Management Plan No 2

Lheidli T'enneh Community Forest

Community Forest Agreement

K1N

Date of Submission:

September 19, 2019-for reference only

Submitted by: Chief Clayton Pountney, Lheidli T'enneh First Nation

Prepared by: Terry Lazaruk, RPF

I confirm that the Management Plan submitted is consistent with the Community Forest Agreement dated June 1, 2010, all relevant forestry legislation, any applicable Higher Level plans under the *Forest and Range Practices Act* and any commitments agreed to by both parties to this agreement.

RPF signature	Company representative signature
Terry Lazaruk	
Printed Name of RPF	Printed name of Company representative

This document was prepared for the Lheidli T'enneh Band

By:

Canadian Forest Products Ltd.

Canfor Administration Centre
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<u>Introduction</u>

Community Forest Description

A detailed overview map (1:50,000) showing the boundaries, and location of the community forest is included in Appendix 1. This map shows where the community forest is located in relation to the City of Prince George and surrounding parks, private and crown lands, roads, rivers and other water features.

The CFA is approximately 13,000 hectares in size with a previous allowable annual cut (AAC) of 28,000m3 comprised of both deciduous and coniferous species. The CFA area is comprised of two units; the Salmon River unit (one parcel) in the Salmon River area to the west of Highway 97, north of Prince George, and the Fyfe unit (two parcels) south of Prince George and west of the Fraser River. A detailed map of the CFA boundaries is shown in Figure 1.

