Foothills Growth and Yield Association

Enhanced Management of Lodgepole Pine (FRIAA Project OF-02-16)

Nutrition and Density Management Trial (EMLP1) Establishment Report

Prepared by:

W.R. Dempster Ph.D., R.P.F.

For the:

Foothills Growth and Yield Association



P.O. Box 6330 Hinton, Alberta T7V 1X6

October, 2007

Table of Contents

1	Introduction	. 3
2	Acknowledgements	. 3
3	Experimental Sites	. 4
4	Plot Layout and Treatment	. 6
5	Tree Measurements	. 9
6	Foliar Analyses	10
7	Database	12
Appe	endix 1. Tie points for locating installations by road	13

List of Tables

Table 1.	List of experimental sites	4
Table 2.	Fertilizer prescription and analysis.	7
Table 3.	Treatment dates and fertilization conditions	8
Table 4.	First-year foliage nutrient and weight values averaged by fertilization treatment 1	11

List of Figures

Figure 1.	Enhanced Management of	Lodgepole Pine Pro	ject - Experimenta	l site locations 5
Figure 2.	Layout of plot clusters in	(a) harvest-origin an	d (b) fire-origin st	ands 6

1 Introduction

The purpose of this trial is to provide FGYA members the ability to determine:

- 1. Which stands on their forest management areas are most likely to respond best to fertilization;
- 2. What yield increases can be expected from the stands most likely to respond.

Following preliminary baseline assessments completed in May 2005, the trial was established in the winter of 2005-2006 and spring of 2006. The trial installation involved the layout and treatment of fixed-area plots in 30 stands, of which 15 were young (10 - 30 years of age) and of post-harvest origin, and 15 were mid-late age (30-80 years) and of natural fire-origin. First-year post-fertilization foliage was sampled and analyzed the following winter (2006-2007). Initial growth responses will be measured in the Fall of 2008, 3 growing seasons after treatment.

2 Acknowledgements

Vic Leiffers and Phil Comeau of the University of Alberta participated in the original design of the project. Rob Brockley, Research Silviculturist, B.C. Ministry of Forests and Range, provided expert guidance in the prescription of the fertilizer blends. West Sky Resource Consultants of Edson, Alberta undertook all fieldwork, including plot layout, thinning, fertilization, measurements, and collection of foliar samples following the first post-treatment growing season. Pacific Soil Analysis of Richmond, B.C. conducted the laboratory analyses of foliage.

The establishment of the trial was supported by FRIAA's *Open Funds* initiative (FRIAA Project # OF-02-16), and supplementary FRIP funding transfers contributed by FGYA members.

3 Experimental Sites

Table 1 lists experimental sites, and indicates their location, origin, and stand breast-height age at time of treatment. Additional location and stand reconnaissance information is stored in the trial database (see Section 7)

Site Number	Forest Management	Origin	Тwp	Rge	Mer	Natural Subregion	Elevation (m)	B.H. Age
Tumber	Aita					Subregion	(111)	(years)
1	ANC	Fire	59	23	5	Upper Foothills	1209	66
2	ANC	Fire	60	22	5	Upper Foothills	1112	68
3	Canfor	Fire	61	3	6	Upper Foothills	1351	60
4	Canfor	Fire	59	4	6	Sub-alpine	1349	92
5	Hinton	Harvest	54	24	5	Upper Foothills	1238	19
6	Hinton	Harvest	54	24	5	Upper Foothills	1281	17
7	Hinton	Harvest	54	24	5	Upper Foothills	1197	10
8	Hinton	Harvest	56	19	5	Lower Foothills	1104	7
9	Hinton	Harvest	49	18	5	Lower Foothills	1064	23
10	Hinton	Harvest	49	18	5	Lower Foothills	1041	22
11	Hinton	Fire	49	23	5	Upper Foothills	1278	35
12	Hinton	Harvest	50	24	5	Upper Foothills	1341	13
13	Millar Western	Fire	60	15	5	Lower Foothills	815	58
14	Millar Western	Fire	60	15	5	Lower Foothills	815	41
15	Sundance	Fire	46	13	5	Lower Foothills	1100	56
16	Sundance	Fire	46	13	5	Lower Foothills	1097	55
17	Sundance	Harvest	46	15	5	Upper Foothills	1255	8
18	Spray Lake	Harvest	30	6	5	Lower Foothills	1346	16
19	Spray Lake	Harvest	30	7	5	Upper Foothills	1473	20
20	Spray Lake	Harvest	30	7	5	Upper Foothills	1480	5
21	Spray Lake	Fire	30	9	5	Upper Foothills	1438	78
22	Sundre	Fire	40	12	5	Lower Foothills	1256	103
23	Sundre	Fire	41	14	5	Upper Foothills	1490	39
24	Sundre	Fire	41	14	5	Upper Foothills	1336	71
25	Weyerhaeuser (GP)	Harvest	65	7	6	Upper Foothills	1084	19
26	Weyerhaeuser (GP)	Harvest	62	6	6	Upper Foothills	1169	19
27	Weyerhaeuser (GP)	Harvest	62	6	6	Upper Foothills	1208	19
28	Weyerhaeuser (Ed)	Harvest	51	16	5	Lower Foothills	1096	10
29	Weyerhaeuser (Ed)	Fire	51	16	5	Lower Foothills	1087	36
30	Weyerhaeuser (Ed)	Fire	51	16	5	Lower Foothills	1102	102

