

# Dawson Forest Planning Area Timber Supply Analysis

## DATA PACKAGE

Report date: **January 24, 2018**

For the period ending: **Sep 11, 2017**

Forsite Project: **1323-001**

Report Prepared for:

**Tr'ondëk Hwëch'in  
Government;**



**Forest Management Branch,  
Yukon Government; and**



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## ***Acknowledgements***

This was a collaborative project of

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- Tr'ondëk Hwëch'in Government;
- Dawson District Renewable Resources Council;
- Yukon Environment; and
- Forsite Consultants Ltd.

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## 1 Introduction

This Data Package has been prepared by Forsite Consultants Ltd under the direction of the staff of the Forest Management Branch, Yukon Government. This document largely follows the format suggested in British Columbia's Supplemental Guide for Preparing Timber Supply Analysis Data Packages (BC Forest Analysis Branch, 2003). The Forest Management Branch is currently developing a Yukon-specific timber supply analysis (TSA) process and standards that will guide future TSA analyses.

Key persons contributing to this document, or providing input data for the analysis include the following:

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### 1.1 Background

*The Dawson area covers the traditional territory of the Tr'ondëk Hwëch'in (TH), and has an approved Forest Resources Management Plans (FRMP).*

*The Forest Management branch (FMB) of the Yukon's Department of Energy, Mines, and Resources (EMR) regulates management, compliance and enforcement of forest resources in the Yukon. To fulfill this mandate, FMB undertakes the task of developing timber supply analysis (TSA) to support FMB's Annual Allowable Cut decision. The Forest Resources Act (FRA) and Regulation's (Regulation) outline the authority and factors that must be considered as part of the AAC determination; see Section 16 (1) of the FRA and Part 3 section 24 of the Regulation. The Regulation has 18 factors to consider prior to making an AAC determination.*

*A timber supply analysis for the Dawson region is scheduled for completion under a contract.*

*(Ref: para. Forest Management Branch, 2015).*

### 1.2 Purpose

The specific purpose of this Data Package is to:

- Provide a detailed account of the land base, growth and yield, and management assumptions related to timber supply that the Director of the Forest Management Branch (FMB) must consider under the *Forest Resources Act* when determining an allowable annual cut (AAC) for the Dawson AAC Region, and how these will be applied and modelled in the timber supply analysis;
- Provide a means for communicating data inputs and analysis methodology to First Nations, forest licensees, FMB and other government agencies' staff, and other forest users;
- Ensure that all relevant information is accounted for in the analysis to a standard acceptable to the FMB staff; and
- Provide the evidentiary basis for the information used in the analysis.

### 1.3 The Timber Supply Analysis Process

The Forest Management Branch (FMB) is the lead agency for this timber supply analysis (TSA) process. The analysis process will include these components:

1. Consolidation of the timber supply-related management assumptions; (\*)
2. Data discovery and technical data consolidation, such as gathering GIS data layers; (\*)
3. Preparation of a Timber Supply Data Package Report which summarizes the data, the management assumptions, and the growth and yield methodology; (\*)
4. Technical analyses and modeling of the timber supply; (\*)
5. Summary and interpretation of modeling results, as a Timber Supply Analysis Report; (\*)
6. Determination of the AAC; and
7. Consultations with others, such as government agencies and interested groups, are expected to occur throughout the above components (\*).

The TSA Technical team will be involved in components 1 to 5, and 7 (\*), while the Director of the Forest Management Branch will make the AAC determination for non-Settlement Land (component 6).

The responsible authority for the Tr'ondëk Hwëch'in may make a determination on allowable cut on the Tr'ondëk Hwëch'in Settlement Lands.

The FMB has issued a contract to Forsite Consultants to complete the timber supply analysis for the Dawson AAC Region. Forsite's main efforts will be on the first five of the components with minor contributions to the consultations (component 7).

Forsite will also deliver a report with recommendations concerning the data preparation and the timber supply analysis process for use in subsequent analyses. This may be used, by FMB, to help establish the specifications for future timber supply analyses.

The major background information used to prepare this Data Package includes:

- *Dawson Forest Resources Management Plan (2013)*;
- *Dawson Forest Resources Management Plan Implementation Memorandum of Understanding (2014)*;
- *The Tr'ondëk Hwëch'in Final Agreement (1998)*;
- *Forest Resources Act (2008)*; and
- *Forest Regulations (2011)*.

See the References section for a more extensive list of information that was consulted when preparing this document.

### 1.4 Location of the Dawson Annual Allowable Cut Region

The Dawson Annual Allowable Cut Region is located mid-way along the western boundary of the Yukon. This is the gray shaded area in Figure 1.



Figure 1. Dawson Allowable Annual Cut Region

The major settlements in the project area are depicted in Figure 2.

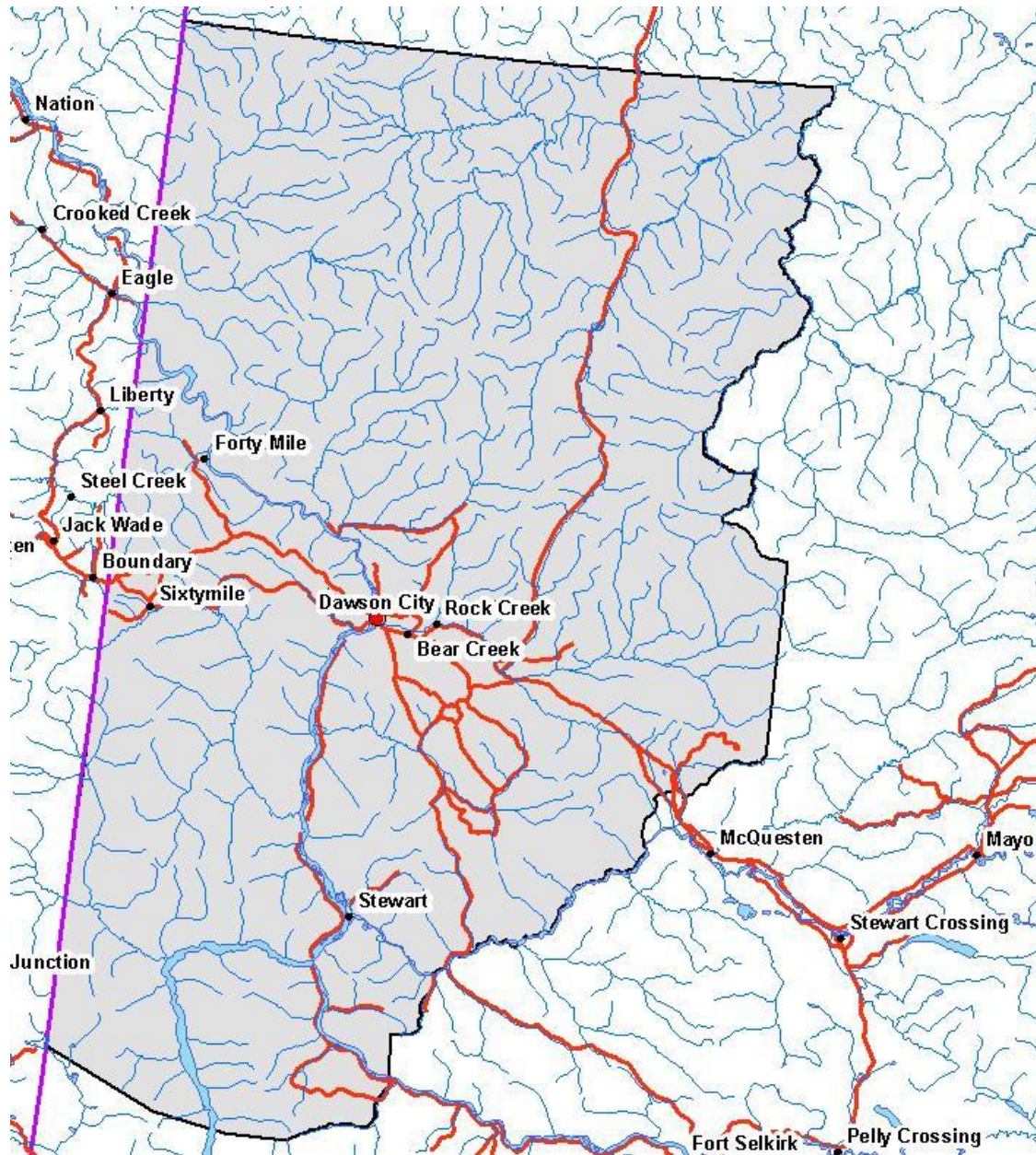


Figure 2. Overview Map of the Settlements in the Dawson AAC Region.

## 2 Inventory and Modeling Files

A GIS format inventory file has been provided to the Forest Management Branch staff for purposes of commenting on the Data Package, and for use in subsequent analysis projects.

The vegetation (forest) inventory that was used in this analysis is summarized in Table 1.

Table 1 Forest Cover Inventory

Characteristic	Description
Standards and format	ESRI file-type geodatabase, A polygon layer with its database table
Inventory date	Several unknown years of inventory, assumed year of compilation is 2006.
Field sampling	Air calls and field sampling used to help calibrate photo interpreters.
Updates	Harvest blocks as of 2015
Vegetation Inventory Manual	Vegetation Inventory Manual 2.1 (2003)

### 2.1 Base Case Option - Overview

The Base Case Option (model run) is the benchmark for the rest of the timber supply analysis. It is based on the current forest management practices within the Dawson AAC Region. This is defined by operational practices, characteristics of and natural resource values found on the landbase, current silviculture practices, and estimates of present and future growth of the forest stands.

Current management includes:

- Harvesting performance over the last 10 years;
- Management to meet requirements such as the Forest Resources Act (2008) and associated regulations, and other locally relevant legislation and policy;
- Management for non-timber resources, including biodiversity, cultural values; wildlife; fish habitat and water quality; and others.

Some of the more significant inventories include maps of:

- Yukon Vegetation Inventory (YVI), or forest inventory, completed in 2006;
- Private and Community lands, and Land Dispositions, etc.; and
- Riparian buffers for streams, lakes and wetlands.

Silviculture practices, harvesting methods and projections of current and future stand yields include:

- Definition of the operating landbase and, conversely, of non-operating areas defined by non-merchantable stands;
- Estimates of stand yields based on the BC Ministry of Forest's Variable Density Yield Projection (VDYP7) software, adjusted by estimates of the maximum-expected yields for local conditions; and
- Basic silviculture practices.

The data and assumptions that are included in the Base Case are described in detail in the following sections.

### 3 Landbase and Inventories

#### 3.1 Forest Cover Inventory

The forest cover inventory is a key component of the analyses. There is one forest cover map (data file) which covers the majority of the Dawson Allowable Annual Cut Region (AACR). The vegetation inventory was completed in 2004 using multiple years of photography listed in Table 1.

While the compilation process resulted in a common database format, in terms of the same number and types of data fields, there are discontinuities evident between the contents of the data fields on opposite sides of the join lines (i.e. across the map-sheet edges) as a result of contractor deliverables.

The inventory contains the age of the photos for each of the maps. The photos vary from 1988 to 2004 (Table 1), with 30% of the area, largely in the far north, having no forest inventory since there is little or no forest at that latitude.

Table 1 Year of Photography of the Dawson Forest Cover Mapping

Year of Photos	Area (ha)	Percent of Total
none	1,467,316	30.0
1988	893,256	18.3
1989	1,444,364	29.5
1990	251,379	5.1
1991	10,252	0.2
1993	2,722	0.1
1994	11,955	0.2
1995	1,100	0.0
1996	258	0.0
1999	95,907	2.0
2000	221,189	4.5
2002	213	0.0
2003	443,122	9.1
2004	50,424	1.0
<b>Total</b>	<b>4,893,457</b>	<b>100</b>

### 3.2 Forest Resource Inventories

The resource inventories used in the analysis process are summarized in Table 2.

Table 2 Resource inventories

Data file	Inventory	Source	Comments / Source
Daw_frm	Forest Resource Mngt Boundary	FMB	
Daw_rdb	Road Buffers	FMB	Derived from road layers
Daw_pla	Placer Permits (Active type 3 and 4)	FMB	
Daw_qtz	Quart Mine Sites	FMB	
Fna_fne	TH Landbase Exclusions	TH	
Daw_rib	Riparian Buffers	FMB	Derived from water layers
Daw_slp	Slope Class	Federal Website	Derived from federal dem
Yuk_agd	Agricultural dispositions	FMB	
Yuk_com	Communities	FMB	
Yuk_dsp	Land Dispositions	FMB	
Yuk_eco	EcoRegions / EcoDistricts	YK Website	
Yuk_fir	Fires	YK Website	Updates the forest cover
Yuk_fns	TH Settlement Land (surveyed)	FMB	
Yuk_fnu	TH Settlement Land (un-surveyed)	FMB	
Yuk_hwz	Highway reserve zone	YK Website	Derived from road data
Yuk_lic	Land Licenses	FMB	
Yuk_lnd	Landings	FMB	
Yuk_log	Logged Areas	FMB	
Yuk_lu	Landscape management Units	YK Website	
Yuk_prk	Parks and Reserves	YK Website	
Yuk_sul	Surveyed Land Parcels	FMB	
Yuk_vri	Forest inventory - YUKON	FMB	Various vintages
yuk_ws	Watersheds - 1 M	YK Website	

The inventories which most impact the landbase reductions or the forest requirements are described below in more detail.

### Ownership or Tenure

Non-contributing ownership or tenures is determined from several GIS layers, or maps (.

Table 3).

*Table 3 Non-contributing Ownership or Tenure Types*

Description	Source
Active Placer Permits	FMB
Quartz Mine sites	FMB
TH Exclusions	TH
Agricultural dispositions	FMB
Communities	FMB
Land Dispositions	FMB
Land Licenses	FMB
Surveyed Land Parcels	FMB

### Landscape Units

Landscape Units divide the TSA into geographic areas that are used for administrative and non-timber resource management. Of special note, they are used to define the strategic forest land use zones in the Dawson Forest Resource Management Plan.

### Roads Inventory

The FMB staff classified the existing road centerlines with right-of-way (ROW) widths, which forms the basis of the road buffers, which are then used as landbase netdowns, and as the basis of the highway reserve zone.

### Stream, Wetland and Lake Inventory

The FMB staff assigned riparian buffer widths to the Canvec stream, lake and wetland features. Buffers were generated for all streams, wetlands and lakes, and then used as landbase netdowns.

## 4 Exclusions from the Timber Harvesting Land Base

There are three major landbase classifications in this analysis: (1) gross landbase, (2) productive, contributing landbase and (3) timber harvesting landbase.