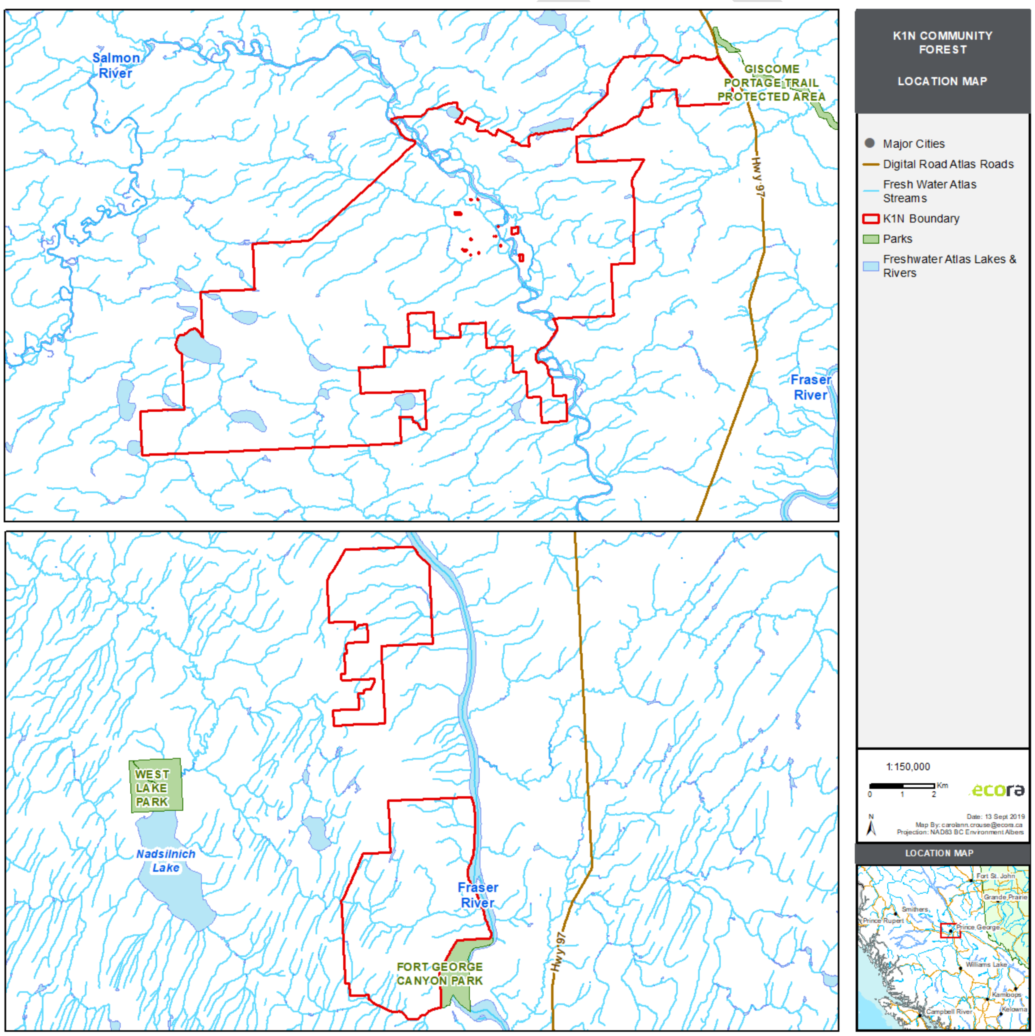

Figure 1: K1N Community Forest Location

Table 1 summarizes the total area, in hectares, of each of the three management units.

Table 1: Area summary by unit for the Lheidli T'enneh CFA

Community Forest Unit	Area (ha)
Fyfe North	1,112
Fyfe South	2,203
Salmon	9,683
Total Area	**12,998**

There are no residences in any of the parcels and other land uses are largely recreational, cultural, guiding and trapping. Main road access is established to the boundaries of the land parcels, with limited road development within them.

The biogeoclimatic (BGC) units occurring over the CFA area generally describe the climate and vegetation of the landbase. There is one BGC zone (Sub-Boreal Spruce) and three BGC subzone variants present across the two management units. The climate of the SBS zone is characterized by moderate annual precipitation, severe snowy winters, and short, warm summers. One BGC subzone variant - the moist cool Mossvale variant (SBSmkl) occurs in the northern (Salmon River) unit. The Fyfe unit contains two BGC subzone variants – the dry warm Stuart variant (SBSdw3) which describes most of the unit, and the moist hot variant (SBSmh) which forms a narrow parallel band along the Fraser River. An overview map showing the BGC units is presented in Appendix 2.

Hybrid spruce, mature aspen, and lodgepole pine are the dominant tree species in both units, with lesser components of subalpine fir and black cottonwood. The community forest area was chosen specifically to support a proportion of deciduous fibre in the AAC. However, the deciduous species present in the CFA generally do not occur in large, continuous pure stands. Coniferous tree species comprise a significant component of the deciduous-leading stands across the CFA landbase.

Fyfe Unit

The Fyfe unit lies adjacent to the City of Prince George's southernmost municipal boundary, and is approximately 3,300 ha in size. Main access to the north parcel of the Fyfe unit is through the Domano Forest Service Road (FSR) which connects to the Fyfe FSR. Access to the south parcel of the Fyfe unit is through the Blackwater and West Lake public roads.

The adjacent West Lake community has a history of farming, logging, recreational and traditional use. The Prince George snowmobile club maintains a trail parallel to the west boundary of both units, connecting to trail networks south of West Lake. The Prince George Tree Improvement Station (PGTIS) is located between the two parcels on lands designated for research purposes. The PGTIS is accessed via the Domano FSR which is gated on either side of the facility to discourage unnecessary traffic through the station and to avoid vandalism.

Fort George Canyon Park borders the southeast corner of the Fyfe unit. This provincial park is a day-use park and is approximately 178 ha in size, consisting of two parcels on either side of the Fraser River. A hiking trail from West Lake Road to the park crosses the south parcel and there is a network of cross country ski trails along Beaverdyke Creek that connect to the main hiking trail. The Fraser River squeezes through the narrow Fort George Canyon featuring rapids, back eddies and massive whirlpools. The park was designated to protect the historic site where paddle-wheeled boats were winched through the canyon and passengers portaged around during the early 1900's. It also protects important historical native fishing sites.