Table 1. List	t of	experimental si	tes
---------------	------	-----------------	-----

Site locations are indicated with pink circles on the map shown in Figure 1. Tie point information for locating the installations from the nearest road is provided in Appendix 1.



Figure 1. Enhanced Management of Lodgepole Pine Project - Experimental site locations

4 Plot Layout and Treatment

Fixed-area treatment plots were established in homogenous areas identified within each of the 30 stands. The sites are adjacent or close to roads. Treatments involved fertilization (all sites) and pre-commercial thinning (harvest-origin sites only), plus untreated controls (see Figure 2).





fertilization sub-plots (each 40 x 40m)

On each of the 15 post-harvest sites selected for both thinning and fertilization treatments, the contractor installed and treated experimental plots as follows:

- 2 "whole-plots" were laid out each $35m \times 105m (3675m^2)$.
- One whole-plot was manually low-thinned to a residual density of approximately 2500 coniferous stems per ha. Crop (leave) trees were selected, tagged and flagged before the thinning, and before or at the same time as the pre-thinning measurement. The thinning treatment included cutting of all deciduous trees on the plot. Cut trees were left lying on site. The other whole-plot was left non-thinned.

- Each whole-plot was split into 3 square sub-plots. On each whole-plot one sub-plot was retained as a non-fertilized control (F1 and F4 in the non-thinned and thinned whole-plots respectively). Nitrogen fertilizer (urea) was applied to the next sub-plot (F2 and F5); and a blended fertilizer was applied to the remaining sub-plot (F3 and F6). The fertilizer was spread evenly by subdividing the plots into swathes marked by string.
- Each sub-plot is 35m x 35 m (1225m²), including an inner assessment area of 200m² (14.14m x 14.14m) and treated buffer not less than 10m in width.

On each of the 15 fire-origin sites selected for fertilization treatments, the contractor installed and treated experimental plots as follows:

- One "whole-plot" was laid out $40m \ge 120m (4800m^2)$.
- The whole-plot was split into 3 square sub-plots. One sub-plot (F1) was retained as a non-fertilized control. Nitrogen fertilizer (urea) was applied to the next sub-plot (F2) and a blended fertilizer was applied to the remaining sub-plot (F3). Each sub-plot is 40m x 40m (1600m²), including an inner assessment area of 400m² (20m x 20m) and treated buffer of 10m width.

Fertilizer prescriptions are described in Table 2, including ingredients by kg per ha and per tonne, and chemical composition by percentage and weight.

Table 2. Fertilizer prescription and analysis

(a) Nitrogen only (sub-plots F2 and F5)

	kg per		Ingredient Analysis (%)					Pla	nt Food	Conten	t (kg)				
Ingredients	ha	Ν	P ₂ O ₅	K ₂ O	Ca	Mg	S	В	Ν	Р	K	Ca	Mg	S	В
Urea	652.2	46							300.0						
Total	652.2								300.0	0.0	0.0	0.0	0.0	0.0	0.0

	kg per		I	ngredient Analysis (%)				Plant Food Content (kg)							
Ingredients	tonne	Ν	P_2O_5	K ₂ O	Ca	Mg	S	В	Ν	P_2O_5	K ₂ O	Ca	Mg	S	В
Urea	1000.0	46							460.0						
Total	1000.0								460.0	0.0	0.0	0.0	0.0	0.0	0.0
	1000.0									0.0	0.0	0.0	0.0	0.0	0.0