The area covered by the initial GIS analysis database extends past the Dawson AAC Region boundary. Those areas outside the boundary and a small amount of area that doesn't contain data required for modelling.

Table 4 are considered "non-contributing" and removed from the data, leaving the gross landbase.

The gross landbase is then "netted down" to a productive, contributing forest landbase (CFLB). The CFLB excludes "non-contributing" areas such as settlements, land dispositions and licenses where forest management does not fall under the jurisdiction of the Forest Resources Act (2008) and on lands do not contribute to the allowable annual cut (AAC). The CFLB also excludes "non-productive" areas such as water, rock, non-forested areas, and non-productive forested types. The CFLB contributes to landscape level objectives for biodiversity and other non-timber resources.

The timber harvesting land base (THLB) is the portion of the productive land base where timber harvesting occurs. The THLB excludes areas that are uneconomic for timber harvesting, parks and protected areas, "no-go" areas that are permanently set aside for other resources, and areas otherwise off-limits to timber harvesting.

Estimates are also made for future reductions to the THLB, such as future roads and landings.

In summary, the netting down of the total GIS database to gross landbase, contributing productive forest landbase (CFLB), and timber harvest landbase (THLB) is summarized in

Table 4 resulting in the net area of CFLB and THLB of 1,681,683 ha and 371,379 ha, respectively (Table 5).

Table 4 Landbase Netdown Types

Starting Area	Remove These Areas	Results In This Area	Acronym
Total Area in GIS Database	Outside, No-data, etc.	<b>Gross Dawson AAC Region Landbase</b>	<b>Gross Area</b>
Gross Dawson AAC Region Landbase	Non-contributing and Non-productive Areas	<b>Contributing / Productive Forest Land Base</b>	<b>CFLB</b>
Contributing, Productive Forest landbase	No-go areas, and Not-harvestable areas	<b>Timber Harvest Land Base</b>	<b>THLB</b>

Table 5 Land Base Areas of the Dawson AAC Region

Geographic Area	Gross Area (ha)
Total Area in Dawson AAC Region	4,893,457
Contributing / Productive Forest Land Base (CFLB )	1,681,683
Timber Harvest Land Base (THLB)	370,654

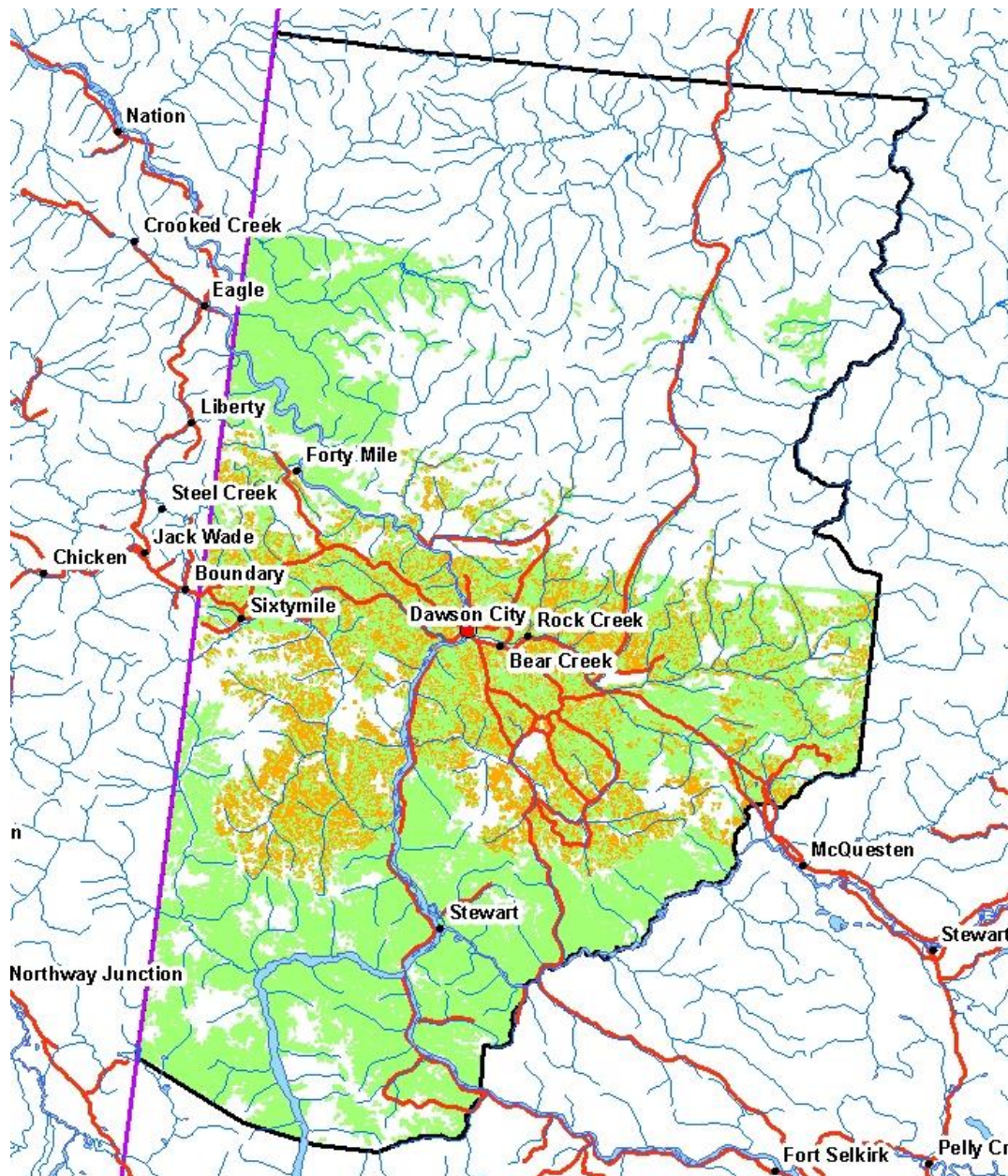


Figure 3 Dawson AAC Region Land Base

Notes: Green areas are contributing, productive forest land base (CFLB). Orange is the timber harvest land base (THLB).

Table 6 presents the individual reductions to the gross area of the Dawson GIS database to arrive at the contributing forest land base (CFLB), and the Timber Harvesting Land Base (THLB).

Table 6 Timber Harvesting Land Base Determination

Landbase / Netdown Category	Area (ha)	Landbase (ha)	Percent of Gross	Percent of CFLB
<b>Dawson FRM - Gross Area</b>	<b>4,893,457</b>	<b>4,893,457</b>	<b>100.00</b>	
<i>Contributing Forest LandBase (CFLB) Netdowns</i>				
<i>No forest inventory</i>	1,464,596		29.93	
<i>Non-Productive</i>	873,888		17.86	
<i>Non-Vegetated</i>	615,858		12.59	
<i>Site Index less than 3</i>	187,089		3.82	
<i>Agricultural Dispositions</i>	210		0.00	
<i>General Dispositions</i>	3,083		0.06	
<i>Land Licenses</i>	511		0.01	
<i>Surveyed Land Parcels</i>	5,133		0.10	
<i>Communities</i>	1,339		0.03	
<i>First Nations Land Exclusions</i>	5,186		0.11	
<i>Active Placer Leases</i>	52,946		1.08	
<i>Quartz Mining</i>	1,358		0.03	
<i>Roads and Rights-of-way</i>	1,942		0.04	
<i>Block-level landings</i>	4		0.00	
<b>Total CFLB netdowns</b>	<b>3,213,143</b>		<b>65.66</b>	
<b>Net CFLB (ha)</b>		<b>1,680,314</b>	<b>34.34</b>	<b>100.00</b>
<i>Timber Harvest Landbase (THLB) Netdowns</i>				
<i>Parks and Hinterland Areas</i>	793,568		16.22	47.23
<i>Slopes over 30%</i>	155,838		3.18	9.27
<i>Highway Buffers</i>	447		0.01	0.03
<i>Aspen Leading Stands</i>	106,919		2.18	6.36
<i>Site Index less than 10</i>	199,612		4.08	11.88
<i>Riparian Buffers</i>	53,275		1.09	3.17
<b>Total THLB netdowns</b>	<b>1,309,660</b>		<b>26.76</b>	<b>77.94</b>
<b>Gross THLB Landbase (ha)</b>		<b>370,654</b>	<b>7.57</b>	<b>22.06</b>
<i>Within-block Retention</i>	74,131		1.51	4.41
<b>Current, Effective THLB Landbase (ha)</b>		<b>296,523</b>	<b>8.66</b>	<b>26.07</b>
<i>Future Roads, Trails, Landings (5%)</i>	14,826		0.30	0.88
<b>Future, Effective THLB Landbase (ha)</b>		<b>281,697</b>	<b>8.22</b>	<b>24.77</b>

Notes:

1. All totals are subject to rounding.

2. Note that any overlaps between net-downs are discounted from the totals in the above table. Any overlap will accrue to the first (highest) category in the table. In subsequent sections the same netdown categories are discussed in more detail and both the gross and the non-overlapping areas are tabulated. The gross areas in subsequent tables may be greater than those in the above table.

## 4.1 Non-productive and non-forest area

Non-productive forest land is not capable of producing a forest stand within a reasonable length of time. This includes alpine forest, non-productive land covered with commercial species, and some deciduous and/or coniferous species.

All non-productive and non-forest stands are removed from both the THLB and the CFLB. These stands do not contribute to meeting the requirements for biodiversity or other non-timber resources. These stands are identified in the inventory using several data fields, including [land type, e.g. "non-vegetated", "Urban/Industrial"], [cover modifier, e.g. "Low Shrub"], [cover type, e.g. "Gravel Pit"], [land cover class, e.g. "lake", "urban"],

The landbase reduction for each netdown class is summarized in Table 7.

Table 7 Non-productive and Non-forest Area Exclusions

Netdown Class	Total Area (ha)	Effective Reduction Area (ha)
No forest inventory	1,464,596	1,464,596
Non-Productive	873,884	873,884
Non-Vegetated	1,443,502	615,851
Site Index less than 3	187,087	187,087
<b>Total</b>	<b>3,969,068</b>	<b>3,141,418</b>

## 4.2 Non-contributing Administrative Classes

The Lands Branch, Yukon Government maintains an updated database of geographic locations of land dispositions. Land dispositions are lands used for non-forestry applications. This includes but not limited to:

- private property,
- agriculture leases and dispositions,
- gravel pit reserves,
- road and transmission line rights-of-way,
- municipal boundaries

(Ref: Unknown. 2009)

These areas do not contribute to the productive forest landbase. They are summarized, for the Dawson Region, in Table 8.

Table 8 Non-contributing administrative classes

Netdown Class	Total Area (ha)	Effective Reduction Area (ha)
Agricultural Dispositions	302	210
General Dispositions	4,885	3,083
Land Licenses	640	511
Surveyed Land Parcels	9,422	5,132
Communities	3,521	1,339
TH Land Exclusions	7,690	5,186
Active Placer Leases	94,692	52,946
Quart Mining	2,208	1,358
<b>Total</b>	<b>123,363</b>	<b>69,767</b>

A number of parcels of land falling within the First Nations lands were identified by Tr'ondëk Hwëch'in representatives, and these areas were removed from the productive, net-landbase. These parcels are the "First Nations Land Exclusions" in the table above.

Of note, it is difficult to estimate the impact of the placer leases, since they move around the landscape over time, and only a portion of each placer lease will impact the forested area. The TSA Technical committee decided to simply remove all the active type 3 and 4 placer leases from the landbase. This is deemed to be an over-estimate of the impact of placer leases in the short term, and a reasonable estimate of their impact in the long term.

Quartz exploration areas cover a significant area on the landbase, but active disturbances are only a small portion of the exploration areas, and many of the disturbed areas are in the alpine. The Clinton Creek Mine and Viceroy Mine footprints (disturbed and deactivated quartz mine sites) were removed from the productive, net-landbase.

### 4.3 Roads trails and landings

Some of the roads are large enough to be typed as non-forest polygons on the forest cover map. These classified roads, trails or landings are not identified as roads per se, they are usually lumped with other non-forest types such as "urban". Classified roads, trails and landings that are in the forest cover inventory are, therefore, a portion of the non-forest reductions in Table 6 .

The area of existing, unclassified roads trails and landings that are not in the inventory are estimated by buffering the road centreline data to form a rights-of-way buffer layer, and including that buffer layer in the net landbase file. The reduction area for existing roads, trails and landings is summarized in Table 9.

Table 9 Reductions for unclassified roads, trails, and landings

Netdown Class	Total Area (ha)	Effective Reduction Area (ha)
Roads and Rights-of-way	5,037	1,942
Block-level landings	6	4
<b>Total</b>	<b>5,043</b>	<b>1,946</b>

The landbase reduction for future roads, trails and landings is described in section 4.3.

### 4.4 Parks and Protected Areas

The Dawson Forest Resource Management Plan divided the area into 17 different landscape units ... "using physiographic boundaries, such as watershed sub basin boundaries and forest productivity conditions. . . ."

