info@fpinnovations.ca
www.fpinnovations.ca

FORT ST. JOHN TIMBER SUPPLY AREA BIOMASS AVAILABILITY ESTIMATION

CONTRACT NUMBER : 1070-20/OT20FHQ182

Kevin Blackburn

January 2020

Unrestricted

ABSTRACT:

The average harvest residue biomass yield per hectare predicted for the Fort St. John TSA is 31.5 oven-dried tonnes per hectare (odt/ha). Over the next 10 years, a total of 2.99 million odt of available biomass are predicted to be generated by harvest in the Fort St. John TSA, or approximately 300,000 odt/yr. Of this, approximately 269,000 odt in total, or 27,000 odt/yr, is expected to be economically available at a price of $60 per oven-dried tonne. Approximately 75% of the total predicted volume is expected to be available at $90/odt, representing a total of 2.25 million odt, or 225,000 odt/yr.

301013814: PROJECT NAME

TYPE OF REPORT

ACKNOWLEDGEMENTS

This project was financially supported by the Ministry of Forests, Lands, and Natural Resource Operations, Innovation, Bioeconomy and Indigenous Opportunities Branch

The author(s) would also like to thank Mehdi Bagheri and Qinglin Li

APPROVER CONTACT INFORMATION

Charles Friesen

Senior Researcher

Charles.friesen@fpinnovations.ca

REVIEWERS

Charles Friesen, Senior Researcher, Fibre Supply

Jean-Francois Gingras, Industry Sector Leader

AUTHOR CONTACT INFORMATION

Kevin Blackburn

Technologist

Fibre Supply

(604) 222-5717

kevin.blackburn@fpinnovations.ca

EXECUTIVE SUMMARY

Forest-origin harvest residue biomass estimates were made by FPInnovations for the Fort St. John Timber Supply Area (TSA), largely following the process previously established for several BC TSAs using FPInterface (2010-2019). The biomass inventory was based on 10-year harvest and road network plans for Crown land provided by the BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) and excludes Tree Farm Licenses, Community Forest Agreements, and First Nations tenures.

The average harvest residue biomass yield per hectare predicted for the Fort St. John TSA is 31.5 oven-dried tonnes per hectare (odt/ha). (Table 4 from the text, follows.)

Biomass Yield
31.5 odt/ha

The biomass ratio, which is the ratio of recovered biomass to recovered merchantable roundwood, is estimated at 21.2%. Over the next 10 years, a total of 2.99 million odt of available biomass are predicted to be generated by harvest in the Fort St. John TSA, or approximately 300,000 odt/yr. Of this, approximately 269,000 odt in total, or 27,000 odt/yr, is expected to be economically available at a price of $60 per oven-dried tonne. Approximately 75% of the total predicted volume is expected to be available at $90/odt, representing a total of 2.25 million odt, or 225,000 odt/yr. (Table 5 from the text, follows.)

Biomass Available (odt)		
at $60/odt	at $90/odt	total ($200/odt)
268,745	2,249,589	2,997,082
per year	per year	per year
26,875	224,959	299,708

An alternate scenario was run by adding a destination in Fort Nelson, even though it currently has no operating mill. At the economic rate of $60/odt it increases availability by approximately 111,000 odt over 10 years, or about 11,100 odt/yr.

Most biomass considered economically available (<= $60/odt) is closer to the delivery points (Fort St. John and Chetwynd) in the southern part of the TSA. The amount of economically available biomass remains relatively consistent through time from approximately 25,000 odt/year in the first 5 years to 28,000 odt/year in the last 5 years.

TABLES OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Forest-origin harvest residue biomass estimates were made by FPInnovations for the Fort St. John Timber Supply Area (TSA), largely following the process previously established for previous BC TSAs using FPInterface (2010-19). The biomass inventory was based on 10-year harvest and road network plans for Crown land provided by the BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) and excludes Tree Farm Licenses (TFLs), Community Forest Agreements (CFAs), and First Nations tenures. Detailed introductory statements applying to this project and the greater project as a whole may be found in the report "Estimating Quesnel Biomass Supply Using FPInterface®." It is hoped that the information in this report will assist in understanding biomass availability for industrial proposals**.**

2. OBJECTIVE

The objective of the project was to calculate the cost of forest-origin biomass as a feedstock in the Fort St. John TSA.

Specific deliverables include:

a. An analysis showing the delivered cost of biomass from point of origin; and
b. An analysis showing the amount of biomass delivered at different price points. A value of $60 for one oven-dried tonne (odt) is regarded as the current market value for biomass, in accordance with the previous analyses.

3. METHODS

1.1 Overall Process

The basic methodology for determining biomass supply in western Canada was established during analysis of the Quesnel and Williams Lake Timber Supply Areas (TSAs). It is reviewed below.

The analysis focused on the Fort St. John TSA and was based on polygon data (tree characteristics) and a road data set supplied by the Ministry. It did not include any nearby woodlots, CFA's, or any First Nations tenures. Including some of these areas could alter the available supply of biomass.

Additionally, stands with small piece size that are not considered merchantable were not included in the analysis. The analysis focused on recovering harvest residues from merchantable stands. Purpose-harvesting unmerchantable stand for biomass could add to the biomass supply and further analysis could be undertaken to determine its profitability. Recent analysis has shown that harvesting these stands is not yet profitable.

The following process map (Figure 1) graphically displays the steps taken to build the final inventory of economically available biomass for the Quesnel TSA. A similar process was used for the Fort St. John TSA.