Salmon River Unit

The Salmon River unit straddles the Salmon River north of Prince George, south of Summit Lake and west of Highway 97, and is approximately 9,700 hectares in size. The Giscome Portage Trail and Protected Area passes near the northeast corner of the unit. The southern boundary of the community forest is bordered by significant agricultural development in the Wright Creek area. In addition to farming, the adjacent Salmon Valley area has a history of timber harvesting, non-timber forest products and recreational use. The Salmon River unit contains numerous small lakes and wetlands; this area supports numerous wildlife species and diverse upland and wetland ecosystems.

There is road access to the periphery of the Salmon unit but the majority of this area is currently not developed. The Salmon FSR parallels the east side of the Salmon River in the northern portion of the unit and connects to Highway 97 north of Salmon Valley. The Muldowan FSR runs north/south on the west edge of community forest boundary and from the Muldowan FSR the 100 and 600 Roads access the Teardrop FSR system. The Wright Creek public road accesses the southern edge of the unit in a number of places and connects to Highway 97 just south of Salmon Valley.

Part A: Linking community values to the management of the Community Forest

1. Mission Statement and Guiding Principles.

The following guiding principles will support resource management goals during the term of the Community Forest Agreement (CFA):

- Develop and promote a safe working environment for the community forest;

- Focus available funding to increase forest productivity knowledge for deciduous stands in the biogeoclimatic units of the CFA (SBSdw3, SBSmh and SBSmkl) and apply this knowledge to optimize timber production

- Utilize initial Annual Allowable Cut (AAC) allocations in the management unit to harvest damaged and vulnerable pine stands on the land base both to prevent unrecoverable losses and to re-establish growing stock on productive sites;

- Allocate a revenue flow from coniferous log sales to establish a road network to support long term management activity;

- Provide capacity building opportunities for selected Lheidli T'enneh representatives in the area of resource management; and

- Seek community support from the Lheidli T'enneh community for resource management goals and strategies.

During any interim reporting over the first ten years of the CFA, or any review associated with the 10 year replacement milestone, these principles will be reviewed, and guiding principles with longer term vision will be explored.

2. Linkage of Community Forest Program Goals to Management Goals

The following management objectives are consistent with the primary goal of creating a sustainable opportunity for the Lheidli T'enneh by integrating environmental, social and economic objectives for the CFA.

2.1 Timber Harvesting Objectives

Timber harvesting tasks include coordinating personnel and developing a harvest schedule based on priority areas. The licensee commits to operating within "the provincial legislative forestry regime" and its CFA requirements. The Lheidli T'enneh Community Forest will continue operations utilizing the newly determined allowable annual cut of __________m^3/year. The cut control is set out in the CFA agreement. Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MOFR) Forest Cover inventory (FC1) information was replaced with updated Vegetation Resources Inventory (VRI) information and was incorporated in the current timber supply and growth & yield analysis pertaining to the CFA. Appendix 4 presents timber supply analysis in support of the current AAC for the CFA.
Timing as well as methods of harvest will be selected based on site specific requirements.
Site plans will describe management objectives on an individual block basis.

2.2 Environmental Objectives

The quality of the environment is of utmost importance to the Lheidli T'enneh. Environmental considerations for the community forest include the protection of water quality, known wildlife and wildlife habitat, sensitive soils and biological diversity. Results and strategies related to these resources and consistent with provincial forestry legislation will direct forest operations and development of the timber resource.

With respect to the environment, the Lheidli T'enneh has developed the following objectives and corresponding management strategies as described in Table 2.