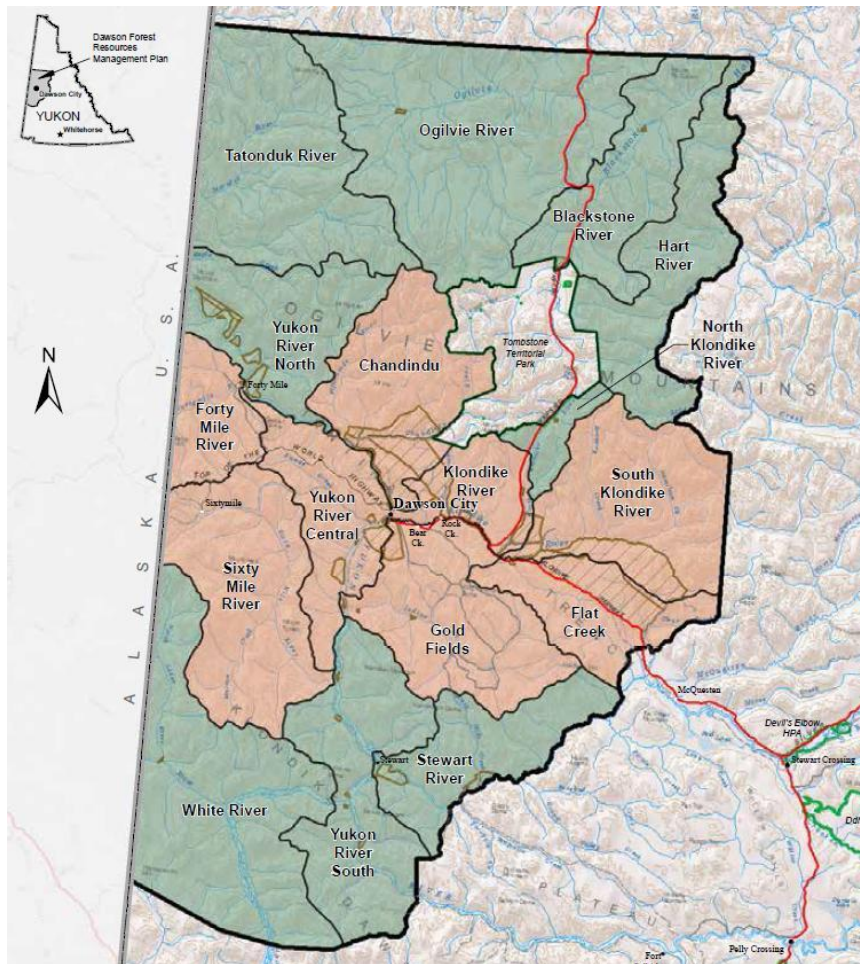
The Dawson FRMP then assigned strategic forest land use zones to the landscape units:

"Strategic forest land use zones that can be applied to the LUs include:

1) *Hinterland Forest Zone (HFZ) – not included in timber supply analysis (TSA). In this zone, small scale harvesting for non-commercial purposes may be permitted. Commercial forest operations would be limited to associated resource developments. The zone may contribute to biodiversity conservation for the entire planning area, subject to further monitoring and evaluation.*

2) *Forest Resource Management Zone (FRMZ) – the location where most forest management activities will occur.*

3) *Community Forest Development Zone (CFDZ) – includes municipal and other developed areas."*  
(ref: Dawson Forest Resource Management Plan, pg. 38)



**DAWSON FOREST RESOURCES MANAGEMENT PLAN**

Management Zoning  
October 2012

- Forest Resource Management Zone
- Hinterland Forest Zone
- Dawson Forest Resources Management Plan
- Tr'ondëk Hwëch'in Settlement Land
- Parks and Protected Areas

Figure 4 Map of Dawson Landscape Units and Strategic Management Zones

The reduction area of parks and protected areas, and the Hinterland Forest Zone is summarized in Table 10.

Table 10 Reductions for Parks and Hinterland Resource Management Zones

Netdown Class	Total Area (ha)	Effective Reduction Area (ha)
Parks and Hinterland Forest Zones	1,754,174	793,568
<b>Total</b>	<b>1,754,174</b>	<b>793,568</b>

## 4.5 Inoperable

Area that is not available for timber harvesting due to physical, silviculture or regeneration difficulties, and economic inaccessibility is classified as “inoperable”. Slopes over 30% were assumed to be inoperable, which is the upper limit to ground based harvest systems stated in the operational Soil Conservation Standards and Guidelines (FMB, 2012).

Table 11 Inoperable land base reduction

Netdown Class	Total Area (ha)	Effective Reduction Area (ha)
Slopes over 30%	799,119	155,981
<b>Total</b>	<b>799,119</b>	<b>155,981</b>

## 4.6 Highway Management Zone

A 60 meter wide strip along both sides of the highways centerline was used to accommodate management for visuals and fire-wood cutting.

Table 12 Highway Buffer land base reduction

Netdown Class	Total Area (ha)	Effective Reduction Area (ha)
Highway Buffers	3,863	447
<b>Total</b>	<b>3,863</b>	<b>447</b>

## 4.7 Non-merchantable stands

Non-merchantable forest types are stands that contain tree species not currently utilized, or timber of low quality, small size and/or low volume, or steep topography, or low stocking. The two classes of non-merchantable stands in the Dawson AAC Region are: aspen-leading stands, and low site class stands.

### Aspen-Leading Stands

There has been no history of harvesting aspen-leading stands in the Dawson region, therefore were excluded in the timber harvesting land base. However, the aspen component was included in the merchantable stand volume for all other stands. The land base reductions for aspen-leading stands are summarized in Table 13. Birch-leading and balsam-leading (poplar) stands were considered merchantable and were retained in the timber harvest land base.

### Low site class Stands

Site class is “*The measure of the relative productive capacity of a site for a particular crop or stand, generally based on tree height at a given age*” (BC Ministry of Forests, 2007). In Yukon, the given age is at 100 years. Low site stands (site index less than 10 m) grow so slowly that they are not deemed to be suitable for commercial forest production. The landbase reductions for low site stands are summarized in Table 13.

Table 13 Non-merchantable Stands Land Base Reductions

Netdown Class	Total Area (ha)	Effective Reduction Area (ha)
Aspen Leading Stands	212,024	107,035
Low Site Class (Site Index less than 10 m).	2,042,566	199,923
<b>Total</b>	<b>2,254,591</b>	<b>306,958</b>

## 4.8 Riparian reserves and riparian management zones

The Riparian Management on Streams and Lakes Regulation (Forest Management Branch, 2011a) specifies the width for the riparian reserves (no harvest areas) and riparian management zones (restricted harvest zone) around streams and lakes. Similarly, the Wetlands Riparian Management Regulation (FMB, 2011b) specifies the reserves and management zones for wetlands. Riparian reserve strategies were implemented in the model by

- Assigning buffer widths to the riparian features inventories. The source data for this was the Canvec streams, wetlands, lakes. “Effective width buffers” were assigned based on adding together the assumed retention for reserves (100%) times the reserve width, and adding that to the assumed retention for the management zone (less than 100%) times the management zone width) and treating the resulting width as a reserve zone with 100% retention. E.g. if reserve zone width and retention is 5m width and 100% retention, and management zone is 6m width and 50% retention, the effective-reserve width is  $(5 \text{ m.} \times 100\%) + (6 \text{ m.} \times 50\%) = 5+3 = 8 \text{ m.}$
- The FMB staff assigned effective-reserve widths to the streams, lakes and wetland features; then
- The streams, lakes and wetland features were buffered in a GIS, and combined into one “riparian buffer” map (i.e. a GIS layer).
- The buffers were then treated as a THLB netdown.

The landbase reductions for riparian buffers are tallied in Table 14.

Table 14 Riparian reductions

Netdown Class	Total Area (ha)	Effective Reduction Area (ha)
Riparian Buffers	447,716	53,275
<b>Total</b>	<b>447,716</b>	<b>53,275</b>

## 4.9 Future Land Base Reductions

### Future Within-Block Retention Areas

A retention rule was used to emulate the silviculture system, which is “selection with variable retention” (Section 6). Retention will be applied in the Patchworks model as a 20% (average) of the forest withheld from logging at the time a block is harvested. Retention is applied as an aspatial factor to the area of each block in the model. The equivalent, future retention area is tallied in in

Table 15.

Note that one of the proposed sensitivity runs is an increase in the percentage of stand retention.

Table 15 Estimate of future within-block retention

(1) THLB Area (ha)	(2) Equivalent THLB Retention Area Assuming 20% Retention (20%) X (1) (ha)	(3) Equivalent Future THLB Area (1 minus 2) (ha)
370,654	74,131	296,697

### Future roads, trails and landings (RTL)

The Yukon Forest Resources Act Soil Conservation Standards and Guidelines state the site occupancy for roads and landings should be a maximum of 5%. That value should be high, on average, if a significant amount of logging occurs on snow. Regardless, the 5% value is used as the estimate of the area of cut-blocks that will become permanent access structures (roads and landings). The roads, trails and landings landbase reduction is applied as a yield curve reduction. The equivalent, future reduction area is tallied in

Table 16.

Table 16 Estimate of future roads, trails, and landings reduction

(1) THLB Area (ha)	(2) THLB Reduction (applied on yield table) (%)	(3) Equivalent Future THLB Reduction Area (1 x 2) (ha)
296,697	5%	14,826

## 5 Description of the Landbase

The exclusions described previously define the extent of the productive forest land, and the timber harvest landbase. The characteristics of their age class distribution, species profile and site index profile are described in the sections below.

### 5.1 Age Class and Species Group Distribution

#### 5.1.1 Age Class of the Dawson Forest

Statistics and charts of the age class distribution are provided in Table 17, and Figure 5 and Figure 6.

Table 17 Dawson AAC Region Age Class Distribution

Age Class	Age Range	THLB (ha)	THLB (%)	NHLB (ha)	NHLB (%)	Total (ha)	Total (%)
0	0	75,529	20.38	281,945	21.53	357,474	21.27
1	1-20	1,915	0.52	4,574	0.35	6,489	0.39
2	21-40	18,422	4.97	52,850	4.04	71,272	4.24
3	41-60	59,254	15.99	298,245	22.77	357,499	21.28
4	61-80	54,800	14.78	201,570	15.39	256,370	15.26
5	80-100	47,159	12.72	193,523	14.78	240,683	14.32
6	101-120	48,990	13.22	113,594	8.67	162,583	9.68
7	121-140	48,785	13.16	108,648	8.30	157,432	9.37
8	141-250	15,702	4.24	54,708	4.18	70,410	4.19
9	251+	98	0.03	3	0.00	101	0.01
	<b>Totals</b>	<b>370,654</b>	<b>100.00</b>	<b>1,309,660</b>	<b>100.00</b>	<b>1,680,314</b>	<b>100.00</b>

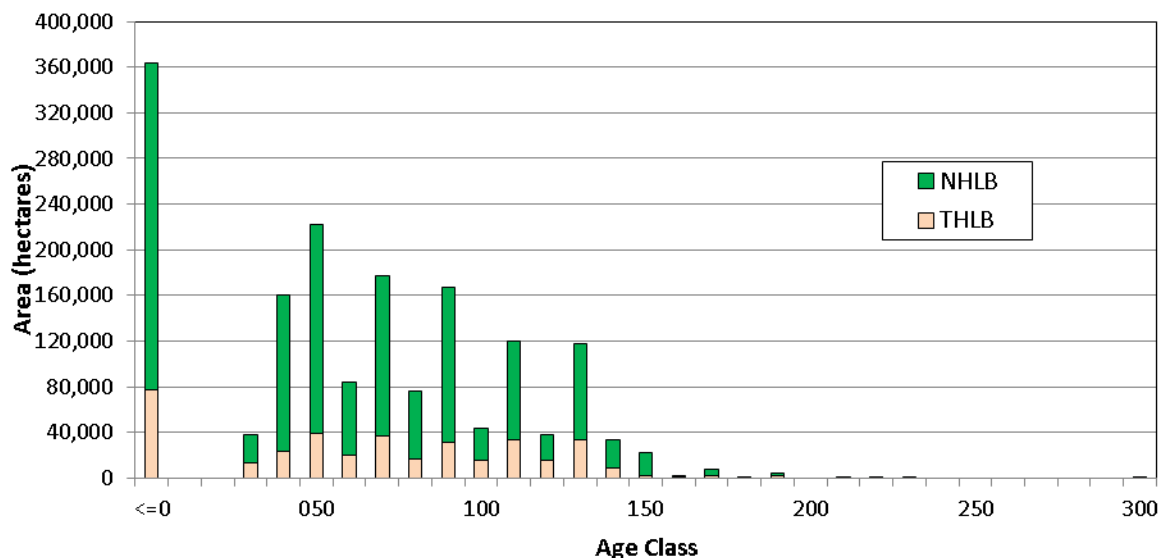


Figure 5 Age class of productive forest

The less than zero (“<=0”) age category includes 359,984 ha of stands that are still in the regeneration delay stage (Section 7.7.2). These areas resulted from previous fires (359,984 ha) and logging (276 ha).

### 5.1.2 Leading Species in the Timber Harvesting Land Base

In the timber harvesting land base (THLB), spruce-leading stands comprise 73% of the forest area, followed by deciduous-leading stands (27 %), and then balsam-leading (1%), and a trace amount of pine-leading.

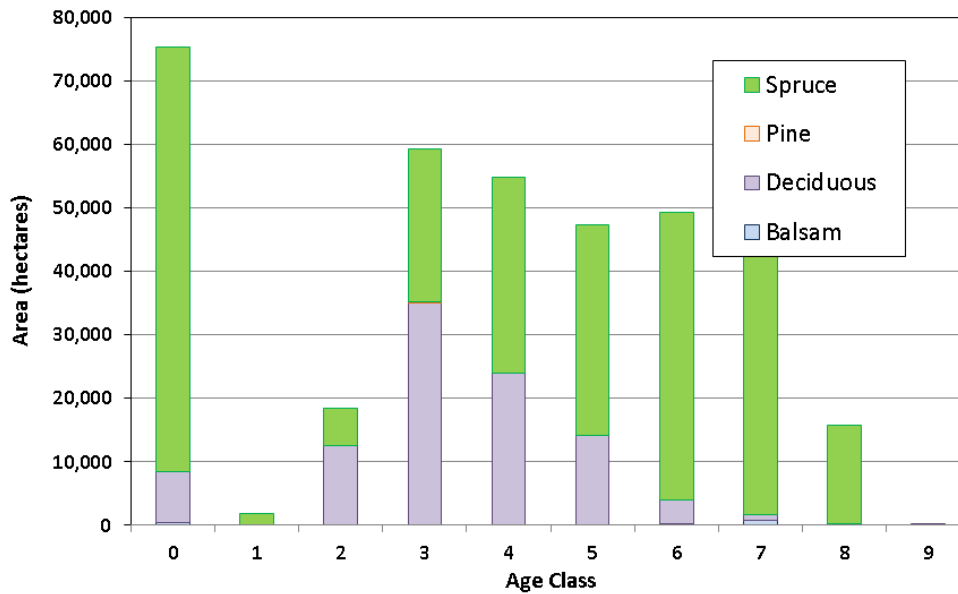


Figure 6 Age class distribution by species group for timber harvesting landbase

Note: Age classes: 0=<1, 1=1-20, 2=21-40, 3=41-60, 4=61-80, 5=81-100, 6=101-120, 7=121-140; 8=141-250, 9=251+

Table 18 Stand Leading Species in the timber harvesting land base (THLB)

	Balsam	Deciduous	Pine	Spruce	Total
Area (ha)	1,978	98,267	212	270,197	370,654
Percent	0.53	26.51	0.06	72.90	100.00

### 5.1.3 Leading Species in the Non-THLB

In the non-timber harvesting land base (NHLB), the leading species are spruce (68 %), deciduous (32 %) followed by balsam (1 %) and a trace amount of pine-leading stands ( Figure 7 and Table 19).