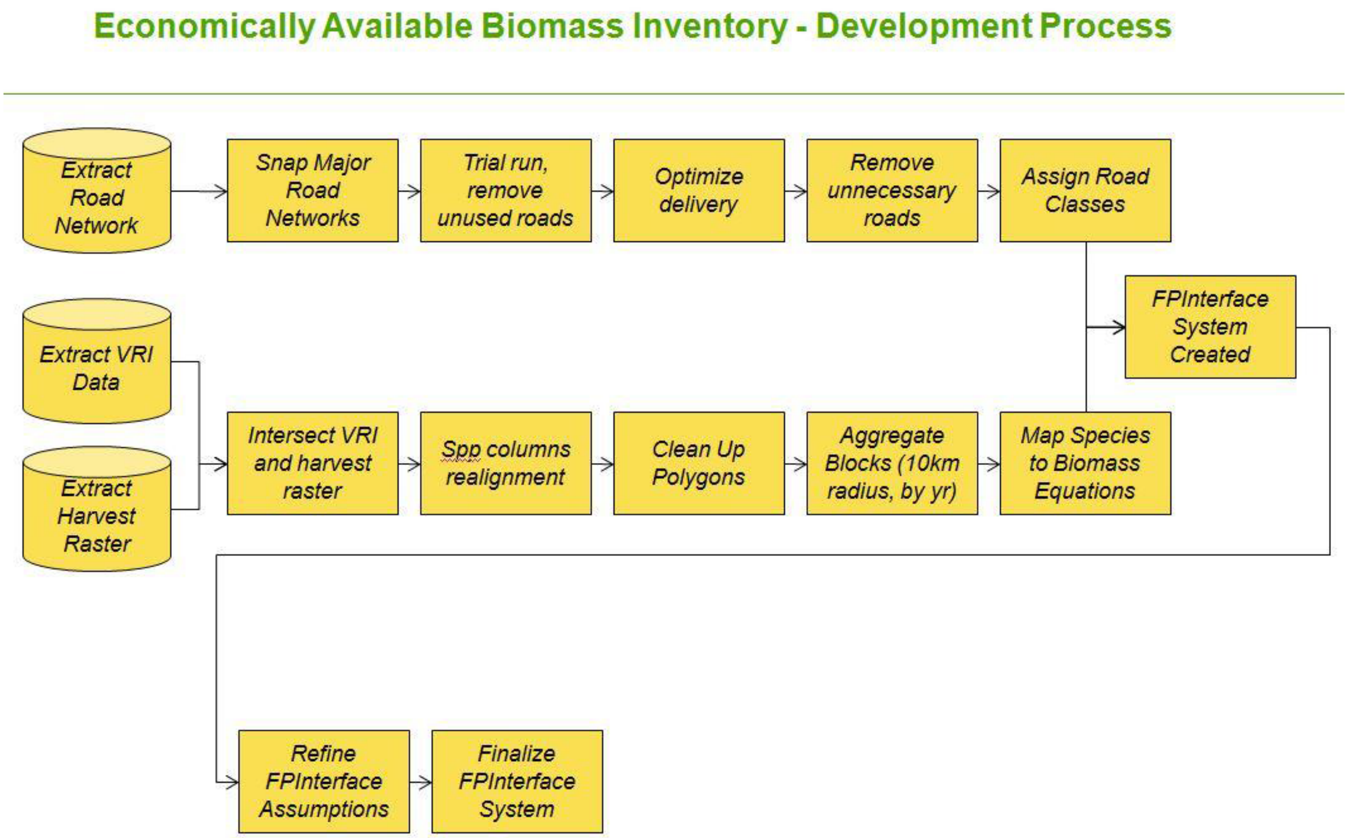

Figure 1. Inventory development process for economically available biomass.

1.2 Data Acquisition

Data layers were acquired from the Ministry for the Fort St. John TSA (excluding woodlots, CFA areas, and any First Nations tenure areas), including VRI (Vegetation Resource Inventory) polygons with attributes, and road linework with attributes. The polygon data was for 10 years of harvest in two five-year periods.

The total 10-year harvest raster is a point in time snapshot. It indicates which polygons are expected to be harvested in the next 10 years. No attempt was made to model possible growth or mortality during the 10-year horizon. Any projections of growth or mortality are already accounted for in the harvestable proportion contained in the harvest raster data.

1.3 Data Transformation

FPInterface requires two major inputs – a polygon layer of harvestable blocks with attributes, and a road layer. The polygon layer must also have a harvest raster built into it, indicating which polygons are to be cut in which time period. To calculate biomass amounts, FPInterface requires both tree size data (or height and dbh (diameter at breast height)) and either stand density (stems per ha) or volume per ha by species in each polygon. When the polygon layer is uploaded, it is necessary to tie species in the resultant to FPInterface species.

In order to speed calculations, polygons with little or no merchantable volume were removed from the resultant. Some of these polygons resulted from the process of intersecting the VRI and the harvest raster layers. Aggregation rules meant some blocks were grouped if they had an identical harvest period.

FPInterface calculates cost in part by finding a transport route from product origin in a polygon (block) to the mill or delivery site. It relies on a continuous path along the road network. If digital road segments are not joined together (snapped), the program is not able to find a path between block and mill, or may find a sub-optimal circuitous path.

Examination of the received data set showed that road snapping was required. A program was used to identify gaps in the road network and close them.

1.4 Biomass Equations

To perform the analysis, tree species indicated in the inventory are tied to single-tree biomass equations in FPInterface. For the Quesnel analysis in 2010-11, these equations were based on “Canadian national tree above ground biomass equations” by Lambert, M.C., C.H. Ung, and F. Raulier, 1996-2008. Although this equation set includes trees from all across Canada including western and northern Canada, there were very few samples from BC. More recently, Lambert et al. have released tree equations for BC (accepted by the BC ministry) and these were incorporated into FPInterface for the Williams Lake and subsequent analyses, including this one.

1.5 FPInterface Parameters

1.5.1 Tree species associations

Species associations were made as follows in Table 1.

Table 1. Species associations

FPInterface species	System label	Named	Original data set
Spruce, White	Sx	White Spruce	S, Sb, Sw, Sx
Aspen, trembling	AT	Trembling Aspen	ACT, AT, ACB
Fir, alpine	BA	Subalpine Fir	BA, BL
Larch, western	LW	Western Larch	LW, LT
Poplar	AC	Poplar	AC, AX
Pine, lodgepole	PL	Lodgepole Pine	PL, PLI
Birch, paper	EP	Paper Birch	EP

1.5.2 Road classes

Unlike the Quesnel dataset, there were no road classes contained in the road data set. However, FPInterface has the ability to assign road classes based on the amount of volume hauled over each section of the road. The volume hauled is for merchantable volume as calculated by FPInterface. The volume and speeds associated with each road class were assigned according to Table 2.

Table 2. Road class associations

FPInterface road class	Minimum volume (m^3)	Maximum volume (m^3)	Road speed (95% / 85%*)
Paved	1,000,001	25,000,000	90 km/h (86 / 77)
Class 1 (off highway)	0	0	70 km/h (67 / 60)
Class 1	500,001	1,000,000	70 km/h (67 / 60)
Class 2	250,001	500,000	50 km/h (48 / 43)
Class 3	125,001	250,000	40 km/h (38 / 34)
Class 4	4,001	125,000	20 km/h (19 / 17)
Class 4 (operational)	0	0	20 km/h (19 / 17)
Class 5 (winter)	0	4,000	20 km/h (19 / 17)

* percent of posted speed

1.5.3 General parameters

The price of fuel can have significant impacts on model results. Some equipment in the model can use diesel and some is eligible for marked fuel. A price of $1.25/litre was assigned which is slightly higher than current rates for diesel but approximates a medium-term average.

The program's default values for productivities and costs of forestry equipment rely on FPInnovations studies and information. If a user has specific values or costs they wish to apply to any phase or machine, these can be used instead of the defaults. For this project, only the default values were used.

Average slope for the area was assigned to CPPA Class 3 (20-32%). Ground strength was rated CPPA Class 2 (good), and ground roughness was rated CPPA Class 2 (slightly even).

1.5.4 Comminution cost

Working time for BC conditions was based on previous base case studies and consists of one 12-hour shift per day, 200 days per year. Grinder utilization was set at 60% and fuel used per productive machine-hour for the grinder was the standard 135 L/PMH (litres per productive machine hour). These are the standard base case parameters used in past FPInnovations studies and enable comparisons to those studies. Here, they produced a grinding cost of $26.82/odt.

1.5.5 Topping diameter

Although BC regulations require a topping diameter of 10.0 cm for most merchantable species, this analysis used 12.5 cm to reflect more common industrial practise. Topping diameter can have a significant impact on the volume of a tree available for biomass use.

1.5.6 Parameters as entered into FPInterface

A summary of some of the parameters as entered into FPInterface follows for the base case, which produces grinding costs of $26.82/odt (Table 3).