Analysis: 46.0 - 0 - 0

(b) Blend (sub-plots F3 and F6)

	kg per		I	ngredie	nt Anal	ysis (%)			Pla	nt Food	Conten	t (kg)		
Ingredients	ha	Ν	P ₂ O ₅	K ₂ O	Ca	Mg	S	В	Ν	Р	K	Ca	Mg	S	В
Urea	545.2	46							250.8						
Monoammonium Phosphate	447.2	11	52				1.5		49.2	100.0				6.7	l
Muriate of Potash	92.4			60							46.0				l
Sulphate Pot. Magnesia	325.3			20		10	21				54.0		32.5	68.3	Ì
Borate granular	20.0							15							3.0
Total	1430.1								300.0	100.0	100.0		32.5	75.0	3.0

	kg per		Ingredient Analysis (%)					Plant Food Content (kg)							
Ingredients	tonne	Ν	P ₂ O ₅	K ₂ O	Ca	Mg	S	В	Ν	P ₂ O ₅	K ₂ O	Ca	Mg	S	В
Urea	381.2	46							175.4						
Monoammonium Phosphate	312.7	11	52				1.5		34.4	162.6				4.7	
Muriate of Potash	64.6			60							38.8				
Sulphate Pot. Magnesia	227.5			20		10	21				45.5		22.7	47.8	
Borate granular	14.0							15							2.1
Total	1000.0								209.8	162.6	84.2	0.0	22.7	52.5	2.1

Analysis: 20.9 - 16.2 - 8.4 - 5.2S - 2.2Mg - 0.21B

Dates of treatments, and conditions during and following fertilization, are itemized for each site in Table 3.

SITE #	Thinning	Fertilization							
	Date	Date	Temp. (high)	Weather	Wind	Surface moisture	Days until rain		
1		May 15 2006	24	sunny	none	dry	5		
2		May 15 2006	24	sunny	none	dry	5		
3		May 7 2006	10	cloudy/drizzle	breezy	damp	5		
4		May 7 2006	10	cloudy/drizzle/hail	breezy	damp	5		
5	Mar 23 2006	May 15 2006	24	sunny	none	dry	5		
6	Mar 23 2006	May 12 2006	10	cloudy/drizzle	breezy	dry	0		
7	Nov 3 2005	May 12 2006	10	cloudy	breezy	dry	0		
8	Nov 16 2005	May 2 2006	9	overcast/drizzle	breezy	damp	0		
9	May 29 2006	Apr 26 2006	18	partly cloudy	none	dry	3		
10	Nov 25 2005	Apr 26 2006	18	partly cloudy	none	dry	3		
11		Apr 27 2006	16	overcast	none	dry	2		
12	Oct 30 2005	Apr 27 2006	16	overcast	none	dry	2		
13		May 10 2006	17	partly cloudy	slight breeze	dry	2		
14		May 10 2006	17	partly cloudy	slight breeze	dry	2		
15		May 3 2006	9	partly cloudy	none	damp	3		
16		May 3 2006	9	partly cloudy	none	damp	3		
17	Nov 22 2005	May 11 2006	17	partly cloudy	none	dry	1		
18	Apr 1 2006	May 5 2006	23	sunny	slight breeze	dry	15		
19	Mar 28 2006	May 5 2006	23	sunny	slight breeze	dry	15		
20	Dec 10 2005	May 4 2006	17	sunny	none	damp	16		
21		May 4 2006	17	sunny	none	dry	16		
22		May 6 2006	12	overcast	slight breeze	dry	6		
23		May 6 2006	12	overcast	slight breeze	dry	6		
24		May 6 2006	12	overcast/drizzle	slight breeze	damp	6		
25	May 28 2006	May 10 2006	17	partly cloudy	slight breeze	dry	3		
26	May 26 2006	May 9 2006	16	sunny	windy	dry	4		
27	May 23 2006	May 9 2006	16	sunny	windy	dry	4		
28	Nov 24 2005	Apr 25 2006	19	sunny	breezy	dry	4		
29		Apr 25 2006	19	sunny	breezy	dry	4		
30		Apr 25 2006	19	sunny	breezy	dry	4		

Table 3. Treatment dates and fertilization conditions

On all experimental sites plot placement and buffers between and surrounding whole-plots were designed to provide a minimum of 20m between assessment plot boundaries, and from assessment plot boundaries to any stand edge (including edges created by the thinning treatment).

Plots were demarcated as permanent sample plots, and all live coniferous trees retained after treatment within plot inner assessment areas and greater than 1.3m in height were tagged and numbered.

Treatment plot corners, inner assessment plot corners, and plot centres were staked. The treatment plot corner stakes were painted orange, and the inner assessment corner stakes painted

red. A blue buffer was painted and flagged on trees around the whole installation, approximately 20 m outside the perimeters of the treatment plots. Locations of treatment plot centres and the corners of the outer blue buffer were recorded with a global positioning system (GPS).

5 Tree Measurements

Trees within plot inner assessment areas were measured before treatment. Thinned plots were checked after treatment to confirm and identify which trees were retained and to ensure that all retained trees were tagged. The following variables were recorded for all live trees 1.3m or greater in height: species, breast-height diameter, height to live crown, average crown radius, canopy position, and damage incidence and severity. Species and height were also recorded for "underheight" live trees over 30cm and under 1.3m in height on harvest-origin sites (but these trees were not tagged).