Table 19 Stand Leading Species in the NHLB

	Balsam	Deciduous	Pine	Spruce	Total
Area (ha)	13,130	415,872	2	880,657	1,309,660
Percent	1.00	31.75	0.00	67.24	100.00

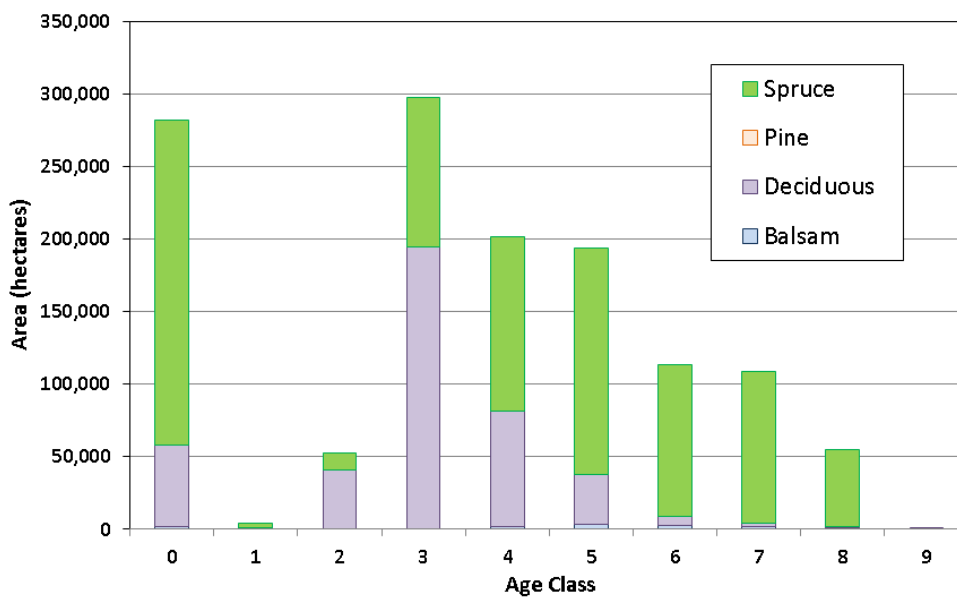


Figure 7 Age class distribution by species group for non-timber harvesting landbase (NHLB)

Note: Age classes: 1=1-20, 2=21-40, 3=41-60, 4=61-80, 5=81-100, 6=101-120, 7=121-140; 8=141-250, 9=251+

## 5.2 Seral Stage Distribution

Age can be grouped into seral stages, as per Table 21, which was adopted from the seral stage definition in the Dawson Forest Resources Management Plan (page 36).

Table 20 Seral Stage Age Class Definition

Seral Stage	Age Range
Pre-seral	Age < 10 years
Early	10 ≤ age < 50 years
Mid Seral	50 ≤ age < 90 years
Mature Seral	90 ≤ age < 130 years

Old Seral	130 ≤ age
-----------	-----------

The seral stage distribution is summarized in Table 21 and Figure 8. The majority of the landbase is Pre-Seral (21%, still in the regeneration period), Mid (33%) and Mature (22 %) seral stages (76% combined). Early (13%) and old seral (11%) comprise the remaining 24% of the seral stages.

Table 21 Seral Stage Distribution in the Dawson AAC Region

Land Base	Pre Seral	Early	Mid	Mature	Old	Total
THLB	77,444	41,499	108,502	94,547	48,662	370,654
NHLB	286,519	175,436	438,277	268,300	141,127	1,309,660
<b>Total</b>	<b>363,963</b>	<b>216,935</b>	<b>546,780</b>	<b>362,847</b>	<b>189,789</b>	<b>1,680,314</b>
<b>Percent</b>	<b>21.66</b>	<b>12.91</b>	<b>32.54</b>	<b>21.59</b>	<b>11.29</b>	<b>100.00</b>

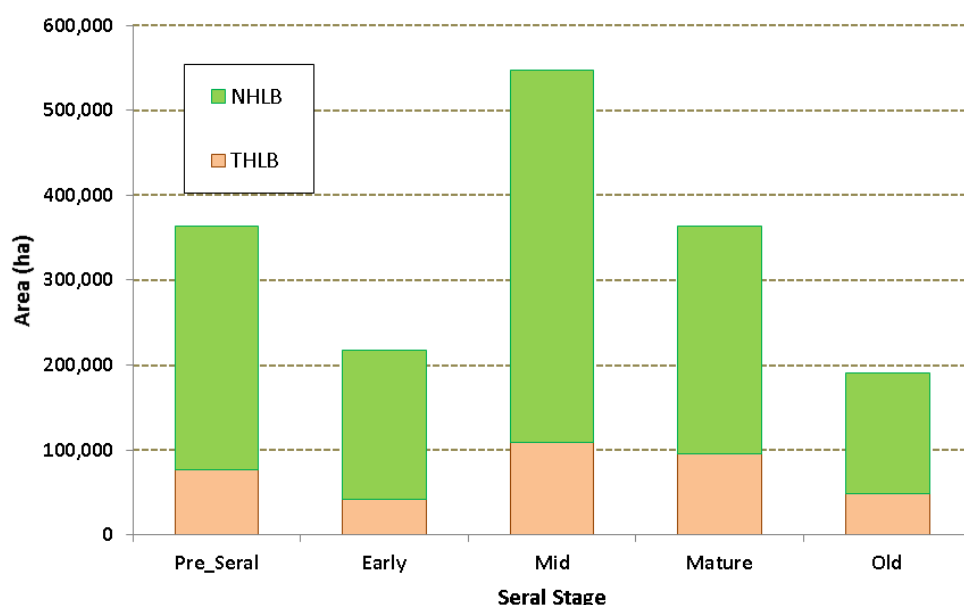


Figure 8 Seral Stage Distribution in the Dawson AAC Region

### 5.3 Site Class Distribution

Site index for the non-timber harvesting and the timber harvesting landbase is depicted in Figure 9. The average site index of the THLB is 13.9 m. No area is found in the THLB with a site index less than 10 meters, as stands with site index less than 10 m. are netted out of the THLB.

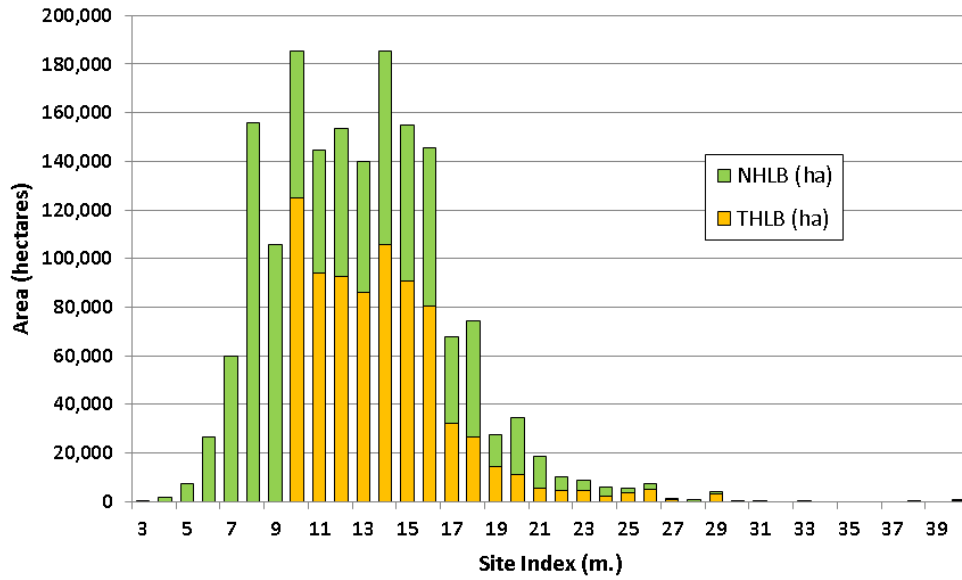


Figure 9 Site index for non-THLB and timber harvesting landbase (THLB)

## 6 Inventory Aggregation

### 6.1 Strata

To reduce the complexity and volume of information in the timber supply analysis, individual stands are aggregated into strata<sup>1</sup>. The groups are commonly based on parameters that determine growth rates, such as the dominant tree species (which is called STRATUM in the vegetation inventory database) and timber growing capability (site index). Other strata-defining parameters typically relate to the silviculture regime (e.g. clearcut or partial cut), and/or the harvesting regime (e.g. ground-based or cable-based systems). For example, Spruce-leading stands on moderate growing sites with a clearcut silviculture regime may be grouped into a single “strata”.

Each “strata” has at least one associated yield table that provides the model<sup>2</sup> with the net, merchantable volume at different stand ages. Only the productive forest stands are assigned to strata and are modeled. The parameters that will be used to define the strata in this analysis are:

- Harvestable, or not-harvestable (essentially THLB or NHLB, respectively);
- Species group (as per the Yukon standard STRATUM definition, such as stands with more than 80% spruce);
- Site Class (as per the Yukon standard definition of good, medium, poor, and low site classes); and
- Silviculture system (only the “selection with variable retention” system is current management.)

These strata-defining parameters are discussed in more detail, below.

#### Stand Breakup / Succession

There are two instances where stand breakup may occur:

- (a) Stands in the non-harvest land base (NHLB) where harvesting will not occur, and
- (b) Stands in the THLB, where harvest may occur.

In both categories, if a stand reaches the age-of-breakup it will revert back to a new stand (see break-up age in section 9). In harvested stands, the portion of the block that is harvested will revert back to a new stand, and the portion not harvested (20% of each block) will continue aging until that portion undergoes stand breakup.

---

<sup>1</sup> Strata: other names are “stand groups”, “analysis units”

<sup>2</sup> Model = forest estate model

## Species Group

The species groupings are based on the vegetation inventory's STRATUM, as per Table 22.

Table 22 Definition of Stratum

Strata Name	Description	STRATUM (YVI Code)
Spruce	Spruce leading stands where the spruce component exceeds 80% based on crown closure.	1
Pine	Lodgepole pine leading stands where the pine component exceeds 80%.	2
Deciduous	Aspen, balsam poplar and white birch leading stands where these exceed 80%.	3
Spruce/Pine	Spruce leading stands where the secondary species is lodgepole pine.	4
Spruce/Deciduous	Spruce leading stands where the secondary species is aspen, balsam poplar or birch.	5
Pine/Spruce	Lodgepole pine leading stands where the secondary species is white spruce or black spruce or fir.	6
Pine/Deciduous	Lodgepole pine leading stands where the secondary species is aspen or balsam poplar or white birch.	7
Deciduous/Spruce	Aspen, balsam poplar or birch leading stands where the secondary species is spruce or fir.	8
Deciduous/Pine	Aspen, balsam poplar or birch leading stands where the secondary species is lodgepole pine.	9
Fir	Fir stands where the fir exceeds 80%.	10
Fir Mix	Fir where secondary species is > 30%	11
Other	Any species or species group not described in the other categories.	12

Note: Definitions are from the 2015 version Yukon Vegetation Inventory

## Site Class

Four site classes are used to differentiate the growth capability of the forest stands (five classes if nil is considered as a class, which is assigned to areas such as lakes.) The four classes are good, medium, poor and low (Table 23), and each is defined by a range of site index values. The area of the "core strata" (species and site class combinations) that are found in the THLB are tallied in Table 24.

Table 23 Site Class Thresholds

Site Class Name	Site Index (m)
Good	SI >20
Medium	SI 15-20
Poor	SI 10-15
Low	SI <10
<nil>	Not forested

Species and site class combinations are the “core” strata (Table 24). Not all the combinations are present in the Dawson AAC Region. The greatest STRATUM of the THLB is stands comprised of over 80% spruce (“01\_Sx80”, 41 %). Most of the THLB is Poor site class (62 %).

Table 24 Area of STRATUM and Site Class Combinations in the THLB

STRATUM (number and species)	Good	Medium	Poor	Totals	Percent
<b>01_Sx80</b>	9,467	30,635	113,397	153,499	<b>41.41</b>
<b>02_P180</b>	0	0	31	31	<b>0.01</b>
<b>03_De80</b>	2,127	6,269	10,036	18,432	<b>4.97</b>
<b>04_SwPI</b>	0	0	39	39	<b>0.01</b>
<b>05_SxDe</b>	7,326	37,335	64,733	109,394	<b>29.51</b>
<b>07_P1De</b>	0	180	0	180	<b>0.05</b>
<b>08_DeSx</b>	4,732	37,897	37,206	79,835	<b>21.54</b>
<b>10_B180</b>	0	37	135	172	<b>0.05</b>
<b>11_B1Mx</b>	0	348	527	875	<b>0.24</b>
<b>12_Othr</b>	213	3,218	4,764	8,196	<b>2.21</b>
<b>Totals</b>	<b>23,864</b>	<b>115,920</b>	<b>230,869</b>	<b>370,654</b>	<b>100.00</b>
<b>Percentage</b>	<b>6.44</b>	<b>31.27</b>	<b>62.29</b>	<b>100.00</b>	

### Silviculture system

The silviculture systems proposed for the Dawson AAC Region is selection with variable retention. It is estimated that, on average, 20% of the original stand is left on-site as within-block retention.

## 7 Growth and Yield

This section describes the information, data sources, assumptions, and methods for generating growth and yield estimates for the standard Yukon STRATA (stand groups) described in section 6.

### 7.1 Site Index

*Site index is an estimate of site productivity for tree growth. This attribute provides a common base for comparing the productivity of different sites.*

*Site index is derived for all forested polygons based on leading species, average height and stand age. The reference age for site index is 100 years.*

Reference: Yukon Vegetation Inventory V3.3

*In British Columbia site index is expressed as potential tree height at 50 years breast height age. SI provides standardized comparisons of productive potential between sites, across a broad range of existing stand conditions. As such, we use it as a silvicultural tool to prescribe treatments and analyse investments. Site Index also serves as the main driver for many growth and yield models, which predict future forest growth and timber yields.*

Reference: SiteTools V3.3

In this analysis we used the BC variable density yield projection software (VDYP7) to predict the initial (call them “uncorrected”) stand yields, so the inputs had to be VDYP7-compatible. It follows that all the outputs from VDYP7 are based on BC standards. This includes the forest data that was used to calibrate VDYP and the assumptions and calibration data that are embedded within the software itself. For example, the input species codes and site index values must be standardized to the BC format to make the software run correctly. As well, the outputs from VDYP7, regardless of the source of the inputs, are based on the BC site index curves, and BC utilization levels that are contained within the VDYP7 software.

### 7.2 Site curves

The standard, British Columbia Ministry of Forests site index curves were utilized in this analysis, since they are embedded within the VDYP7 software. The standard site index curves are tallied in Table 25. Species not listed are mapped to their nearest similar species.