Table 3. FPInterface parameters

Run Descriptor	Base Case - Default Grinding Efficiency
run name	Fort St. JohnV1
output name	Biomass - Fort St. JohnV1
block system	Blocks_FortStJohn.shp
road system	Roads_DawFSJ.shp
transfer yard(s)	Chetwynd, Fort St. John
cost per transfer yard, respectively	0
year(s) analyzed	All
species attribute linking	BC
automatic assignment of road class by volume	Yes
road maintenance	Yes
haul speeds	Graduated
haul speeds at 95% / 85% of posted	Yes
transport shifts / day	1
transport hours / shift	12
transport days / year	200
transport fuel price / litre	$1.25
ground strength	2 - good
ground roughness	2 – slightly even
average slope %	20-32
slash used for biomass	Yes
full stem used for biomass	No
chip destination	Chetwynd, Fort St. John
topping diameter	12.5 cm
truck used for logs	Tridem B-train
truck used for chips	3-axle
harvesting fuel price / litre (x3)	$1.25
harvesting shifts / day (x3)	1
harvesting hours / shift (x3)	12
harvesting days / year (x3)	200
harvesting system	full tree with roadside processing
felling & processing	mechanized and bunched
skid type	skidder with grapple
type of roadside processing	cut-to-length

on site biomass treatment (roadside)	comminution
recovery season	Winter
slash freshness	>3 months
slash pre-piled at roadside	Yes
grinder size type	horizontal 600 kW
biomass fuel price / litre (x2)	$1.25
biomass hours / shift (x2)	12
biomass shifts / day (x2)	1
Biomass days / year (x2)	200
grinder efficiency	60%
Grinder fuel use (L/PMH)	135
indirect costs - biomass ($ value)	$0.00
indirect costs - harvesting ($ value)	$0.00

1.6 Delivery Locations

All harvest residues from in-woods operations (not from mills) were directed to large industrial areas in or near the Fort St. John TSA. In this model, Chetwynd and Fort St. John were used as delivery locations due to having mills in their communities. An additional system run was completed using Fort Nelson as an added destination. Fort Nelson currently has no mills in the community, however there is a possibly that one opens in the next 10 years. Initial comminution was set to take place at roadside, and costs are calculated for biomass trucked to the delivery locations.

1.7 Biomass Calculations

The biomass calculations in FPInterface produce a volume of total available biomass once merchantable roundwood has been removed. For this project, only biomass transported to roadside was considered recoverable while biomass likely to remain at the stump or dispersed on the cutblock was not. Once it is transported to roadside, some biomass becomes unavailable due to handling and technical losses. The remainder is considered recovered biomass. Figure 2 shows this breakdown with the numbers from the 10-year harvest of the base case with normal grinder utilization of 60% and fuel usage of 135 L/PMH.

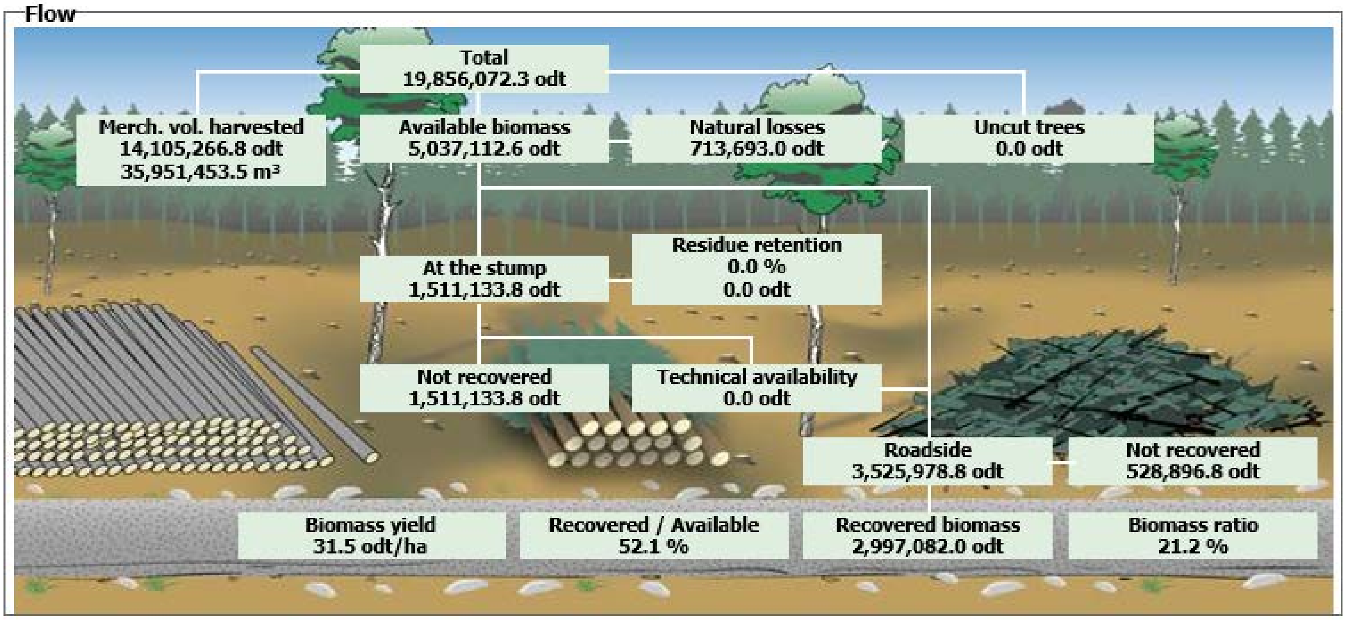

Figure 2. Recoverable biomass at delivery locations.

4. RESULTS AND DISCUSSION

1.8 Summary of Key Results

All results from the different runs performed in FPInterface are summarized in Appendix 1. The FPInterface analysis of biomass supply in the Fort St. John TSA, based on inventory information and the road network supplied by the Ministry, indicates an average biomass yield of 31.5 oven-dried tonnes (odt) per hectare for the base case. This is in the form of comminuted hog fuel and comes from harvest residues only – tops, branches, and other roadside logging waste. Mill residues are not predicted by the model. Biomass yield is shown in Table 4.

Table 4. Biomass yield for Fort St. John TSA

Biomass Yield
31.5 odt/ha

1.8.1 Biomass amounts

In total, for the base case (two delivery locations : Fort St. John and Chetwynd) there are predicted to be 2,997,082 odt that can be recovered from roadside and trucked to the delivery locations over the course of 10 years. The amount of available biomass is relatively consistent throughout both 5-year periods. The first 5-year period has the lowest amount of available biomass, possibly due to a lower planned harvest area and/or a lower biomass ratio of 20.8% compared to 21.7%. The amount of biomass available each year works out to approximately 300,000 odt/yr, for all price points in the study area. The amount of biomass available in each 5-year period varies from 291,000 odt/yr in period 1 to 309,000 odt/yr in period 2. Key amounts of biomass availability for three price points are shown in Table 5. The economically available volume at $60/odt is estimated at 27,000 odt/year, as described below.

Table 5. Key availability amounts

Biomass Available (odt)		
at $60/odt	at $90/odt	total ($200/odt)
268,745	2,249,589	2,997,082
per year	per year	per year
26,875	224,959	299,708

Additionally, the model indicates that there are about 2,200,000 odt of biomass that would be left on the cutblock and would not make it to roadside. This is approximately 74% of the amount removed for biomass and includes material that falls off trees naturally and material that breaks off timber and is left on the ground during normal harvesting operations. This vast amount of material retained in the forest is much higher than that deemed necessary to replenish the forest floor and prevent nutrient degradation to the soil. Additionally, 530,000 odt of biomass material that makes it to roadside is not recovered due to technical handling efficiencies, that is, the material is too small or large for machine handling or is incorrectly positioned for economic accessibility.

1.8.2 Biomass ratio

The biomass ratio (BR) is the ratio of recovered biomass to recovered merchantable roundwood. The BR is 21.2% for the base case scenario. In this case 14,105,266 odt of roundwood are expected along with 2,997,082 odt of biomass. The BR is shown in Table 6.

Table 6. Biomass ratio

Biomass Ratio	
2,997,082	odt of biomass
14,105,266	odt of roundwood
21.2%	

Knowing the biomass ratio for an area can be useful in making rough predictions of the amount of available harvest residue if the amount of merchantable timber harvest is known.