The following codes were used and levels of accuracy (where specified) were required.

Code	Species
FA	Sub-alpine Fir
FB	Balsam Fir
LT	Tamarack (Larch)
PJ	Jack pine
PL	Lodgepole Pine
SB	Black Spruce
SE	Englemann Spruce
SW	White Spruce
PB	Balsam (Black) Poplar
AW	Aspen (White) Poplar
BW	White Birch
DC	Dead coniferous
DD	Dead deciduous

Species:

DBH: Diameter was measured at breast height (1.3 m from the point of germination) in cm to nearest 0.1cm. In case of any defect at the point of measurement such as swellings or large branches, diameter was taken immediately below or above the defect. DBH accuracy: +/- 0.1cm

Height: The current total height for each tagged tree was recoded in metres, to the nearest 0.1m (fire-origin sites) or 0.01m (post-harvest sites). Heights were measured to the tallest live portion of the crown, excluding the terminal bud. Height accuracy: lesser of +/-0.2m or 2%

Height to Live Crown: This is the height from the ground level to the base of the continuous live crown. Height to Live Crown accuracy: +/- 5%

Average Crown Radius: Measured by assessing the distance from the tree bole to the edge of the crown margins (drip zone), taken in four cardinal point directions (north, south, east and west) from the stem out and recorded as an average of the four directions. Average Crown Radius accuracy: lesser of +/- 0.3m or 5%

Crown Class: The position of an individual tree within the canopy of the stand. This was not recorded for trees with broken tops or severe lean. Allowable crown class codes were:

Code	Crown Class	Description
D	Dominant	Crowns extend above the general level of the canopy
С	Co-dominant	Crowns form the general level of the canopy.
Ι	Intermediate	Crowns below but extending into the bottom of the general level of the canopy
S	Suppressed	Crowns entirely below the general level of the canopy

Crown Class accuracy: +/- one class (no more than 10% error per plot)

Damage Incidence and Severity: A maximum of 2 damage incidence codes were recorded per tree. Valid damage are listed below.

Code	Description	Code	Description
AH	Animal - Horse trampling	ID	Insects - Defoliators
AL	Animal - Rabbit/hare	IB	Insects - Wood borers
AT	Animal - Bear	IT	Insects - Terminal weevils
AC	Animal - Beaver	IR	Insects - Root collar weevils
AR	Animal - Ungulate rubbing	IA	Insects - Aphids
AB	Animal - Ungulate browsing	IO	Insects - Other
AS	Animal - Squirrel	PD	Physical defects - Dead or damaged top
AP	Animal - Porcupine	PL	Physical defects - Dead top lateral assuming dominance
AO	Animal - Other	PM	Physical defects - Broken or missing top
DN	Disease - Needle rust	PC	Physical defects - Crook or Sweep
DH	Disease - Hypoxylon canker	PT	Physical defects - Mechanical
DA	Disease - Atropellis canker	PF	Physical defects - Forked tree
DR	Disease - Armillaria mella	PB	Physical defects - Leaning or bent tree
DC	Disease - Conks	PR	Physical defects - Rot or decay
DD	Disease - Die back	PS	Physical defects - scar or cat face
DM	Disease - Dwarf mistletoe	WH	Weather - Hail
DB	Disease - Blister rust	WF	Weather - Frost heaving
DW	Disease - Western gall rust	WC	Weather - Frost crack
DI	Disease - Witches' broom	WN	Weather - Snow or ice
DO	Disease - Other	WR	Weather - Red belt
		WB	Weather - Blow-down

The severity of each damage incidence was categorized as follows:

1: Minimal: Tree expected to fully recover with little effect on tree growth or form. If incidence is disease such as gall rust or mistletoe, it is limited to lateral branches.

2: Moderate: Growth rate likely to be reduced and / or tree form adversely affected. If incidence is disease such as gall rust or mistletoe, it is apparent on the bole.

3: Severe: Tree will probably die or be rendered non-merchantable due to extensive bole damage, defect or disease.

6 Foliar Analyses

Preliminary foliage collections and analyses were conducted in early 2005 and formed the basis for design of the experimental fertilizer prescriptions. Note that these collections were made in the same stand areas in which the permanent plots were subsequently located, but were not directly referenced or necessarily actually within the permanent plots. These data are retained in the project database.

Foliage was sampled from the all the trial sub-plots between December 1, 2006 and January 17, 2007. Samples were collected from the inner assessment area of each sub-plot. Thus a total of 135 subplots were sampled: 6 in each of the 15 harest-origin sites, and 3 in each of the 15 fire-origin sites.