Table 25 Standard BC Ministry of Forests' site index curves

Species	Source
Lodgepole Pine (Pl)	Thrower (1994)
White Spruce (Sw) + (Sx)	Nigh (1997)
Balsam fir (Bl)	Chen and Klinka (2000)
Trembling Aspen (At)	Nigh, Krestov and Klinka (2002)

### 7.3 Utilization level

Utilization levels define the maximum height of stumps that may be left on harvested areas, the minimum top diameter (inside bark), and the minimum diameter at breast height (dbh) of stems that must be removed from harvested areas. These factors (Table 34) are used when calculating the merchantable stand volume in the analysis. Again, these are BC standards, and are embedded within the VDYP7 software. As such they are an approximation of the utilization expected for the commercial harvesting of trees for producing dimension lumber.

Table 26 Utilization levels

Species	Utilization		
	Minimum dbh	Maximum stump height	Minimum top dib
All Species	12.5	30	10

Notes: dbh = diameter at breast height. Dib = diameter inside bark;

## 7.4 Decay, waste and breakage

This analysis used the standard DWB values that are embedded within British Columbia's VDYP7 model, which are based on species, age, and biogeoclimatic subzone. Decay, waste and breakage factors are applied to natural stand yield tables to obtain net harvest volumes per hectare.

*Decay is caused by wood-rotting fungi, which produce soundwood losses due to physical and chemical processes. Waste is the soundwood portion of a tree or log which has more than 50% decay, considered non-recoverable under current utilization standards. Breakage represents all soundwood losses due to felling and yarding. The broken pieces are considered too small to be merchantable.*

Ref: BC TIPS V 4.3 Help Manual

For the purposes of this project, BC's Boreal White and Black Spruce (BWBS) subzone was the biogeoclimatic zone used as input to the VDYP7 software. The fine details of the growth and yield components within VDYP model are available on the BC Ministry of Forests website.<sup>3</sup>

## 7.5 Volume reductions

All aspen-leading stands were netted out of the THLB. The aspen component of all other stands remained in the stand yield tables (Table 27)

Table 27 Volume Reductions for Aspen

Stand type	Volume reduction
Aspen-leading stands	100% of the stand

<sup>3</sup> [https://www.for.gov.bc.ca/hts/vri/biometric/bio\\_growth.html](https://www.for.gov.bc.ca/hts/vri/biometric/bio_growth.html)

## 7.6 Yield table development – Pre-First Harvest Stands

Stands are grouped into strata primarily based on similar species and site index value. A yield table is developed for each strata. These species and site index strata may be subdivided further depending on the modeling requirements. If necessary, the species and site index strata may be considered as “core strata”, in this document, when that differentiation is important. For most discussions, it is sufficient to use the generic term “strata” to refer to the standard species and site index combinations.

The initial yield tables for each forest stand in the inventory were derived using the VDYP7 software. Yield tables for strata are derived by pooling, and weighting (by area) the yield curves for each forest stand in that strata.

The sequence of developing the yield curves was, in simplified terms:

- All the required inputs were remapped to VDYP7-compatible codes. For example, species codes were converted to the BC standard species codes. The Yukon’s code “W” for birch was converted to BC’s code “EP”;
- All Yukon site index values (reference age 100) were converted from BC values (reference age 50), using the BC Site Tools software;
- Each stand in the Yukon inventory was run through the VDYP7 software to produce a yield table for that stand. The result is one yield table for each forest polygon in the forest inventory;
- FMB staff estimated the maximum-expected stand volume for the strata, i.e. for each of the species group and site class combinations;

All the VDYP7 yield tables, within each strata, that went above the maximum-expected yield were pooled into a weighted yield table;

The maximum volume in the weighted yield table was compared to the maximum-estimated value, and a correction factor calculated that would reduce the weighted yield table value to the maximum-estimated value. The formula for the correction factor for each strata is:

$$\text{Strata Correction Factor} = \frac{\text{Maximum Expected Volume}}{\text{Maximum Volume from Weighted Table}}$$

- The result is a correction factor for each strata;
- The strata correction factor was applied to each of the individual stand yield tables that belonged in that strata, to produce a “corrected” yield table for each stand; then
- The corrected stand yield tables were again pooled, by strata, into one corrected-and-weighted yield table, for each strata;
- The result is one yield table for each strata (each species group and site index combination).

The weighted site index values for the THLB-type strata are in *Table 28*.

A more detailed description of the yield table process is described in Appendix B, which includes the conversion of the multi-layered stand attributes to weighted-single-layer-equivalent stand attributes.

Table 28 Site Index for the Core Strata in the Timber Harvest Land Base

Core STRATA	STRATUM	Species Group Name	Site Class	Maximum Expected Volume	Regen Delay	Area (ha)	Site Index (m)	Post-harvest STRATA
101	01	Sx80	G	140	10	9,468	23.0	201
102	01	Sx80	M	140	10	30,720	16.2	202
103	01	Sx80	P	75	12	113,477	11.3	203
104	02	PI80	P	40	12	31	11.0	204
105	03	De80	G	80	10	2,127	23.5	205
106	03	De80	M	80	10	6,270	16.2	206
107	03	De80	P	40	12	10,037	12.4	207
108	04	SwPI	P	40	12	39	11.0	208
109	05	SxDe	G	140	10	7,326	23.6	209
110	05	SxDe	M	140	10	37,338	16.2	210
111	05	SxDe	P	80	12	65,149	11.8	211
112	07	PIDe	M	80	10	180	17.7	212
113	08	DeSx	G	80	10	4,732	23.9	213
114	08	DeSx	M	80	10	38,033	16.5	214
115	08	DeSx	P	30	12	37,209	12.4	215
116	10	BI80	M	80	10	37	15.4	216
117	10	BI80	P	40	12	135	13.0	217
118	11	BIMx	M	80	10	348	15.4	218
119	11	BIMx	P	40	12	527	12.7	219
120	12	Othr	G	80	10	214	23.0	220
121	12	Othr	M	80	10	3,218	15.6	221
122	12	Othr	P	40	12	4,765	12.3	222

## 7.7 Yield Table Development - Post-harvested Stands

After harvesting, existing natural stand strata (100 series numbering) regenerate back to essentially the same stand definition (species group and site index class). The post-harvested strata are numbered in the 200 series (Table 28). The difference between the 100 and 200 series is a 5% reduction in yields in the post-harvest yields to account for the area covered by roads, trails and landings that is incurred during the first harvest.

### 7.7.1 Silviculture management regimes

The only silviculture regime in this analysis is “selection with variable retention”. Retention is estimated as 20% retention, on average, within every harvested block.

### 7.7.2 Regeneration delay

Regeneration delay is the time between harvesting and the time when a new stand is initiated. The delay incorporates both the time taken to establish a stand, and the age of seedling stock planted, if applicable.

A regen delay was estimated for each of the “core strata” (STRATUM and SITE CLASS), based on the local knowledge of the FMB staff (Table 29). These delays occur prior to stand initiation, after either harvesting or after stand breakup (Section 9.0).

Table 29 Regeneration Delays for Core Strata

Disturbance Or Treatment Event	Species Group	Site Index Class			
		Good (G) SI ≥ 20 m	Medium (M) 15 ≤ SI < 20 m	Poor (P) 10 ≥ SI < 15 m	Low (L) 0 < SI < 10 m
Logged or Stand Breakup	Spruce_Fir_80%	8-10	8-10	10-12	10-12
	Pine_80%	8-10	8-10	10-12	10-12
	Decid_80%	8-10	8-10	10-12	10-12
	Spruce_Pine	8-10	8-10	10-12	10-12
	Spruce_Decid	8-10	8-10	10-12	10-12
	PL_Spruce/Fir	8-10	8-10	10-12	10-12
	PL_Decid	8-10	8-10	10-12	10-12
	Decid_Spruce/Fir	8-10	8-10	10-12	10-12
	Decid_Pine	8-10	8-10	10-12	10-12
Burned	ANY	25	25	30	30

## 8 Silviculture

### 8.1 Current non-stocked area (NSR)

Not satisfactorily restocked (NSR) areas are identified in the forest inventory under the “land cover class”. NSR areas are largely old burns, although a very small portion could be past harvesting. The NSR area in the Dawson Region is summarized in Table 38.

Table 38 Not Satisfactorily Restocked (NSR) Area

AAC Region	NSR (ha)
Dawson	187,410

## 9 Unsalvaged Losses

Each year a portion of the forest is killed by natural events. These events include a number of catastrophic factors such as wildfire, insects, disease, blowdown, and flooding, etc. Stands also undergo “break-up” (non-catastrophic senescence, death and regeneration).

Endemic, background-type pest losses are built into the growth and yield model (VDYP7). The catastrophic factors, along with senescence, are modeled using leading species-based succession ages (Table 30). When a stand reaches its age of break-up the stand will revert back to age=0, and a new stand will regenerate after the appropriate regeneration delay. Stand breakup may occur in any productive stand, within both the NHLB or the THLB.

Table 30 Age of Stand Breakup

Stand Leading Species	Break-up / Age of Succession
Spruce- and Balsam-leading	250 years
Pine-leading	200 years
Aspen- and other Deciduous-leading	150 years

## 10 Non-Timber Forest Resource Management

Forest cover requirements are commonly applied in the timber supply model to accommodate the timber and strategic non-timber resource objectives. Often, management zones are defined with targets or thresholds specified on the amount of harvesting within those zones.

These requirements maintain appropriate levels of specific forest types that are needed to satisfy the objectives for wildlife habitat, biological diversity, etc. Forest cover requirements are used by the model to limit harvesting within the THLB.

These requirements are typically expressed as one of three conditions:

- no harvesting (or “no go” areas); or alternately “go light” areas in terms of
- a maximum amount of forest that can be younger than age X (or shorter than height Y);
- a minimum amount of forest that must be older than age W (or taller than height Z)

The Dawson Forest Resources Management Plan (FRMP) does not specify measurable targets for the strategic objectives and indicators in section 7 of the FRMP. One of the proposed sensitivities is based on applying targets (harvesting thresholds).

The management of riparian areas, soils (site disturbance), Hinterland Forest Resource Management Zones and general wildlife guidelines are summarized in Table 31, along with the modeling of these objectives (Table 32).

Table 31 Non-Timber Resource Guidelines

Non-Timber Resource Value	Criteria used to Delineate the Zone or Group	Rationale / Comments
Riparian Areas	Reserves (buffers) around classified streams, lakes and wetlands.	Equivalent-width reserve zones are based on the Riparian Management on Streams and Lakes and the Wetlands Riparian Management Regulations which specify management zone and reserve zone buffers are to be established around riparian features.
Hinterland Zone	Productive forest within specific Landscape Units	Currently managed as a “no harvest” zone. May change in the future.
Site disturbance and access management	Productive forest within each cut-block.	The Soil Conservation, Standards and Guidelines Regulation specify that a maximum area of 5% of a harvest block may be occupied by skid trails.
Wildlife, General	Productive forest within each cut-block.	A fixed 20% of the forested area in each block is retained on-site.

Table 32 Modeling of the Non-Timber Resource Guidelines

Non-Timber Resource Value	Non-Timber Harvest Land Base (NHLB, ha)	Timber Harvest Land Base (THLB, ha)	Gross Land Base (ha)	Modeling Requirements
Riparian Areas	188,778	N/A	641,078	No harvest within riparian buffers around classified streams, lakes and wetlands.
Hinterland Zone	791,787	N/A	2,847,923	No Harvest Area
Site disturbance	N/A	371,378	N/A	Apply a 5% reduction to the future yield tables to account for future roads, trails and landings.
Wildlife, General	N/A	371,378	N/A	Retain 20% of the forested area, of each cut-block, when the block is harvested.

In general, riparian management was addressed through a netdown process that reflected an equivalent-width no harvest buffer around stream, lake and wetland features. The Hinterland Zone, one of the Special Resource Management Zones, is modelled as a “no harvest” zone. Site disturbance is modeled as a reduction to the yield tables, and 20% of the productive forest will be retained within each cut-block for general wildlife and biodiversity purposes.

## 11 Timber Harvesting

### 11.1 Minimum harvesting age / merchantability standards

For this analysis, stands will be eligible for harvest, in the model, if they are within the timber harvesting land base, and contain a minimum merchantable volume of 75 m<sup>3</sup>/ha. This ensures that the timber supply model is harvesting stands that meet reasonable economic criteria, and emulates what is generally the current practice by forest licensees. The definition of merchantable wood includes all coniferous and deciduous species.

Note that this is a minimum, and is not the actual volume (and not any specific age when the stand meets that volume) at which stands are forecast for harvest. Some stands may be harvested at the minimum thresholds to meet forest-level objectives while other stands may be not be harvested until well past their "optimal" timber production age for other reasons, such as to even out the harvest flow to a "sustainable" level.

Only a portion of the stands within the timber harvest landbase attain the required 75 m<sup>3</sup>/ha however (Table 33). Of the 371,379 ha. of stands in the THLB only 140,010 ha will attain 75 m<sup>3</sup>/ha at some age, while 231,369 never do.

Table 33 Minimum age to reach merchantability criteria

Strata Name	Age to Reach 75 m <sup>3</sup> /ha	Area of Stands That DO Attain 75 m <sup>3</sup> /ha (ha)	Area of Stands That Do NOT Attain 75 m <sup>3</sup> /ha (ha)
Sx80 - G	78	9,467	0
Sx80 - M	114	30,635	0
Sx80 - P	---	0	113,397
PI80 - P	---	0	31
De80 - G	115	2,127	0
De80 - M	135	6,269	0
De80 - P	---	0	10,036
SwPI - P	---	0	39
SxDe - G	74	7,326	0
SxDe - M	114	37,335	0
SxDe - P	---	0	64,733
PIDe - M	109	180	0
DeSx - G	115	4,732	0
DeSx - M	125	37,897	0
DeSx - P	---	0	37,206
BI80 - M	146	37	0
BI80 - P	---	0	135
BIMx - M	148	348	0
BIMx - P	---	0	527
Othr - G	125	213	0
Othr - M	153	3,218	0
Othr - P	---	0	4,764
			0
<b>Totals</b>	--	<b>139,785</b>	<b>230,869</b>

## 11.2 Operability / harvest systems

All harvesting will be assumed to be done using ground-based systems, such as skidders. No cable or aerial systems (e.g. helicopter) are assumed.

## 11.3 Initial Harvest Rate

The Base Case harvest forecast will use an iterative process to find a reasonable, initial harvest rate that produces a sustainable harvest flow for the short term (first 20 years) and a transition to the long term sustainable harvest flow, without major disruptions in between.

The initial harvest level for the Base Case harvest forecast will approximate the theoretical long run sustained yield estimate, which is the sum of the area of each strata times its maximum mean annual increment. This value is estimated as 101,529 m<sup>3</sup>/year (*Table 34*).