1.8.3 Cost availability

FPInterface conveniently breaks down the available supply into delivered cost in $10 increments. At the presumed market rate of $60/odt, the amount available over 10 years is predicted at 268,745 odt or about 27,000 odt per year. The complete results in $10 increments for the entire 10 year period can be seen below in Table 7 and Figure 3.

Table 7. Fort St. John biomass 'cost-availability' for base case

Base Case		
Cost $/odt	Odt Available	Odt/year
10	-	-
20	-	-
30	-	-
40	-	-
50	22,818	2,281.8
60	268,745	26,874.5
70	989,928	98,992.8
80	1,594,657	159,465.7
90	2,249,589	224,958.9
100	2,601,781	260,178.1
110	2,764,051	276,405.1
120	2,853,869	285,386.9
130	2,901,211	290,121.1
140	2,928,031	292,803.1
150	2,971,219	297,121.9
160	2,985,425	298,542.5
170	2,987,184	298,718.4
180	2,987,184	298,718.4
190	2,995,638	299,563.8
200	2,997,082	299,708.2

The amounts are cumulative. So the amount available at $60/odt, for example, includes all the biomass at $50/odt and the additional biomass available between $50 and $60 per odt.

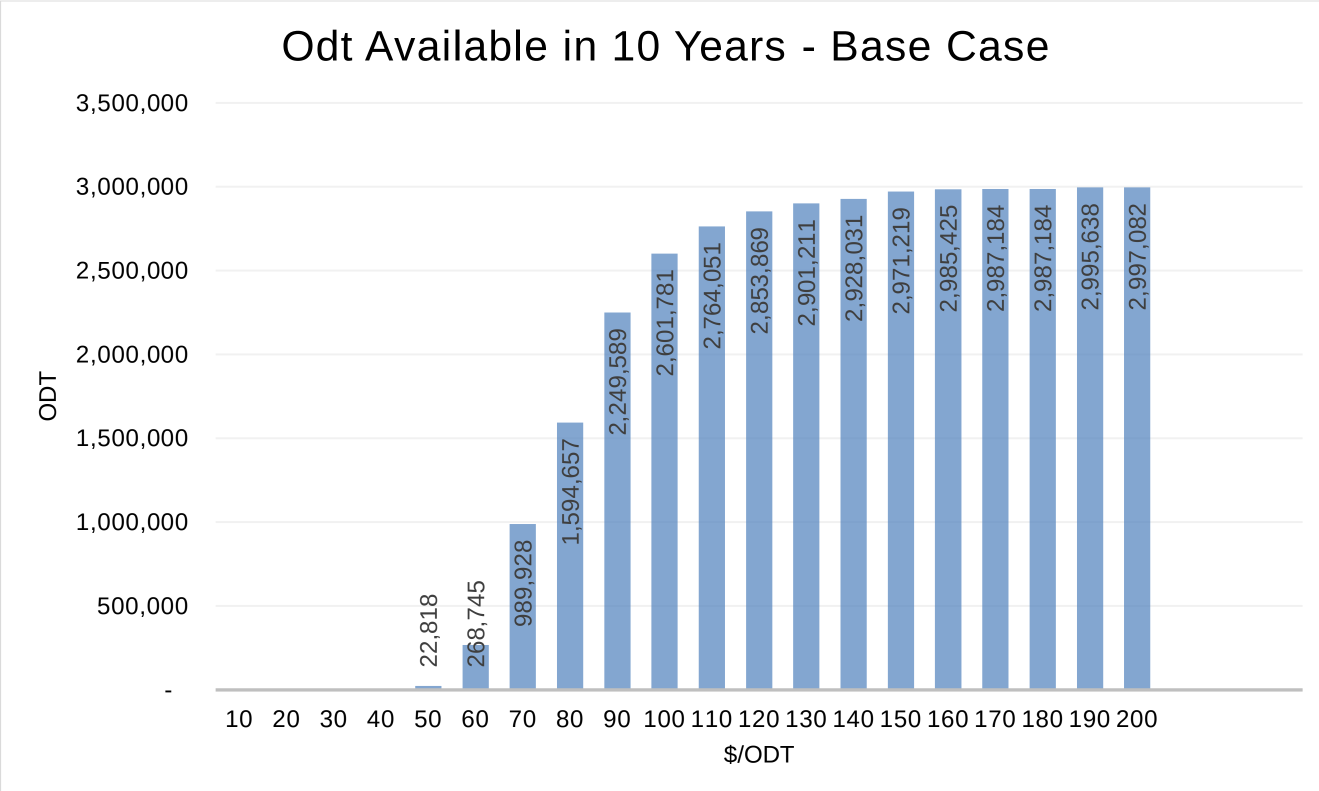

Figure 3. Fort St. John biomass 'cost-availability' in base case.

1.8.4 Fort Nelson scenario

In addition to the base case scenario, a scenario with an added delivery location in Fort Nelson was examined. Although there is currently no mill in Fort Nelson, the high volume of merchantable wood in the region warrants a closer look at this scenario and how this affects the biomass availability at different price points. The additional delivery location in Fort Nelson changed the amount of economically available biomass, and produced the results in Table 8 and Figure 4, below.

Table 8. Fort St. John biomass 'cost-availability' – scenario

	Base case		Scenario – Added Fort Nelson	
Cost $/odt	Odt Available	Odt/year	Odt Available	Odt/year
$10	-	-	-	-
$20	-	-	-	-
$30	-	-	-	-
$40	-	-	-	-
$50	22,818.0	2,281.8	43,217.3	4,321.7
$60	268,745.4	26,874.5	379,871.3	37,987.1
$70	989,928.2	98,992.8	1,081,185.2	108,118.5
$80	1,594,656.7	159,465.7	1,829,811.1	182,981.1
$90	2,249,588.5	224,958.9	2,559,228.4	255,922.8
$100	2,601,780.9	260,178.1	2,864,524.6	286,452.5
$110	2,764,050.5	276,405.1	2,957,628.9	295,762.9
$120	2,853,869.4	285,386.9	2,984,452.2	298,445.2
$130	2,901,210.9	290,121.1	2,993,249.2	299,324.9
$140	2,928,031.4	292,803.1	2,996,293.1	299,629.3
$150	2,971,219.0	297,121.9	2,996,293.1	299,629.3
$160	2,985,425.4	298,542.5	2,996,293.1	299,629.3
$170	2,987,184.1	298,718.4	2,996,293.1	299,629.3
$180	2,987,184.1	298,718.4	2,997,082.0	299,708.2
$190	2,995,637.5	299,563.8	-	-
$200	2,997,082.0	299,708.2	-	-

Graphically, this is represented in Figure 4.

