut a 2"x 4" out of trees
- Slopes < 40%
- Volume/ha – approximately 30% of the vol/ha is removed