Samples were collected from 3 dominant or co-dominant live healthy tagged lodgepole pine trees close to the plot centre. The trees were free from major defect, insect infestation, or stem disease that was not representative of the overall stand condition. The samples were collected from the new 2006 foliage and from the upper part of the crown: i.e. the base of the upper 1/3 of the live crown. Samples from each tree were kept separate and carefully annotated with the site, plot and tee number. They were collected, bagged, cold stored and sent to the laboratory as twigs, clipped to include only the latest season's growth.

The laboratory analyses involved separate weight measurement for foliage from each tree based on 100 fascicles per tree, and then combining equal weights of foliage from each tree into a single sample per plot for nutrient analysis. The analyses provided the following sample estimates for each sub-plot:

- Foliar mass (3 x 100 fascicle dry weights)
- Percentage composition of N, P, Ca, Mg, K, S;
- Concentrations (arts per million) Cu, Zn, Fe, Mn, B, and available SO4-S.

Table 4 shows values averaged across the whole trial by fertilization treatment (blend, nitrogen only, and none). Results suggest substantial uptake of nitrogen and boron in the fertilized plots, and resulting increases in needle mass.

Variable	Blend	Nitrogen	None	Total
N %	1.47	1.36	1.10	1.31
Р%	0.15	0.14	0.13	0.14
Ca %	0.19	0.18	0.19	0.19
Mg %	0.08	0.08	0.08	0.08
К %	0.44	0.41	0.40	0.41
S %	0.11	0.09	0.09	0.10
Cu ppm	3.3	3.5	3.5	3.4
Zn ppm	40.9	41.9	44.0	42.3
Fe ppm	45.2	47.9	52.0	48.4
Mn ppm	381.4	383.5	405.8	390.2
B ppm	32.2	8.4	10.7	17.1
SO4-S ppm	95.2	47.8	124.7	89.2
Needle dry weight gm (100				
fascicle basis)	5.89	5.14	4.45	5.16

Table 4.	First-year	foliage nutrie	nt and weight	t values averaged	l by fertilizatio	n treatment

7 Database

Data for the trial were compiled into a Microsoft Access database which is available to FGYA members and project collaborators. The database (EMLP1v3R) contains the following tables.

- 2004 Recon Inventory: summary of mensurational statistics from the stand reconnaissance on which the trial design was based;
- 2005 Recon Foliar: results of foliar analyses conducted on samples collected from the selected stands prior to trial installation;
- 2006 Sites: summary information on experimental sites (plot clusters) established in the winter of 2005-06
- 2006 Locations: UTM and legal coordinates of sub-plot centres and plot buffers;
- 2006 Treatments: indicates which treatments were assigned to which sub-plots during 2005-06 thinning and 2006 fertilization;
- 2006 Trees: measurements and status of all tagged trees >= 1.3m in height;
- 2006 Underheight: lists species and heights of non-tagged trees between 0.3m and 1.3m in height;
- 2007 Foliar: results of foliar analyses conducted on samples collected one growing season following treatment.

Descriptions of data fields are provided in the design view of each table, in look-up tables, and / or are cross referenced to this report.