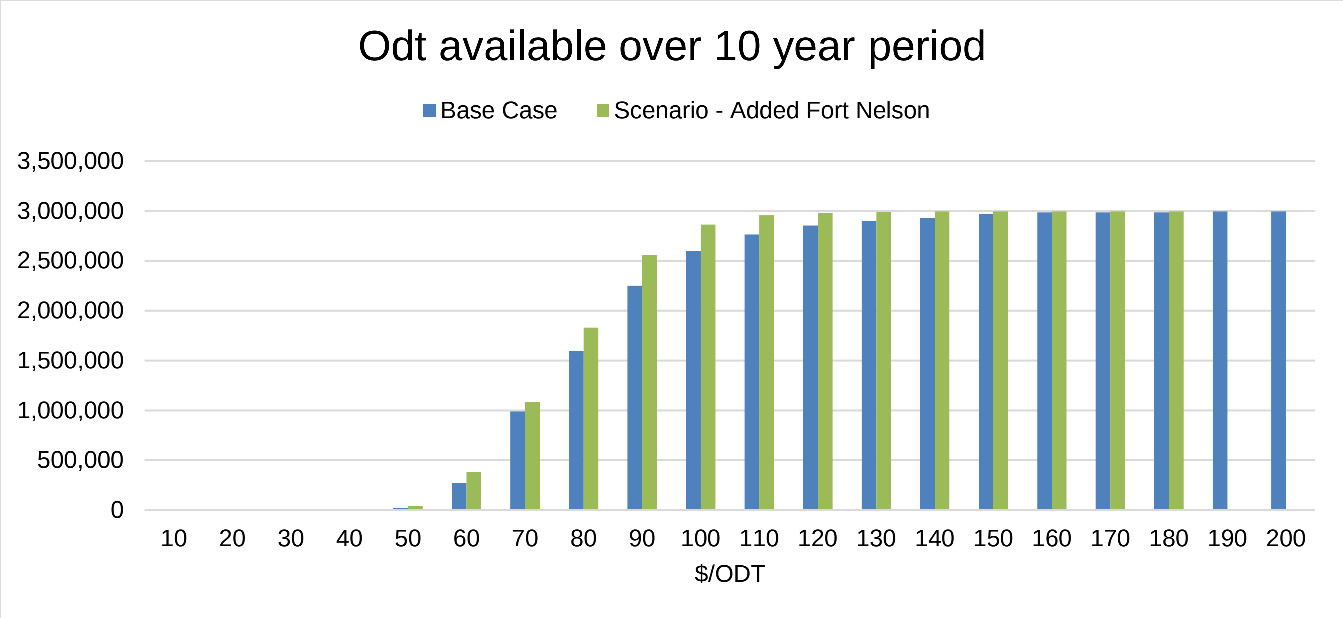

Figure 4. Fort St. John biomass 'cost-availability' – base case and Fort Nelson scenario.

The addition of Fort Nelson as a destination increased the economically available biomass by approximately 111,000 odt over 10 years or 11,100 odt per year. This difference at $60/odt, the presumed market rate for biomass, is highlighted in Figure 5.

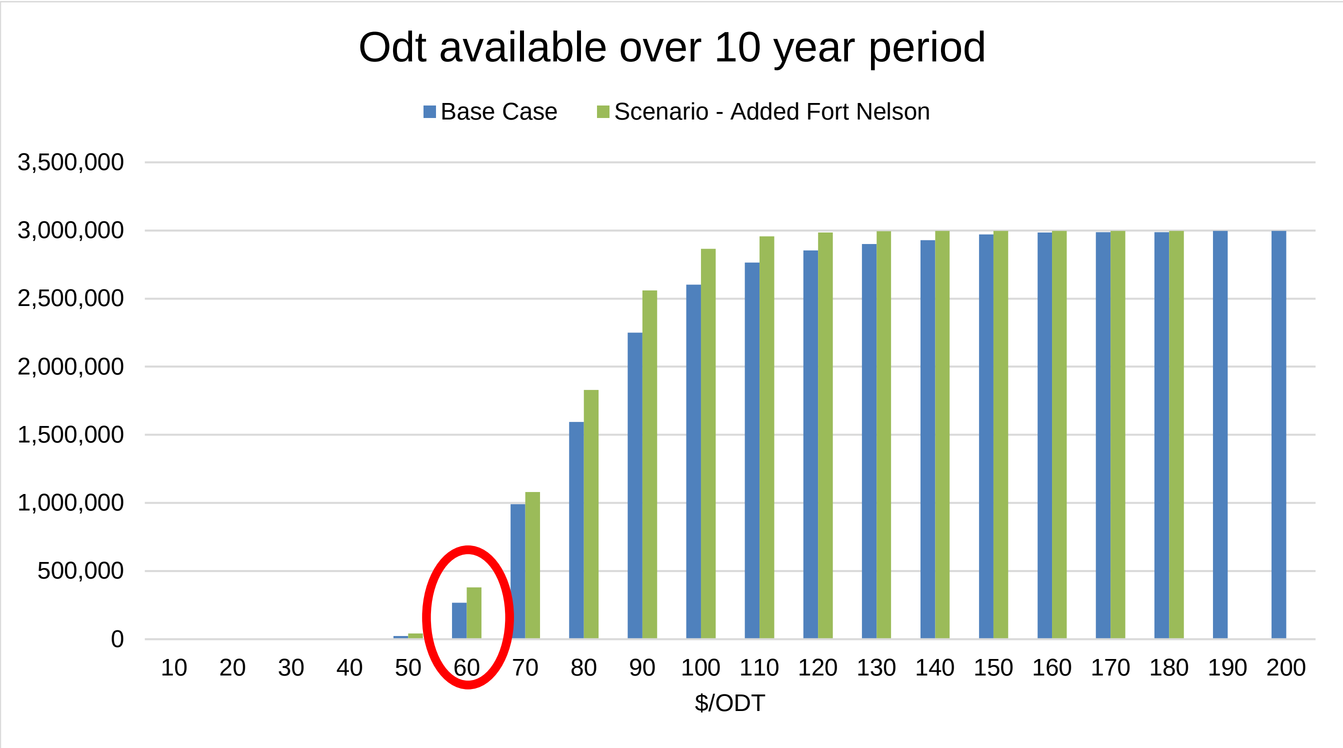

Figure 5. Fort St. John biomass 'cost-availability' – difference at $60/odt.

This means that much more biomass is available when Fort Nelson is added as a destination. The actual difference in cost per delivered oven-dried tonne of biomass is only $5.25, but the impact this has on availability is much greater because of the spatial distribution of biomass. The average price for delivered biomass across the study area is shown in Table 9.

Table 9. Average cost of delivered biomass across entire study area

Scenario	Average cost of delivered biomass
Base case	81.22
Scenario – Fort Nelson	75.97

In this case, the difference in delivered costs has been attained by decreasing the distance to the nearest delivery point. However, differences to delivered costs can also be created by changes to equipment or practices that raise or lower operating costs. For example, if greater efficiency in grinding technology is realized, it can dramatically increase the amount of biomass that is economically available, especially, at the lower price points.

1.8.5 Mapping

The distribution of costs by cutblock is shown graphically in FPInterface with a colour scale ranging from green to red, as in Figure 6 and 7, below. The costs range to $192/odt for the blocks farthest from the delivery points. The blocks are coloured in colour increments with the greenest points being the ones with the lowest delivered biomass costs, and the reddest ones being the most expensive, with a yellow transition in the middle.