This is based on 140,010 hectares out of the total 370,654 ha of THLB, as 230,869 hectares of stands in the THLB (*Table 35*) have such low growth rates that they never reach the minimum volume for harvest of 75 m<sup>3</sup>/ha.

*Table 34 Theoretical Long Run Sustained Yield for Merchantable THLB Stands*

(Col A) Strata Name	(Col B) Area (ha)	(Col C) Maximum Mean Annual Increment (m <sup>3</sup> /ha/year)	(Col D) Theoretical Long Run Sustained Yield (Col B x C) (m <sup>3</sup> /year)
Sx80 - G	9,467	1.07	10,130
Sx80 - M	30,635	0.74	22,670
De80 - G	2,127	0.7	1,489
De80 - M	6,269	0.61	3,824
SxDe - G	7,326	1.12	8,205
SxDe - M	37,335	0.69	25,761
PIDe - M	180	0.73	132
DeSx - G	4,732	0.74	3,501
DeSx - M	37,897	0.63	23,875
BI80 - M	37	0.52	19
BIMx - M	348	0.51	178
Othr - G	213	0.64	137
Othr - M	3,218	0.5	1,609
<b>Totals</b>	<b>139,785</b>	<b>--</b>	<b>101,529</b>

Note: Merchantable THLB Stands are stands that will attain the minimum of 75 m<sup>3</sup>/ha at some age.

If a lower minimum volume threshold is chosen, then some of the theoretical long run sustained yield from the non-merchantable stands in *Table 35* would become available.

*Table 35 Theoretical Long Run Sustained Yield for Non-Merchantable THLB Stands*

(Col A)	(Col B)	(Col C)	(Col D)
Strata Name	Area  (ha)	Maximum Mean Annual Increment  (m <sup>3</sup> /ha/year)	Theoretical Mean Annual Increment (Col B x C) (m <sup>3</sup> /year)
Sx80 - P	113,397	0	41,957
Pl80 - P	31	0	8
De80 - P	10,036	0	3,011
SwPl - P	39	0	9
SxDe - P	64,733	0	25,246
DeSx - P	37,206	0	8,557
Bl80 - P	135	0	34
BlMx - P	527	0	127
Othr - P	4,764	0	1,096
<b>Totals</b>	<b>230,869</b>	<b>--</b>	<b>80,044</b>

Note: Non-Merchantable THLB Stands are stands in the timber harvest land base that never attain the minimum volume of 75 m<sup>3</sup>/ha at any age due to an extremely low growth rate.

## 11.4 Harvest rules

Harvest rules have the objective of influencing the model so the harvest profile in the model will reasonably match the harvest profile seen on-the-ground. Licensees don't necessarily follow an "oldest-first" harvest priority. Numerous pressures influence forest operations and the harvest profile may vary over time. The most common examples are salvage operations that focus on bark beetle infestations or wildfires.

For the Base Case, no harvest priority will be assigned in the Patchworks model, which is the default for Patchworks. Instead, the model attempts to harvest the best combination of stands, at the best time, to meet all the active targets (e.g., the target harvest level, balanced against the target seral retention for biodiversity).

## 11.5 Harvest profiles, Harvest priorities

Two types of profiles or harvest priorities may be included in the analysis: those that actively control or influence the model behavior, and those that are passively tracked or reported, either during the time the model is running, or after a model run is finished (aka "post processed reports"). Two examples of harvest profiles / priorities are provided in *Table 36*.

*Table 36 Examples of Harvest Profiles and Harvest Priorities*

Parameter	Examples of Harvest Profiles or Harvest Priorities
Landbase	Harvest From First Nation Settlement Lands versus Public Lands
Coniferous / Deciduous	Harvest Volume of Coniferous versus Deciduous

### Active Model Controls.

The harvest flow from the First Nations Settlement Lands and the Public Lands will each be tracked and separately controlled so that they will provide information appropriate as input to determining a separate AAC for each of the areas. The total harvest flow will be the passive total of the two controlled harvest flows.

### **Passive Model Profiles, or Reports**

The Dawson Forest Resources Management Plan (FRMP) does not specify targets for the strategic objectives and indicators that are in section 7 of the FRMP. Several reports will be included in the Analysis Report to describe the status of common indicators, such as the proportion of early, mid and old seral on the landbase, over the planning horizon (25 decades).

## **11.6 Silviculture Systems**

Silviculture systems are predominately selection harvest with variable retention. Natural regeneration is the predominant method of regeneration.

## **11.7 Harvest flow objectives**

The biological capacity of the land base in combination with the objectives for the non-forest resources will dictate the sustainable harvest level. There are many possible harvest flows for any particular land base. In this analysis, the base case harvest level will reflect the following objectives:

- Attempt to maintain a constant harvest level for as long as possible during the short term (1 to 20 years), and if possible extend this harvest level into the mid-term (20 to 100 years);
- If necessary, as the growing stock is depleted, decrease the harvest level in the mid-term as little as possible; and
- Transition to an even-flow, long-term harvest level that produces a non-declining growing stock in the long term (200 to 300 years).

For the base case, the species, age-class and volume-class distribution of the harvest will be summarized and reported. Modeling will be performed for at least 300 years, using 10-year periods, and reporting will be for the first 250 years. This meets the recommendation of the Dawson Planning Team:

*To provide for the long-term sustainability of the area's forests and the needs of future generations, the planning timeline for some values, such as timber resources, is two stand rotations (200 to 300 years).  
(Reference Dawson Planning Team, 2006)*

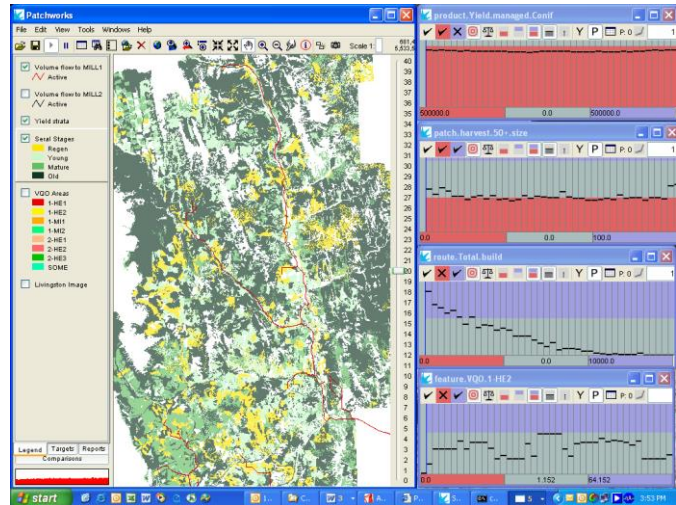
## 12 Timber Supply Modeling and Forecasts

This section provides a summary of the modeling which will be completed following the acceptance of the Data Package. This includes the model and the intended harvest forecasts that will be completed, and which will then be documented in the Timber Supply Analysis Report.

### 12.1 Model

The Patchworks modeling software was used for forecasting and analysis. This suite of tools was developed by Tom Moore / Cary Lockwood and is sold / maintained by Spatial Planning Systems Inc. of Deep River, Ontario (Tom Moore - [www.spatial.ca](http://www.spatial.ca)).

Patchworks is a fully spatial forest estate model that is capable of incorporating real world operational considerations into a strategic planning framework. It utilizes a goal seeking approach and an optimization heuristic to schedule activities across time and space in order to find a solution that best balances the targets/goals defined by the user. Targets can be set on any aspect of the problem formulation. For example, the solution can be influenced by issues such as mature/old forest retention levels, young seral disturbance levels, patch size distributions, conifer harvest volume, growing stock levels, snag densities, CWD levels, ECA's, specific mill volumes by species, road building/hauling costs, delivered wood costs, net present values, etc.



## 12.2 Base Case

The Base Case scenario represents the current management practices within the Dawson AAC Region. This is defined by operational management practices, characteristics of and natural resource values found on the landbase, current silviculture practices, and estimates of present and future growth of forest stands. The preceding sections described the assumptions and data that are included in the Base Case.

The following sections describe the model runs that will be completed to find a suitable Base Case harvest flow (i.e. the benchmark) against which all the sensitivities will be compared.

## 12.3 Alternate Harvest Flows

The harvest flow is the estimated rate of harvest for each period (10 years = 1 period) over a long term planning horizon (250 years or more). There are many possible harvest flows with different starting harvest levels and with different rates of declining and/or increasing harvests between periods. For example, it is possible to ‘trade off’ the mid- or long-term harvest for short-term harvest, or vice versa.

A number of harvest flows will be produced for the Base Case option (Table 37). These provide a picture of the trade-offs that are inherent in developing the recommended Base Case harvest flow.

Table 37 Alternate Base Case Harvest Flows

Alternate Harvest Flow	Key parameters	Number of Runs
Non-declining even flow.	Maximum harvest level with no increase and no decline in harvest in any period.	1
Non-declining increasing flow.	Maximum initial harvest level with increases when possible, and no declines in harvest in any period.	1
Increased initial starting harvest level	Increased initial harvest level above the “non-declining, increasing” flow, with reasonable decreases in the mid-term.	1
Decreased initial starting harvest level	Decreased initial harvest level below the “non-declining, increasing” flow, with reasonable increases in the near mid-term, and possible decreases in the late mid-term.	1
<b>Totals</b>		<b>4</b>

## 12.4 Sensitivity Analyses

Sensitivity runs are used to test the uncertainty inherent in the data and management assumptions and are performed by modifying one input and examining the impact that change has on the model outputs. The sensitivity runs provide a picture of what factors in the Base Case are most influential, in relative terms, to the outputs.

The proposed sensitivities from the response to the contract Request For Proposals were:

Regeneration delay – 2 scenarios that analyze an increase and decrease in the regeneration delay period.

Wildfire – 2 scenarios that analyze the impact on harvest flows if the past wildfire trends change, both (a) if the suppression efforts on the net land base are very effective, or fires are reduced; and (b) if the suppression efforts are less effective, and/or the wildfire frequency and intensity increases into the future (for example, due to the forecasted global warming).

Minimum harvest ages – 2 scenarios that analyze a 10-year change in the minimum harvest ages.

Yield curve estimates – 2 scenarios that analyze an increase or decrease in the yield curves.

Within-block retention – 2 scenarios that analyze higher and lower within-block retention levels (compared to the retention in the base case scenario).

Some of the above sensitivities may be exchanged for others. For example, a sensitivity which includes biodiversity / wildlife / watershed forest resource requirements (maximum harvest thresholds) may be included.

As of the date of publishing this document the TSA Technical Committee had not yet determined the top ten (10) sensitivity analyses that will be completed in this timber supply analysis.

## References

### Yukon Governments

- Dawson Forest Management Planning Team. 2013. Dawson Forest Resources Management Plan. March 2013.
- Dawson Forest Resources Management Plan Implementation Memorandum of Understanding (2014). MOU between the Tr'ondëk Hwëch'in and the Government of Yukon. November 14, 2014.
- Govt. of Yukon. 2015. Timber Supply Analysis for the Dawson and Haines Junction Annual Allowable Cut Regions. A Request for Proposals, prepared by Energy, Mines and Resources, Forest Management Branch. February 20, 2015.
- The Tr'ondëk Hwëch'in Final Agreement (July 16, 1998), and Amendment to the 1998 Tr'ondëk Hwëch'in Final Agreement: 9.6.1 Land Exchange, and Amendment to the 1998 Tr'ondëk Hwëch'in Final Agreement: P.C. 2009-0612. April 23, 2009.

### Yukon Legislation and Operational Guidelines

- Govt. of Yukon. 2008. Forest Resources Act. Assented to December 09, 2008
- Forest Management Branch. 2011a. Riparian Management on Streams and Lakes, Standards and Guidelines. Forest Resources Regulation, Yukon Forest Resources Act. Forest Management Branch. Energy Mines & Resources, Yukon Government. Effective October 11, 2011.
- Forest Management Branch. 2011b. Wetlands Riparian Management, Standards and Guidelines. Forest Resources Regulation, Yukon Forest Resources Act. Forest Management Branch. Energy Mines & Resources, Yukon Government. Effective October 11, 2011.
- Forest Management Branch. 2012. Soil Conservation, Standards and Guidelines. Forest Resources Regulation, Yukon Forest Resources Act. Forest Management Branch. Energy Mines & Resources, Yukon Government. Effective July 3, 2012.
- TSA Technical Committee. 2015. Terms of Reference. Committee for Timber Supply Analysis (TSA) Technical 'Committee'. Region: Champagne and Aishihik Traditional Territory (CATT). Unpublished document.
- Connectivity Planning Sub-Group. 2008. Habitat Connectivity Planning Recommendations for Forest Harvest Planning in the Champagne and Aishihik Traditional Territory by the Connectivity Planning Sub-Group. Final edits May 2008. (CAFN, YG-Forest Management Branch)
- Govt. of Yukon. 2014. Yukon Vegetation Inventory Manual. Version 3.1 July 31, 2014. Forest Management Branch, Energy, Mines and Resources, Yukon Government
- Unknown. 2009. Watson Lake Region Timber Supply Overview. Final Draft. Unpublished report. June 19, 2009.

### British Columbia

- Jahraus and Assoc. and Churlish Consulting. 2008. VDYP7 Sensitivity Analysis. Report prepared for: Ministry of Forests and Range. Prepared by: Jahraus & Associates Consulting Inc., Maple Ridge BC, & Churlish Consulting Ltd., Victoria BC. Final Draft. AUGUST 2008.
- Ministry of Forests. 2003a. Supplemental Guide for Preparing Timber Supply Analysis Data Packages. Forest Analysis Branch, Ministry of Forests, June 2003
- Ministry of Forests. 2003b. Modeling Options for Disturbance Outside the THLB - Working Paper. Forest Analysis Branch, Ministry of Forests, June 2003.
- Ministry of Forests. 2007. Glossary of Statistical Reporting Terms. Timber Supply Branch. Web site address: <http://www.for.gov.bc.ca/hts/inventory/reports/glossary/index.html>
- Ministry of Forests. 2009. Variable Density Yield Projection Volume 3 - VDYP7 Console Interface Guide. Version 3. Ministry of Forests, Forest Analysis and Inventory Branch, Victoria, B.C. September 2009.
- Ministry of Forests. 2016. TIPSYP v4.3 - April 5, 2016. <https://www.for.gov.bc.ca/hts/growth/download/download.html>

## APPENDIX A. DEVELOPMENT OF THE YIELD TABLES

### General Procedure

The construction of yield tables is portrayed by the next four figures. It starts with grouping all the stands' yield tables for one STRATA, as shown in Figure B.1. In this example there are 10 stands in this group.