Appendix 1. Tie points for locating installations by road

Site Number	FMA	Tie Point
1	Alberta Newsprint	FROM FOX CREEK HEAD NORTHWEST 3.4 KM ON HWY 43 TO BIGSTONE ROAD ON THE LEFT. DRIVE ABOUT 58 KM SOUTH TO THE ANC ROAD AND TURN RIGHT AND DRIVE WEST TO KM 159 (TP). FROM TP 50M AT 220 DEGREE TO EAST CORNER OF TREATMENT #1.
2	Alberta Newsprint	FROM HINTON FOLLOW WILLOW CREEK RD NORTH TO JW RD. THEN FOLLOW TO KM 76 ON JW RD AND TURN LEFT ONTO 5.33.302 RD. FOLLOW 4.4KM AND TURN RIGHT AT FOUR WAY STOP. FOLLOW 12.9 KM PAST BERLAND RIVER AND TURN RIGHT. FOLLOW 16.1 KM AND TURN LEFT. FOLLOW 12.8 KM AND TURN LEFT. FOLLOW 3.2 KM TO TIEPOINT ON SOUTHSIDE OF RD. 75M@ 160' TO CENTER OF PLOT 1 TREATMENT AREA
3	Canfor	FROM G.P. GO SOUTH ON HWY 40, 36 KM AND TURN LEFT ONTO CANFOR ROAD AND GO 43 KM (AT SIGN 2-92)TO THE FORESTRY TRUNK ROAD. GO ON 45 KM TO TP. (JUST IN FRONT OF WESTVIEW REST AREA) TP TO NORTHWEST CORNER OF TREATMENT PLOT 3 20M@145'
4	Canfor	FROM GRANDE CACHE HEAD APPROX 25 KM SOUTH ON HWY 40. TURN NORTH ONTO FTR. (GOODWIN RD) AND FOLLOW APPROX 29 KM. TURN LEFT JUST PAST THE RED AND WHITE CANFOR SIGN (258KM) AT FORK. TIEPOINT IS 150M ON THE WESTSIDE OF THE RD JUST PAST THE FORK. TP TO NORTHEST CORNER OF TREATMENT PLOT 1 25M@310'
5	Hinton Wood Products	FROM HINTON HEAD NORTH ON WILLOW CREEK RD TO KM 19. TURN RIGHT ON D RD AND FOLLOW TO KM 36. TURN NORTH AND FOLLOW 3.2 KM. TURN NORTH AND FOLLOW 1.8 KM TO A FORK AND STAY RIGHT AT FORK AND FOLLOW FOR 300M TO TIE POINT. FROM TP GO 26M NOETH TO SOUTH-WEST CORNER OF TREATMENT #3.
6	Hinton Wood Products	FROM HINTON HEAD NORTH ON WILLOW CREEK RD TO KM 19. TURN RIGHT ON D RD AND FOLLOW TO KM 36. TURN NORTH AND FOLLOW 3.2 KM. STAY LEFT AT FORK AND FOLLOW 0.8 KM TO A FORK AND STAY RIGHT AND FOLLOW 200M TO A FORK AND STAY RIGTH FOR ANOTHER 200M TO TP ON LEFT SIDE.
7	Hinton Wood Products	FROM HINTON HEAD NORTH ON WILLOW CREEK RD TO KM 19. TURN RIGHT ON D RD AND FOLLOW TO KM 36. TURN NORTH AND FOLLOW 3.2 KM. TURN NORTH AND FOLLOW 1.8 KM TO A FORK AND STAY RIGHT AT FORK AND FOLLOW FOR 800M. TURN LEFT AND FOLLOW 700M TO TIEPOINT (BUFFER IS ROADSIDE). TP TOT SOUTHEAST CORNER OF TREATMENT PLOT 1 20M@6'
8	Hinton Wood Products	FROM EDSON GO NORTH ON HWY 748 TO AMOCO RD.TURN LEFT ON EMERSON CREEK RD AND GO 5.8 KM TO HAUL RD AND TURN RIGHT. FOLLOW 4.2KM TO PIPELINE AND PARK. WALK SOUTHEAST 150M ALONG PIPELINE TO TIEPOINT AT SOUTHSIDE WHERE PIPELINE TURNS EAST.
9	Hinton Wood Products	FROM EDSON HEAD WEST ON HWY 16 TO HWY 47 20.5 KM SOUTH TO SUNDANCE ROAD (SD). GO 19.6 KM THEN TURN RIGHT AND CONTINUE 2.3 KM TO FORK. AT FORK KEEP LEFT AND GO 1.6 KM TO CLEARING ON WEST SIDE OF ROAD. TP ON NORTHWEST CORNER UP CLEARING. FROM TP TO SOUTHWEST CORNER OF TREATMENT #1 GO 83M AT 290 DEGREES.
10	Hinton Wood Products	FROM HINTON TAKE ROBB RD TO KM 75 AND INTERSECTION OF "O" RD. STAY LEFT AND CONTINUE 800M AND KEEP RIGHT AT FORK. CONTINUE 5.5KM UNTIL TIEPOINT ON SOUHTHSIDE OF RD.TIE POINT TO NORTH WEST CORNER OF TREATMENT PLOT 1, 25M @192'