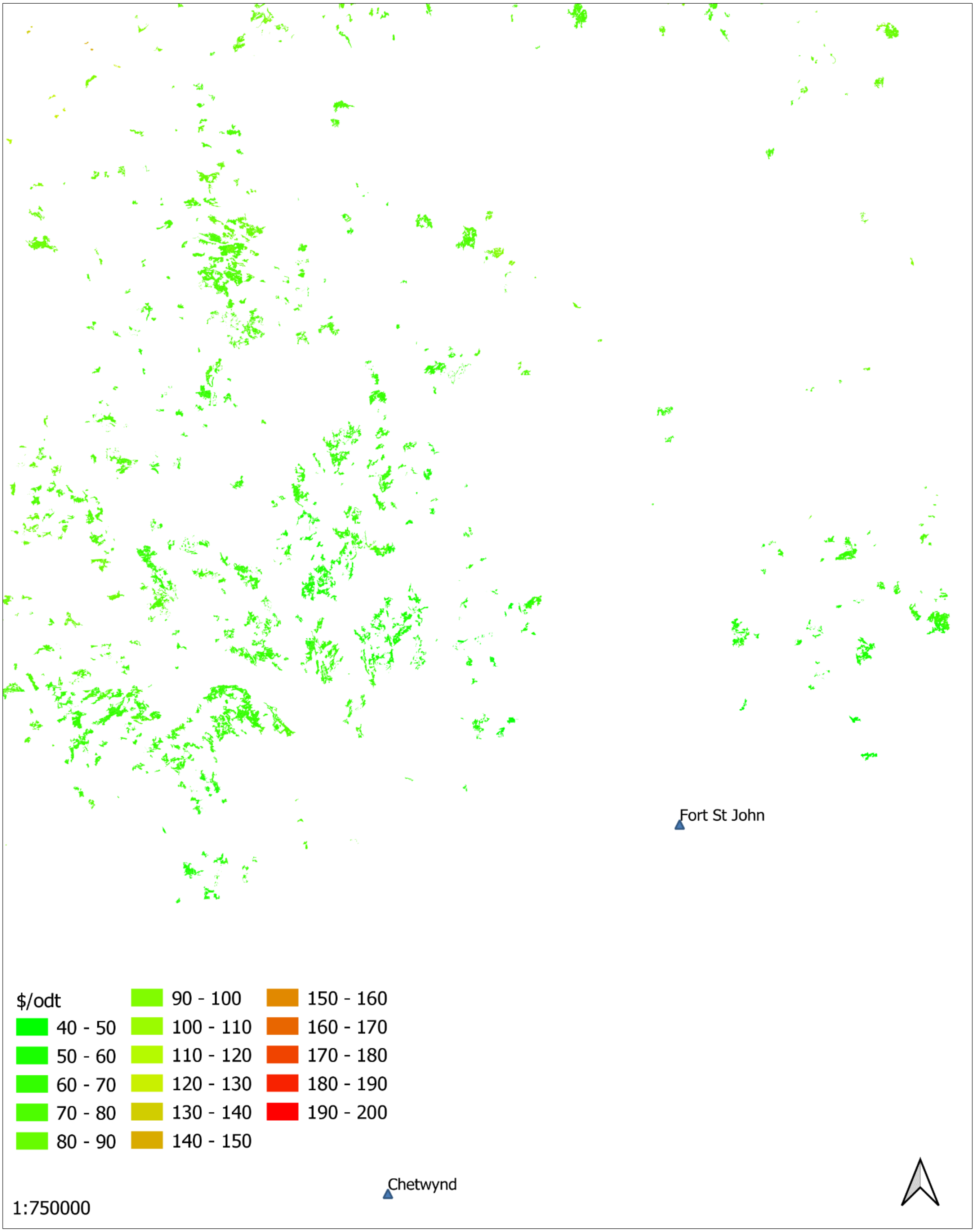
Fort St John
$/odt
40 - 50
50 - 60
60 - 70
70 - 80
80 - 90
90 - 100
100 - 110
110 - 120
120 - 130
130 - 140
140 - 150
150 - 160
160 - 170
170 - 180
180 - 190
190 - 200
Chetwynd
1:750000

Figure 6. Spatial distribution of cutblocks by delivered biomass cost per odt (South).

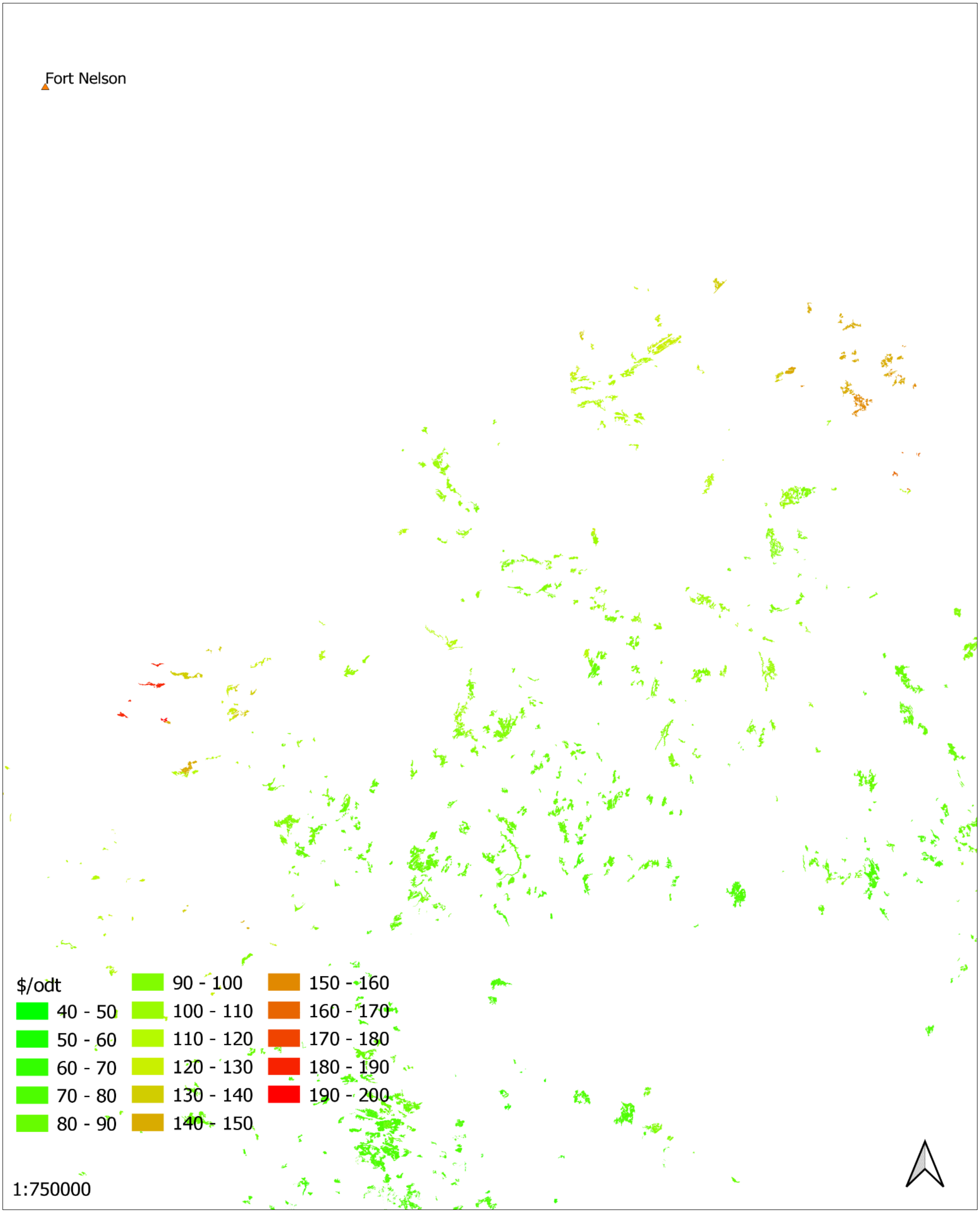

Figure 7. Spatial distribution of cutblocks by delivered biomass cost per odt (North).

The delivery points (Fort St. John and Chetwynd) are represented by the blue triangles. Fort Nelson is labelled as an orange triangle. All biomass from the study area shown in Figure 6 and 7 was scheduled for delivery to Fort St. John and Chetwynd only.

Showing the roads on the map makes it a little more difficult to distinguish the blocks but these are shown in Figure 8.