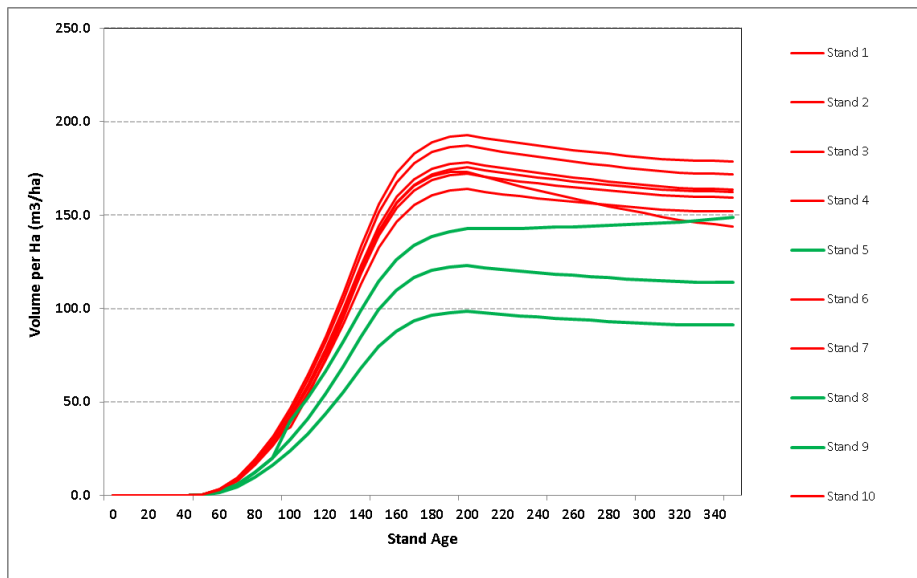


Figure A.1. VDYP-Predicted Yield Tables for the Ten Stands in a STRATA

The maximum, weighted volume/ha for this STRATA is the brown dashed line (Figure B.2). Stands are separated into those that go above that expected maximum volume threshold (red) and those that are always below or equal to that threshold (green).

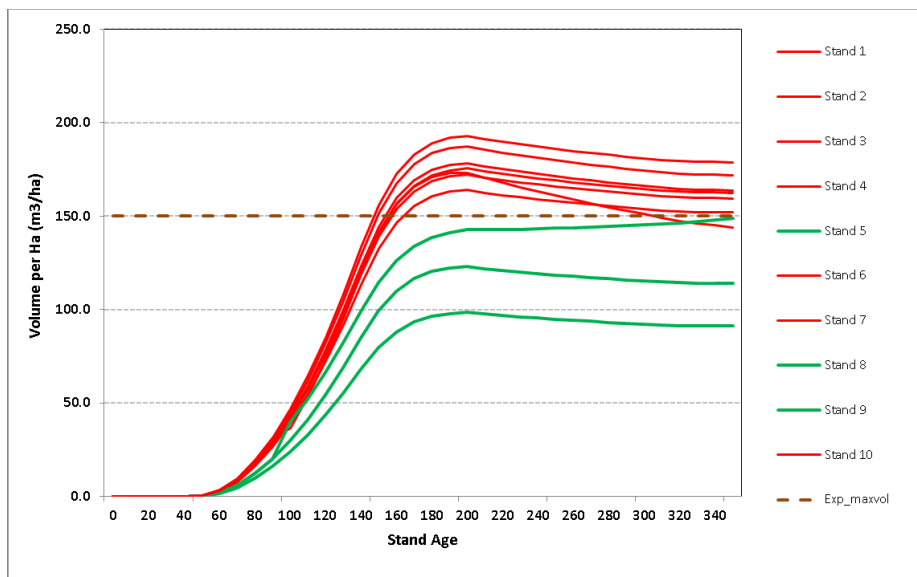


Figure A.2. Expected Maximum Volume vs. VDYP-Predicted Volumes

The maximum volume/ha for all the above-the-line (red) yield tables (Figure B.2) is calculated. This value is a weighted-by-area value. The correction factor for this STRATA is now computed. This is the purple

diamond line's value (Figure B.3), divided by the brown dashed line's value (Figure B.2). In this example, it is = (150 m<sup>3</sup>/ha / 175 m<sup>3</sup>/ha) or 0.86.

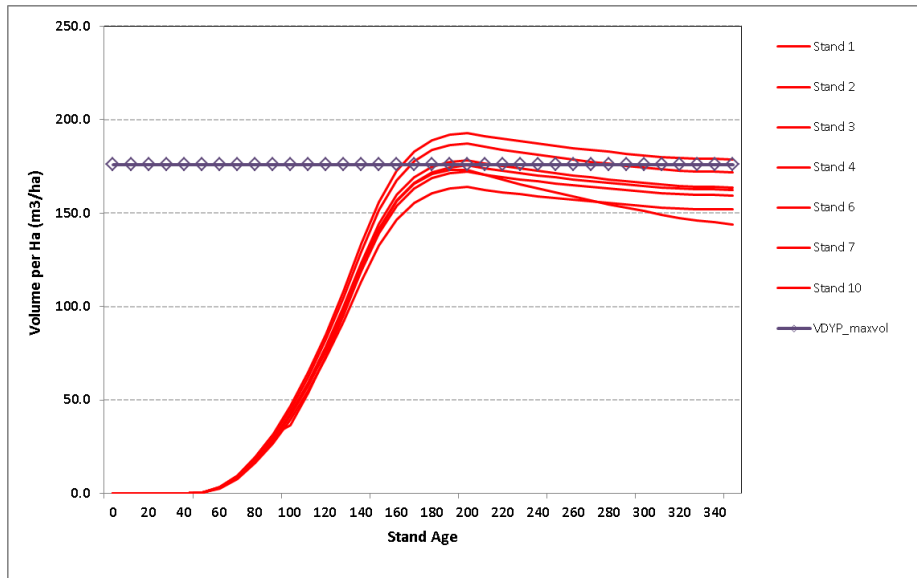


Figure A.3. Weighted Yield Table Correction Factor

After weighting all the yield tables for all the stands in the STRATA (stands 1 to 10, Figure B.1), and multiplying by the correction factor (0.86) the final, estimated yield table for the STRATA is the red line (Figure B.4). That line MUST always be less than, at any stand age, the maximum expected yield for that STRATA (i.e. the brown dashed line in Figure B.4).

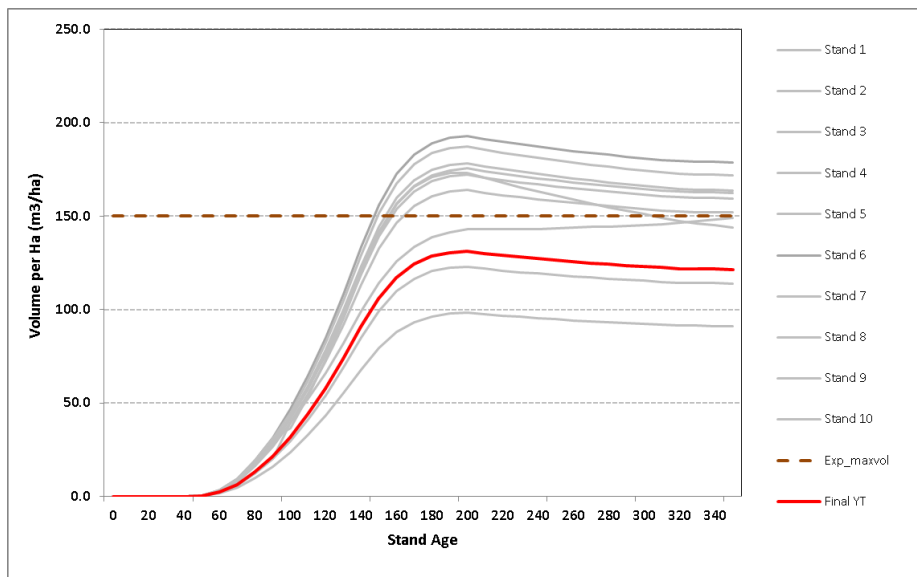


Figure A.4. Weighted yield table for one strata (example only)

Similarly, the volume of each individual species, for the STRATA, is the weighted-proportion of each species in that yield table multiplied by the yield table value. The weighted-proportion of each species in a STRATA

is derived by calculating the weighted-stand-area multiplied by the weighted-species-proportion in each stand, for each yield table in that STRATA.

Many of the components of the total volume have been estimated for all the STRATA yield tables, and appear in an accompanying Excel spreadsheet.

## STRATUM

STRATUM is defined in the new forest inventory manual as per the following table (Ref: YVI Manual 3 Ver3, 2015). STRATUM is an unfortunate name as it is one of the parameters used to determine the analysis STRATA. A more appropriate name for STRATUM would be "SPECIES\_GROUP".

Table A.1. Yukon Standard Strata Names and YVI Stratum Code

Strata Name	Description	STRATUM YVI Code
Spruce	Spruce leading stands where the spruce component exceeds 80% based on crown closure.	1
Pine	Lodgepole pine leading stands where the pine component exceeds 80%.	2
Deciduous	Aspen, balsam poplar and white birch leading stands where these exceed 80%.	3
Spruce / Pine	Spruce leading stands where the secondary species is lodgepole pine.	4
Spruce / Deciduous	Spruce leading stands where the secondary species is aspen, balsam poplar or birch.	5
Pine / Spruce	Lodgepole pine leading stands where the secondary species is white spruce or black spruce or fir.	6
Pine / Deciduous	Lodgepole pine leading stands where the secondary species is aspen or balsam poplar or white birch.	7
Deciduous / Spruce	Aspen, balsam poplar or birch leading stands where the secondary species is spruce or fir.	8
Deciduous / Pine	Aspen, balsam poplar or birch leading stands where the secondary species is lodgepole pine.	9
Fir	Fir stands where the fir exceeds 80%.	10
Fir Mix	Fir where secondary species is > 30%	11
Other	Any species or species group not described in the other categories.	12

For single-layered stands the STRATUM is fairly straight-forward. For multi-layered stands a weighting methodology is used that spans the layers within one stand. The process for multi-layered stands is described below. This process is essentially the same for single layered stands, except weighting by layer is not necessary.

### 1. Species Percentage(s)

The weighted crown closure (CC) for every species is based on:

- For each individual species (n) within each layer (i), total the CC percent for each species (n) times the CC for the layer (i).
- Total all the layer CC's' and all the individual species-times-layer CC's.
- The total of all the weighted species, or the total of the CC for the layers, is sometimes greater than 100%.
- Prorate each of the weighted species totals back to one weighted CC value for each species, for the stand, with a total of 100% overall.

## 2. Species Codes and Species Groups

### (a) Species Codes

VDYP7 uses a set of specific species codes and generic species codes which conflict with the YVI inventory codes. For example, the YVI code of “W” (birch) would be interpreted by VDYP7 as willow (brush). VDYP7 expects the code “EP” to denote paper birch.

Similarly, the YVI code “F” is for balsam fir, but VDYP7 would interpret this as the generic code for Douglas fir (FD), and more specifically as either interior Douglas fir (FDi) or coastal Douglas fir (FDc), depending on the biogeoclimatic subzone value. VDYP7 also expects “BL” to denote balsam fir (or more specifically *abies lasiocarpa*), and “AC” to denote cottonwood.

Therefore, the YVI species codes and some species group naming are remapped to VDYP7-acceptable codes in the analysis database, as per Table B.2.

Table A.2. Yukon YVI Species Codes and VDYP7 Database Codes.

Common Name	Yukon Forest Cover Inventory Code	VDYP7 Input Database Code
Aspen	A	AT
Balsam Poplar	B	AC
Fir	F	BL
Larch	L	LT
Pine	P	PL
Black Spruce	SB	SB
White Spruce	SW	SW
Birch	W	EP

### (b) Individual Species vs “Species Groups”

The definition of STRATUM uses the terms “spruce”, “deciduous”, “pine”, and “fir”, and not individual species names. For example, “spruce” may be either white spruce (SW) or black spruce (SB), and “deciduous” is any of aspen (AT), cottonwood (AC) or birch (EP). “Fir” is balsam fir (a true fir, BL), and “pine” is lodge-pole pine (PL).

It is assumed that the “species groups” define the STRATUM, not the individual species. Therefore, the definitions of STRATUM (Table B.1) have been modified by substituting “species group total CC” for the more generic terms of spruce, deciduous, fir, and pine. Species group codes are intended to be used in the database, and coding is used as per the following table.

Table A.3. Database Codes for Species Groups

Individual Species Common Names	Individual Species Codes	Species Group Name	Species Group Database Code
White spruce, black spruce	SW, SB	Spruce	SX
Aspen, poplar, birch	AT, AC, EP	Deciduous	DE
Fir (or balsam)	BL	Balsam	BA
Pine	PL	Pine	PL
Larch, tamarack	LT	Larch	LW

The STRATUM definitions also refer to “secondary species” which can be confused with the species occurring in the second place in the layer’s species list (i.e. the second position in the 4 data fields for species1, species2, species3, and species4.)

Rather than using the species in the second database position (which appears to be the assumption used when the STRATUM values were assigned in in the YVI data), the species groups' CC totals are sorted into decreasing order, and the second highest species group total CC is assumed to be the "secondary species".

For example: if SW 10 denotes 10% SW in the layer, and the layer species and percentages are:

**AT 40 SW 30 SB 30**

If we pool the species into groups, the description becomes:

**SX 60 DE 40**

The STRATUM is now considered to be "spruce with deciduous as the secondary component" and not "deciduous with spruce as the secondary species".

### (c) Merchantable Species

As of the date of this document, all species are considered merchantable. The proportion of the stand in each of AT, AC, and EP was tracked separately to allow total deciduous volume to be separated into the three deciduous components (AC, EP, and AT).

### **Yield Tables (Volume/Age Tables)**

In multi-layered stands, the TOTAL\_VOLUME is estimated using the following process. Single layered stands use the equivalent process, except there is no weighting by layer.

1. The VDYP7 software is used to produce a yield table for each layer;
2. The TOTAL\_VOLUME of each layer is prorated by the layer's CC. For example, if layer 1 has CC of 40 and layer 2 has CC of 20, then
  - a. TOTAL\_VOLUME for layer 1 is weighted by  $(40 / [40+20])$ , or 0.667;
  - b. TOTAL\_VOLUME for layer 2 is weighted by  $(20 / [40+20])$ , or 0.333; and
  - c. The final TOTAL\_VOLUME is the sum of the weighted TOTAL\_VOLUME from layer 1 and layer 2, or 1.00.
3. The above calculations are performed at each age in the yield table (i.e. at age 0, 10, 20, up to age 350). The result is a weighted yield table for every multi-layered stand. The yield table from a multi-layer stand is, at this stage, essentially the same as the yield table for a single-layer stand.