11	Hinton Wood Products	FROM HINTON HEAD SOUTH ON THE ROB ROAD 27KM TO THE GREGG RIVER ROAD (G). FOLLOW (G) ROAD 7 KM AND TURN LEFT ONTO A ROAD JUST AFTER A BRIDGE. FOLLOW 4 KMS. TP ON SOUTH SIDE OF ROAD. FROM TP TO NORTH CORNER OF TREATENT #1 GO 48M@ 120'
12	Hinton Wood Products	FROM HINTON HEAD 20.5 KM SOUTH DOWN ROBB RD THEN TURN RIGHT ONTO MCLEOD CLASS 3 RD THEN 2.5KM TO T.P. ON RIGHT. THEN TRAVEL 50M AT 310 DEGREES.
13	Millar Western	FROM WHITECOURT HEAD NW 25.5KM ON HWY 43, THEN TURN LEFT ON WINDFALL ROAD. GO ON 15KM, TURN RIGHT 2 KM AND TURN RIGHT AGAIN FOR 750M TO TP. TP TO SOUTHEAST CORNER OF TREATMENT #1 GO 25M AT 300 DEGREE.
14	Millar Western	FROM WHITECOURT HEAD NW 25.5KM ON HWY 43, THEN TURN LEFT ON WINDFALL ROAD. GO ON 10 KM TO TP AND GO 25M AT 30 DEGREE TO SOUTHEAST CORNER OF TREATMENT#1.
15	Sundance	HWY 16 EAST OF EDSON TO WOLF LAKE ROAD. FOLLOW 81.7 KM SOUTH TO ELK RIVER ROAD THEN TURN WEST. FOLLOW .7 KM AND TURN SOUTH ONTO OIL ROAD. FOLLOW 3.7 KM AND TURN NORTHEAST ONTO OIL ROAD. FOLLOW IT FOR 4.9 KM TO A FORK THEN TURN LEFT AND GO 280 M TO TP. FROM TP GO 100M @ 270 DEGREE TO NORTHEASR CORNER OF TREATMENT #1.
16	Sundance	HWY 16 EAST OF EDSON TO WOLF LAKE ROAD. FOLLOW 81.7 KM SOUTH TO ELK RIVER ROAD. FOLLOW 0.7 KM AND TURN SOUTH ONTO OIL ROAD. FOLLOW 3.7 KM AND TURN N-E ONTO OIL ROAD. FOLLOW 4.9 KM TO FORK, STAY RIGHT. FOLLOW 1.3 KM TO FORK TURN RIGHT. FOLLOW 100M TO INTERSECTION OF PIPELINE AND ROAD. TIE POINT ON EAST SIDE OF ROAD.T/P TO CENTER OF PLOT 1, 149M@150'
17	Sundance	FROM HINTON, HEAD DOWN ROBB RD UNTIL KM 75 OR "O" INTERSECTION AND STAY LEFT. GO 800M AND TURN LEFT AT FORK. FOLLOW HAUL RD 7.2KM UNTIL IT MEETS "SD" RD AND TURN RIGHT. FOLLOW "SD" RD FOR 40.5KM AND TURN RIGHT ONTO HAUL RD. FOLLOW FOR 4.8KM TO KM 65 MARKER AND TURN LEFT. FOLLOW HAUL RD 2KM TO TIEPOINT ON EAST SIDE OF RD. TP TO NORTHWEST CORNER OF TREATMENT PLOT 4 25M@90'
18	Spray Lake Sawmills	FROM SUNDRE GO SOUTH ON HWY 760 FOR 9.7 KM, THEN TURN RIGHT 1.1 KM TO FALLEN TIMBER TRAIL. GO SOUTH 10.5 KM AND TURN RIGHT ON TWP 3-10 FOR 600M THEN TURN LEFT ON RD 5-3. GO ON FOR 2.9KM AND TURN RIGHT ON FALLEN TIMBER ROAD AND GO 14.5 KM TO DOC MILLS RD. GO 325M TO TP. FROM TP GO 100M @ 140 DEGREE TO SOUTHWEST CORNER OF TREATMENT #4.
19	Spray Lake Sawmills	FROM SUNDRE GO SOUTH ON HWY 760 FOR 9.7 KM, THEN TURN RIGHT 1.1 KM TO FALLEN TIMBER TRAIL. GO SOUTH 10.5 KM AND TURN RIGHT ON TWP 3-10 FOR 600M THEN TURN LEFT ON RD 5-3. GO ON FOR 2.9KM AND TURN RIGHT ON FALLEN TIMBER ROAD AND GO 17.9 KM TO SHELL GAS PLANT. GO 750M ON OIL ROAD TO TP AND GO 100M @ 310 DEGREE TO SOUTHEAST CORNER OF TREATMENT #4.
20	Spray Lake Sawmills	FROM SUNDRE GO SOUTH ON HWY 760 FOR 9.7 KM, THEN TÜRN RIGHT 1.1 KM TO FALLEN TIMBER TRAIL. GO SOUTH 10.5 KM AND TURN RIGHT ON TWP 3-10 FOR 600M THEN TURN LEFT ON RD 5-3. GO ON FOR 2.9KM AND TURN RIGHT ON FALLEN TIMBER ROAD AND GO 17.9 KM TOSHELL GAS PLANT. GO2.5KM ON OIL ROAD TO TP AND PLOT IS ON SOUTH SIDE. T/P TO PLOT 1 CENTER 93M@123'
21	Spray Lake Sawmills	FROM SUNDRE TAKE THE COAL ROAD AND GO ON 45.2 KM TO THE FORESTRY TRUNK ROAD, TURN LEFT FOR 18.3 KM TO THE BURNT TIMBER CAMPGROUND (TP). TP IS ON WEST SIDE. TP TO NORTHEAST CORNER OF TREATMENT PLOT 1 100M@260'