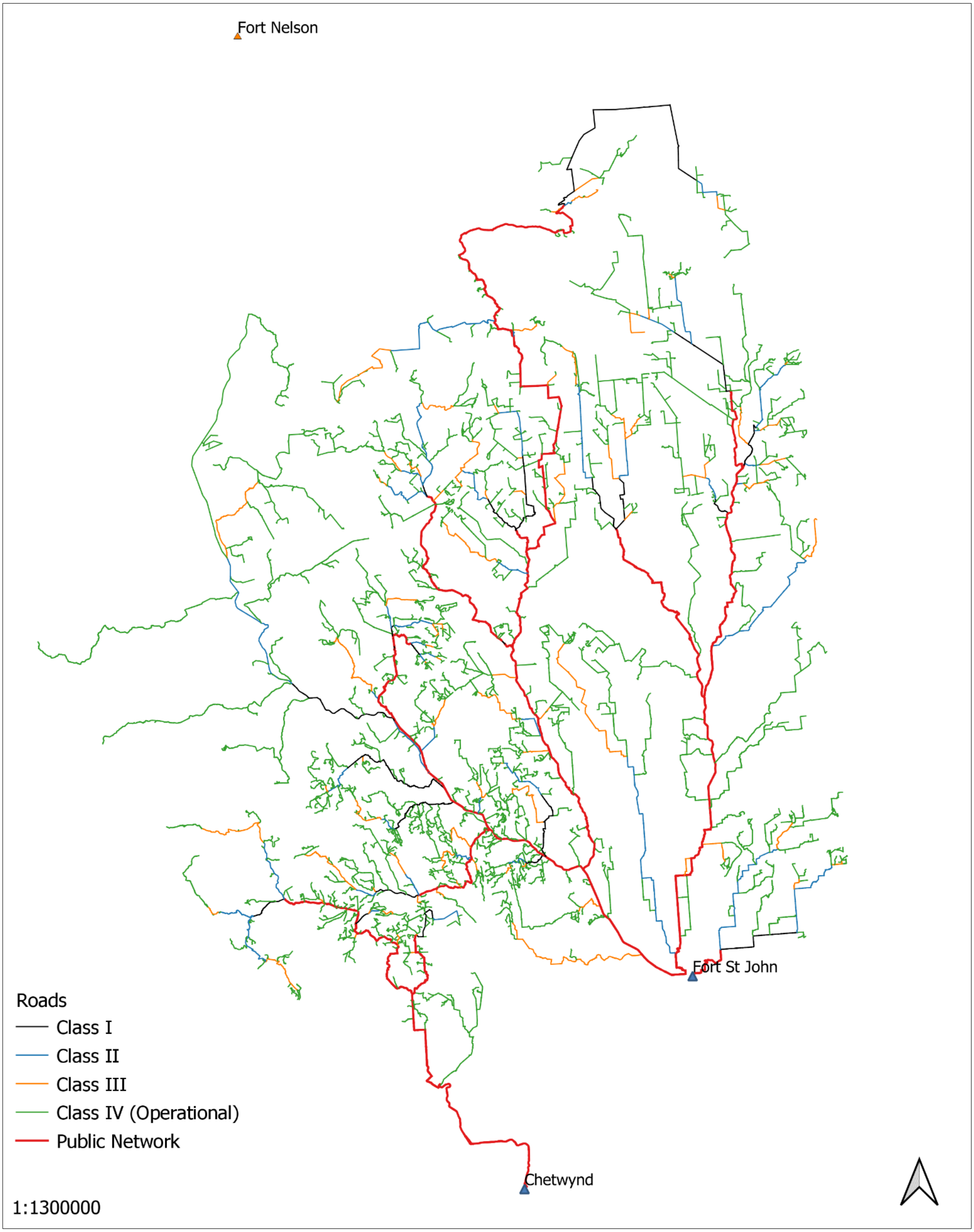
Fort Nelson
Fort St John
Chetwynd
Roads
Class I
Class II
Class III
Class IV (Operational)
Public Network
1:1300000

Figure 8. Road classification in the Fort St. John TSA.

The different colours associated with the roads represent different classes of roads. Each road class has a unique set of speed associations for loaded and empty trucks that help to determine the cycle times used to calculate the delivery cost for biomass. Most of the slowest roads are in green on this map, while the fastest ones are coloured red and black. Road class is determined by the amount of harvest volume that passes over the road. In order to reduce clutter, winter roads and roads without harvest volume were removed from the map.

1.8.6 Temporal distribution of harvest

The harvest data contains a temporal period assigned to each cutblock. There are two periods in the data representing five-year periods. The first period covers the first five years of cutblocks, and the second period covers the last 5 years.

The harvest projection shows a relative steady supply of available biomass between each harvest period, as shown in Figure 9.

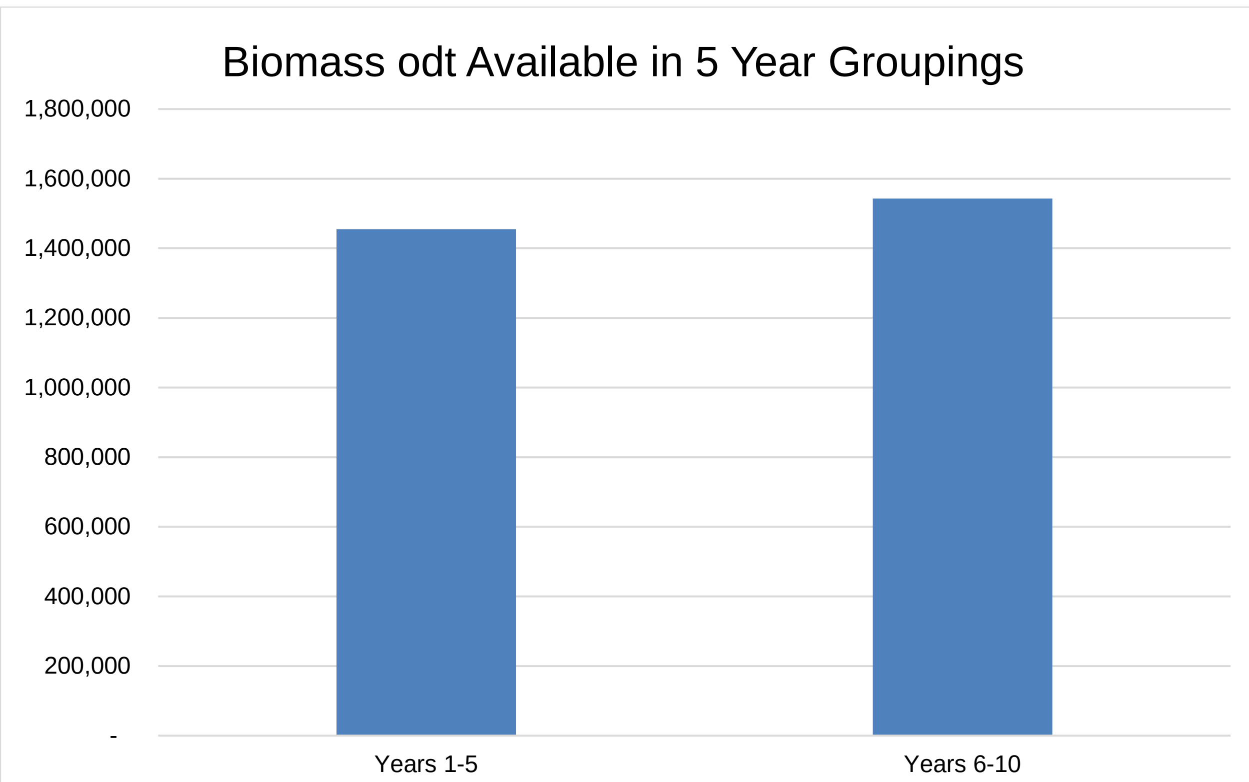

Figure 9. Biomass recoverable by period.