The TOTAL\_VOLUME at this stage is a gross estimate of the volume that has to be further reduced and further divided to account for the following:

1. VDYP7 is calibrated for BC conditions using BC data, so the volumes (and growth) that are predicted by VDYP are expected to be higher than what is found in the Yukon.
2. The volume of individual species and/or species groups' need to be separated from each other.
3. Live and dead volumes need to be separated from each other.

### **STRATA: Yield Tables for the CATT and Dawson Areas**

All forested stands' were classified by their AOI (CATT or Dawson), STRATUM and SITECLASS, as per Table B.4, which is specific to the CATT area.

At minimum, each of the shaded cells requires a yield table. The exception is for cells where there is no forested area that meets that particular combination of area-of-interest, stratum and site class.

Each of the cells shaded light blue contains a unique key. For example, CAT\_04\_M denotes the CATT area, Stratum 04 (Spruce/Pine) and Site Class M (medium, 15-20 m.) A similar table exists for the Dawson

area, except the code “CAT” is replaced by “DAW”. These codes are used in some of the Excel and database tables as unique keys (identifiers).

Table A.4. Strata Codes for the CATT

STRATUM (Species)	STRATUM (Number)	Site Class Good	Site Class Medium	Site Class Poor	Site Class Low
Spruce	01	CAT_01_G	CAT_01_M	CAT_01_P	CAT_01_L
Pine	02	CAT_02_G	CAT_02_M	CAT_02_P	CAT_02_L
Deciduous	03	CAT_03_G	CAT_03_M	CAT_03_P	CAT_03_L
Spruce/Pine	04	CAT_04_G	CAT_04_M	CAT_04_P	CAT_04_L
Spruce/Deciduous	05	CAT_05_G	CAT_05_M	CAT_05_P	CAT_05_L
Pine/Spruce	06	CAT_06_G	CAT_06_M	CAT_06_P	CAT_06_L
Pine/Deciduous	07	CAT_07_G	CAT_07_M	CAT_07_P	CAT_07_L
Deciduous/Spruce	08	CAT_08_G	CAT_08_M	CAT_08_P	CAT_08_L
Deciduous/Pine	09	CAT_09_G	CAT_09_M	CAT_09_P	CAT_09_L
Fir	10	CAT_10_G	CAT_10_M	CAT_10_P	CAT_10_L
Fir Mix	11	CAT_11_G	CAT_11_M	CAT_11_P	CAT_11_L
Other	12	CAT_12_G	CAT_12_M	CAT_12_P	CAT_12_L

### Factoring the VDYP7 (BC) Volumes to Yukon Volumes

The most rigorous method of calibrating the VDYP7-predicted volumes to the Yukon volumes would be to predict volumes for a number of field-sampled locations, and then build correlation factors between the two estimates (e.g. VDYP-generated vs field-generated values). In our case, we do not have a statistically significant number of field plots, or even a significant number of field plots to generate reasonable correlations.

Instead, based on the expectation that the VDYP-predicted volumes will generally be significantly higher than the Yukon volumes, maximum volumes for each strata were estimated by FMB staff (or if not provided, then by the Forsite analyst), and the maximum values were used to reduce the VDYP7-generated volumes to expected values.

The estimated maximum volume value for each AAC Region, STRATUM and SITECLASS combination are provided in Table B.5, and for comparison the values for the Dawson AAC Region are provided in Table B.6.

Table A.5. Maximum Expected Strata Volumes for the Haines Junction AAC Region

STRATUM	Species Class	Species Class	Good SI >20	Medium SI 15-20	Poor SI 10-15	Low SI <10
1	Sw	Spruce_Fir_80%	200	200	100	100
2	PI	Pine_80%	140	140	70	70
3	D	Decid_80%	140	140	70	70
4	SwPI	Spruce_Pine	200	200	100	100
5	SwD	Spruce_Decid	200	200	150	150
6	PISw	PL_Spruce/Fir	140	140	70	70
7	PID	PL_Decid	140	140	70	70
8	DSw	Decid_Spruce/Fir	140	140	70	70
9	DPI	Decid_Pine	140	140	70	70
10	F	Fir > 80%	200	200	70	70
11	FOs	Fir 30%Other	200	200	70	70
12	Other	Any Other	140	140	70	70

Table A.6. Maximum Expected Strata Volumes for the Dawson AAC Region

STRATUM	Species Class	Species Class	Good SI >20	Medium SI 15-20	Poor SI 10-15	Low SI <10
1	Sw	Spruce_Fir_80%	140	140	75	75
2	PI	Pine_80%	80	80	40	40
3	D	Decid_80%	80	80	40	40
4	SwPI	Spruce_Pine	140	140	40	40
5	SwD	Spruce_Decid	140	140	80	80
6	PISw	PL_Spruce/Fir	80	80	40	40
7	PID	PL_Decid	80	80	40	40
8	DSw	Decid_Spruce/Fir	80	80	30	30
9	DPI	Decid_Pine	80	80	30	30
10	F	Fir > 80%	80	80	40	40
11	FOs	Fir 30%Other	80	80	40	40
12	Other	Any Other	80	80	40	40

The following procedure was used to generate a VDYP-reduction factor for every STRATA (combination of AAC Region, STRATUM, and SI class):

- Each stand was classified and grouped into the STRATA (AAC Region + STRATUM + SITECLASS).
- Each stand yield table was examined and the maximum volume within that yield table (across all ages) was recorded (YT\_MAX\_VOL, or yield table max volume).
- Stands were then separated into two groups within each of the STRATA:
  - YT\_MAX\_VOL is greater than the expected STRATA maximum volume; or
  - YT\_MAX\_VOL is less than or equal to the expected maximum volume.
- A weighted (by area) maximum volume/ha (str\_maxvol)(\*1) was calculated for all the stands where YT\_MAX\_VOL is greater than expected maximum volume for that STRATA.
- A VDYP7 to Yukon volume correction factor was then calculated based on dividing the STRATA maximum expected volume (str\_maxvol) (\*1) by the VDYP-generated volume (vha\_gt) (\*2) which produced a reduction factor (\*3), i.e. **(\*1) / (\*2) = (\*3)**

See the accompanying Excel workbook (as of October 27 2016):

1609\_Sep28\_1525\_Detailed\_AU\_STRATA\_YT\_CHARTS\_crv\_xls0.xlsx

The Excel contains data/fields that document the (\*n) values in the above procedure:

(\*1) = Column CP, name = **str\_maxvol**, is the expected STRATA maximum volume per hectare

(\*2) = Column CR, name = **vha\_gt**, is the volume per hectare weighted estimate for stands with yield table maximum values that are greater than the expected maximum volume for that STRATA

(\*3) = Column CS, name = **nsgt\_fact**, is the natural stands greater than expected volume per hectare volume reduction factor

The Excel sheet also has a dynamic graph in the far left that will change depending on the number entered into **cell: B2**.

### **DEAD\_VOLUME and LIVE\_VOLUME**

The procedure is:

1. There is extensive dead spruce (from spruce bark beetle), and some dead aspen (from large aspen tortrix) in the area (John Cosco, pers. comm.)
2. An estimate of the proportion of dead spruce, or aspen, can be inferred from the disturbance coding in each polygon. A disturbance code of "DI" denotes insect disturbance (or kill).
3. Four disturbance "triplets" are found in each polygon's data record. The triplets are:
  - a. A disturbance code, e.g. "DI" as above;
  - b. A disturbance layer pointer, or identifier, e.g. if 1 then the disturbance triplet pertains to layer 1; and
  - c. A disturbance percentage, e.g. 60 = 60% kill, if the disturbance is "DI". Values range up to 100, implying all the spruce is dead, assuming the layer contains some spruce.
4. A maximum of two disturbance types are to be assigned to one layer, hence 2 layers x 2 disturbance codes are found in the YVI database as 4 disturbance triplets in each data record (which relate to one stand). Many combinations are found for the number of disturbance triplets pointing to layer 1 and layer 2, for example:
  - a. Triplet 1 and 2 point to layer 1, and triplet 3 points to layer 2;
  - b. Triplet 1 points to layer 1, and triplets 2 and 3 point to layer 3, etc.

However, some layers have two DI- type disturbances (insect kill) pointing to them, each with a different percentage kill.

The layer pointers contain the values 1, 2 and sometimes "P". The "P" is assumed to point to the whole polygon, and while most of these triplets are old fire disturbances, some are also DI-type insect kill. Some "P" (polygon) triplets also have DI-type triplets that point to layer 1 (or 2), hence two DI-type disturbances point to the same layer.

5. The rules used to resolve the conflicts were:
  - a. If two DI-type disturbances point to the same layer, then the largest of the two disturbance percentages is chosen to reflect the percentage kill.

- b. If any spruce occurs in a layer to which a DI-type disturbance is pointed, then the dead volume is assumed to be spruce (not aspen).
- c. If only aspen occurs in a layer to which a DI-type disturbance is pointed, then the dead volume is assumed to be aspen.
- d. If no spruce nor aspen occurs in a layer to which a DI-type disturbance is pointed, then no dead volume is assumed.
- e. However, only the dead spruce needs to be estimated, or tracked, as all the aspen is assumed to be a non-merchantable species.

### **STAND\_AGE**

Every stand must be assigned one age. In single layered stands there is only one stand age. In multi-layered stands, each layer may have a different age. The age of the stand in multi-layer stands will be determined as:

- a. The age of the layer with the highest crown closure (CC); else
- b. If each layer has the same CC, the age from the coniferous-leading layer, else
- c. If both layers are coniferous-leading, the age of the oldest layer.

The combination of the following items allows us to estimate the volume of dead spruce:

- The age of the stand (above);
- The age at which the spruce was killed;
- The yield table;
- The species composition (or more specifically, the spruce percentage); and
- The spruce disturbance percentage (which is assumed to equal the dead percentage).

### **DEAD\_VOLUME**

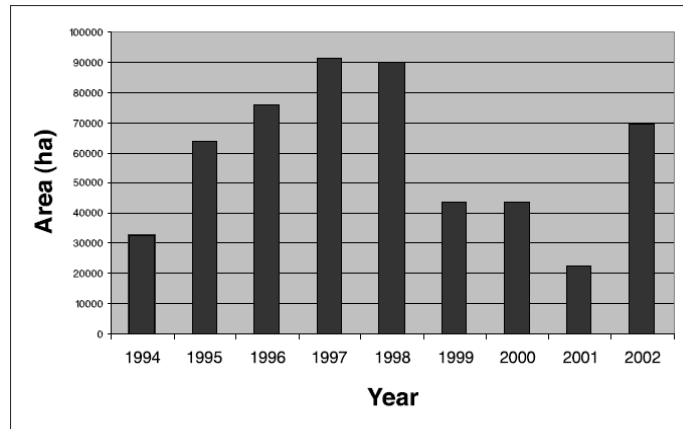
Only dead spruce volume is estimated and tracked.

The STRATA's yield table (not the layer's yield table) will be used to estimate the volume at any age for any stand. The rules for assigning stand age are in the above section.

Each yield table contains, for each 10-year age, the total volume (weighted by layer CC) and weighted species percentages (weighted by species CC and layer CC). Each stand, and each STRATA, are assigned a weighted spruce bark beetle kill percentage.

Crown closure (CC) is assumed to be proportional to volume, e.g. if a stand is 50% spruce, which is actually based on CC, then it will be assumed to be 50% spruce by volume.

The year of death for spruce over the entire CATT area is assumed to be 1999. This is the year depicted as the peak of the beetle attack in the next figure, which was taken from page 6 of the CATT - Strategic Forest Management Plan.



*This figure illustrates annual levels of new beetle infestation. The data are not indicative of a cumulative impact over time, as much of the area infested could be the result of in-filling on previously attacked stands.*

Each stand has its own age as of 2014 (the year of inventory), so its yield table must be referenced to a calendar year, e.g. a 150 year old stand in 2014, the year of inventory, must be back-aged to calendar year 1999 (the year of death for spruce) when the stand was 135 years old. Similarly, a 215 year old stand, even if it is the same STRATA as the 150 year old stand, must be referenced back to age 200 to estimate the dead spruce volume.

The volume of spruce is read from the yield table (at age 135 in the first stand, and age 200 in the second), then the weighted disturbance percentage is applied. The rules for assigning disturbance percentage are above. This determines the proportion of the total spruce volume that is assumed to be dead. That volume is tallied and remains constant for the “shelf-life” of the spruce, which is estimated to be 40 years.

After 40 years, the dead spruce volume is assumed to be unusable and drops to zero volume. Therefore, the calendar year 2038 (40 years after 1999) is the last year that any of the dead spruce volume is assumed to be usable (or merchantable).

### **LIVE\_VOLUME**

Live spruce volume is the converse of the dead spruce but is based on the percentage, as the live spruce component will continue to grow and add, or loose, volume over time according to its yield table.

Other species in the stand will grow until the succession age is reached, when the stand is assumed to fall apart and the age and volume are both reset to 0.

### **DEAD\_VOLUME\_RECOVERY**

“Dead-volume-recovery” is the infilling of the growing space, over time, that was created by the dead spruce. The recovered volume will be based on the following:

- a. Volume recovery starts after the regeneration delay, as per the REGEN DELAY table (below).

- b. The proportion of spruce volume that fills the dead volume growing space will follow the same shape as the STRATA yield curve, but is reduced to the proportion of the stand that was killed (and delayed by the regen period).
- c. When the succession age is reached, the stand is assumed to fall apart, and the age is reset to 0, and then the regen delay starts prior to stand initiation. This reset will also be performed on the recovering volume as well.

## REGEN\_DELAYS

Regen delay values were provided by FMB staff, and are depicted in the following table.

Table A.7. Regeneration Delay Values

Species Code	Species	Good SI > 20 m	Medium 15 > SI ≤ 20	Poor 10 > SI ≤ 15	Low 0 > SI ≤ 10
Sw	Spruce_Fir_80%	8-10	8-10	10-12	10-12
PI	Pine_80%	8-10	8-10	10-12	10-12
D	Decid_80%	8-10	8-10	10-12	10-12
SwPI	Spruce_Pine	8-10	8-10	10-12	10-12
SwD	Spruce_Decid	8-10	8-10	10-12	10-12
PISw	PL_Spruce/Fir	8-10	8-10	10-12	10-12
PID	PL_Decid	8-10	8-10	10-12	10-12
DSw	Decid_Spruce/Fir	8-10	8-10	10-12	10-12
DPI	Decid_Pine	8-10	8-10	10-12	10-12

A regen delay is applied after these events:

- a. Stand succession; or
- b. The harvest of live volume; or
- c. After the year of death for that portion of the stand that is in-filling the portion of the stand that was killed by the spruce bark beetle.