22	Sundre Forest Products Ltd.	FROM ROCKY MOUNTAIN HOUSE (JNT. OF HWY. 22 AND HWY 11) DRIVE 55.4 KM WEST, THEN TURN LEFT ON RG ROAD 12-4A. HEAD SOUTH FOR 400M TO TP. FROM TP GO 150M WEST TO NORTH EAST CORNER OF TREATMENT #1.
23	Sundre Forest Products Ltd.	FROM ROCKY MONTAIN HOUSE ON JUNCTION OF HWY 22 AND HWY 11, 71.1 KM TWARDS NORDEG AND TURN NORTH ONTO SWALE MAIN LINE, FOLLOW 1.6 KM. AT FORK STAY LEFT AND FOLLOW 9.4 KM TO TP ON NORTH SIDE OF ROAD. TP TO MIDDLE OF EAST SIDE OF TREATMENT PLOT 1 75M@ 360'
24	Sundre Forest Products Ltd.	FROM ROCKY MONTAIN HOUSE ON JUNCTION OF HWY 22 AND HWY 11, 71.1 KM TWARDS NORDEG AND TURN NORTH ONTO SWALE MAIN LINE, FOLLOW 1.6 KM. AT FORK STAY RIGHT AND FOLLOW 1.2 KM TO TP ON WEST SIDE OF ROAD. TP TO EAST CORNER OF TREATMENT PLOT 1 50M@315'
25	Weyerhaeuser (north)	FROM G. P. GO SOUTH ON HWY 40 ABOUT 60 KM TO WEYERHASER NORTH ROAD, TURN RIGHT AND GO 9.1 KM TO MAJOR JUNCTION. AT JUNCTION TURN LEFT AND FOLLOW 14.7 KM TO TP ON RIGHT SIDE. FROM TP GO 25M AT 0 DEGREE TO SOUTHEAST CORNER OF TREATMENT #4.
26	Weyerhaeuser (north)	FROM HWY 40 & KAKWA RIVER, FOLLOW HWY 40 14.8 KM NORTH TO HUSKY RD. FOLLOW 5.9KM TO FORK. TURN RIGHT ONTO RAT CREEK RD. FOLLOW 15.3KM TO FORK AND STAY LEFT ON RAT CREEK RD. FOLLOW 4.3 KM TO 'T' INTERSECTION, TURN LEFT ONTO MAIN HAUL RD. FOLLOW 7.5 KM AND TURN LEFT ONTO PINE RDG. RD. FOLLOW 5.5 KM TO FORK AND TURN RIGHT 900M TO TP.
27	Weyerhaeuser (north)	FROM HWY 40 & KAKWA RIVER, FOLLOW HWY 40 14.8 KM NORTH TO HUSKY RD. FOLLOW 5.9KM TO FORK. TURN RIGHT ONTO RAT CREEK RD. FOLLOW 15.3KM TO FORK AND STAY LEFT ON RAT CREEK RD. FOLLOW 4.3 KM TO 'T' INTERSECTION, TURN LEFT ONTO MAIN HAUL RD. FOLLOW 7.5 KM AND TURN LEFT ONTO PINE RDG. RD. FOLLOW 4.5KM AND TURN RIGHT ONTO BLOCK (60) RD. FOLLOW 3.7 KM TO TIEPOINT ON RIGHT SIDE OF RD (ON BEND IN RD).
28	Weyerhaeuser (south)	FROM EDSON HEAD WEST TO SCHLICK RD INTERSECTION AND TURN SOUTH ONTO HAUL RD. TRAVEL 17.5 KM AND TURN EAST AND TRAVEL 12.6 KM TO TIEPOINT(SOUTHSIDE OF ROAD).TIE POINT TO NORTH CORNER OF TREATMENT PLOT 1 50M@225'
29	Weyerhaeuser (south)	FROM EDSON, HEAD WEST ON HWY 16 APPROX 2 KM. TURN SOUTH ONTO RGE. RD. 181A AND FOLLOW FOR 17.4 KM. TURN LEFT AND FOLLOW 13.6 KM TO TIEPOINT ON SOUTHSIDE OF RD.
30	Weyerhaeuser (south)	FROM EDSON, HEAD WEST ON HWY 16 APPROX 2 KM. TURN SOUTH ONTO RGE. RD. 181A AND FOLLOW FOR 17.4 KM. TURN LEFT AND FOLLOW 15 KM TO TIEPOINT ON SOUTHSIDE OF RD.