Looking at the economic harvest available (the amount at $60/odt) in Figure 10, the amount is comparable to the total biomass available at any price point. This suggests that the distance of the blocks to the delivery points is quite consistent between the two periods.

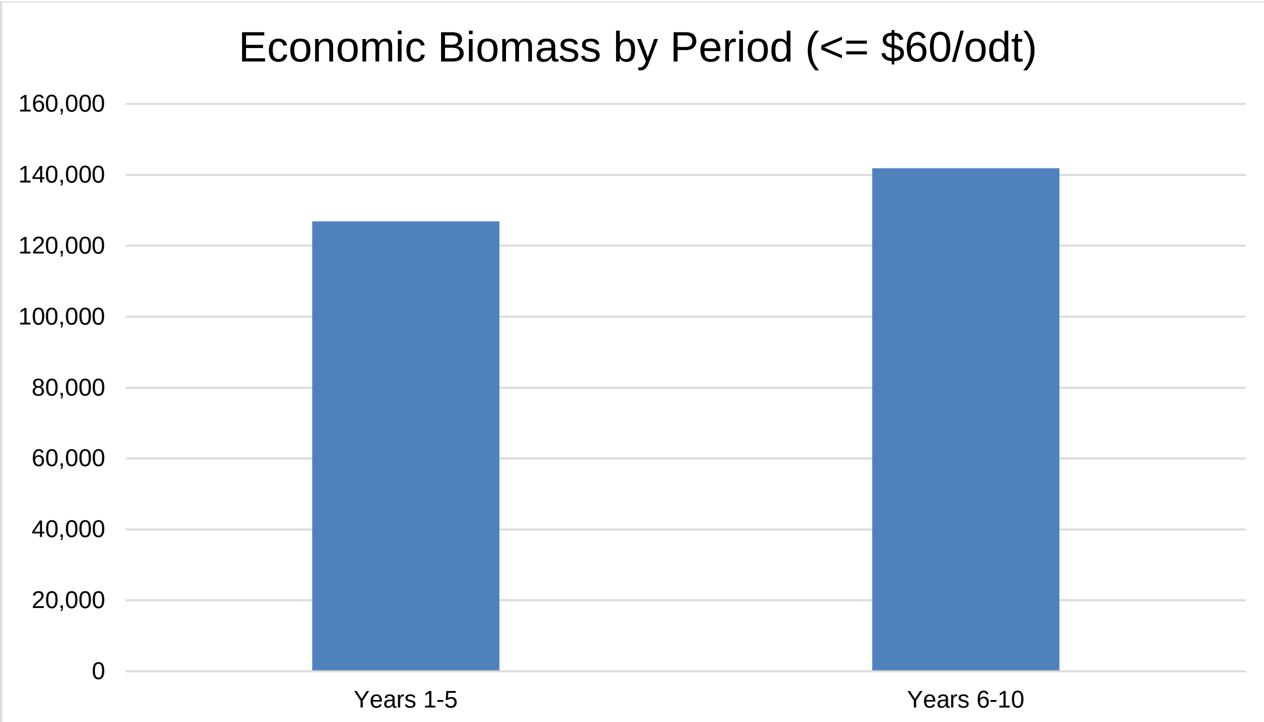

Figure 10. Economic biomass recoverable by 5-year grouping.

The data for cost availability by period at all price points in $10 increments is shown in Table 10 and 11 for both the base case and the Fort Nelson scenario. The differences in economically available biomass between periods is very small in the base case, however in the Fort Nelson scenario the economically available biomass increases by almost 14,000 odt/year in period 2. This signifies that blocks are closer to Fort Nelson during the second period.

Table 10. Cost availability by period – base case

Base Case	Period 1 - years 1-5		Period 2 - years 6-10	
Cost $/odt	Odt Available	Odt/year	Odt Available	Odt/year
$10	-	-	-	-
$20	-	-	-	-
$30	-	-	-	-
$40	-	-	-	-
$50	12,730	2,546	10,088	2,018
$60	126,855	25,371	141,890	28,378
$70	486,815	97,363	503,113	100,623
$80	770,841	154,168	823,816	164,763
$90	1,079,877	215,975	1,169,712	233,942
$100	1,266,462	253,292	1,335,319	267,064

$110	1,346,199	269,240	1,417,852	283,570
$120	1,390,746	278,149	1,463,123	292,625
$130	1,413,615	282,723	1,487,596	297,519
$140	1,415,776	283,155	1,512,256	302,451
$150	1,441,319	288,264	1,529,900	305,980
$160	1,450,134	290,027	1,535,291	307,058
$170	1,450,245	290,049	1,536,939	307,388
$180	1,450,245	290,049	1,536,939	307,388
$190	1,454,399	290,880	1,541,239	308,248
$200	-	-	1,542,683	308,537

Table 11. Cost availability by period – Fort Nelson scenario

Fort Nelson	Period 1 - years 1-5		Period 2 - years 6-10	
Cost $/odt	Odt Available	Odt/year	Odt Available	Odt/year
$10	-	-	-	-
$20	-	-	-	-
$30	-	-	-	-
$40	-	-	-	-
$50	16,455	3,291	26,762	5,352
$60	155,287	31,057	224,584	44,917
$70	526,871	105,374	554,314	110,863
$80	867,898	173,580	961,914	192,383
$90	1,213,648	242,730	1,345,580	269,116
$100	1,393,390	278,678	1,471,135	294,227
$110	1,435,102	287,020	1,522,527	304,505
$120	1,449,176	289,835	1,535,276	307,055
$130	1,452,774	290,555	1,540,475	308,095
$140	1,453,610	290,722	1,542,683	308,537
$150	1,453,610	290,722	-	-
$160	1,453,610	290,722	-	-
$170	1,453,610	290,722	-	-
$180	1,454,399	290,880	-	-

1.8.7 Results appendices

Appendices summarizing the different runs performed in FPInterface and showing the results of each run are included in Appendix 1.

5. CONCLUSION

The harvest residue biomass yield per hectare predicted for the Fort St. John TSA is on average 31.5 oven-dried tonnes per hectare (odt/ha). Over the next 10 years a total of 2.99 million odt of available biomass are predicted to be generated by harvest in the Fort St. John TSA, or approximately, 300,000 odt/yr. Of this approximately 269,000 odt in total, or 27,000 odt/yr, is expected to be available at the economic price of $60 per oven-dried tonne. Approximately 75% of the available amount is expected to be available at $90/odt: a total of 2.25 million odt, or 225,000 odt/yr. The biomass ratio, which is the ratio of recovered biomass to recovered merchantable roundwood, is estimated at 21.2%.

A scenario with an added delivery location in Fort Nelson was developed, resulting in transportation costs being reduced by $5.25/odt. At the economic rate of $60/odt, this scenario increased availability by approximately 111,000 odt over 10 years, or about 11,000 odt/yr. If further increases in efficiency or lowered cost can be realized, there could be an increase in available biomass.

Most biomass considered economically available (<= $60/odt) is closer to the delivery points. The amount of economically available biomass remains consistent throughout both periods. However, with the addition of Fort Nelson as a destination, the economically available biomass increases more during the second period, suggesting more blocks being closer to that community at the back end of the harvest schedule.