Table 2: Objectives and corresponding management strategies intended to meet the environment-related goals for the Lheidli T'enneh CFA

Objective	Management Strategy
1.0 Maintain or conserve biodiversity values within the CFA	1.1 Cooperate with regional initiatives to coordinate biodiversity objectives; 1.2 Maintain a variety of deciduous habitat types; and 1.3 Incorporate management practices that retain structural diversity
2.0 Maintain or conserve soil integrity	2.1 Where sensitive soils exist, modify timber management practices to prevent unwanted soil disturbance, landslides or the alteration of natural drainage patterns; 2.2 Rehabilitate areas as required where soil disturbance exceeds legislative limits; 2.3 Ensure timely re-vegetation of deactivated roads and large contiguous areas of exposed soil; and 2.4 Utilize existing road systems as much as possible.
3.0 Manage appropriately for identified fish and wildlife and their habitat	3.1 Operate within provincial legislation and guidelines for endangered or threatened wildlife species; 3.2 Implement road deactivation where necessary to protect identified species at risk; 3.3 Design and implement effective protocols for the protection of fish and fish habitat; and 3.4 Implement road deactivation where necessary to prevent soil erosion.
4.0 Maintain or protect riparian integrity	4.1 Correctly identify, classify and map streams, wetlands and lakes and their corresponding riparian areas; and 4.2 Design and implement effective prescriptions for the protection and conservation of riparian area integrity and function.

2.3 Social Objectives

Table 3 outlines the primary social objectives for the CFA as well as strategies for achieving them.

Table 3: Objectives and corresponding management strategies intended to meet social-related objectives for the Lheidli T'enneh CFA

Objective	Management Strategy
1.0 Develop and promote a safe work environment	1.1 Ensure contractors are adequately trained for their jobs; 1.2 Ensure proper safety protocols and systems are in place and adhered to; and 1.3 Ensure proper reporting to WorkSafeBC as necessary.
2.0 Communicate performance to directors, contractors, customers and the Lheidli T'enneh community	2.1 Provide standard referral packages to First Nations, trappers and guides; 2.2 Promote public awareness at regular Band meetings and other community forums such as the Lheidli T'enneh website and newsletters when appropriate; 2.3 Provide opportunities for community members to provide input into planning processes; and 2.4 Monitor and report contractor compliance and performance
3.0 Maintain visual quality	3.1 Design CFA development activities in respect of established VQO's and known scenic areas; and 3.2 Consider public concern and comment regarding visual quality when designing community forest activities.
4.0 Manage in respect of existing recreation resources	4.1 Maintain an open avenue for communication with local area users and recreation groups; 4.2 Maintain contact with the Ministry of Environment (Parks) when conducting CFA activities adjacent to the Fort George Canyon Provincial Park; and 4.3 Provide opportunity for public comment and consider public concern and comment regarding community forest development in close proximity to recreational features.
5.0 Manage to protect cultural heritage resources	5.1 Provincial laws regarding conservation of cultural and heritage resource will guide planning and operations; 5.2 Maintain communication with First Nations who have overlapping traditional territory; and 5.3 Maintain current records of cultural heritage resources within the CFA.

2.4 Economic Objectives

Important economic objectives include enhancing the existing forest resource, and working with this long term community forest agreement with the Province of B.C. Table 4 describes the strategies that will assist in meeting these objectives.

Table 4: Objectives and corresponding management strategies intended to meet the economic objectives for the Lheidli T'enneh CFA.

Objective	Management Strategy
1.0 Enhance the value of the CFA	1.1 Continue Site Index linked to Biogeoclimatic Ecosystem Classification (SIBEC) research over the CFA area 1.2 Explore the appropriateness of current deciduous growth assumptions and site indices used to predict productivity; and 1.5 Prioritize and promptly harvest beetle-killed stands.
2.0 Enhance and build new economic opportunities associated with management of the CFA	2.1 work to assess the opportunities associated with both pulp and bioenergy facilities in increasing utilization within the CFA; and 2.2 Where the above item identifies opportunities, build those relationships to further increase economic benefits from a variety of products off of the CFA; and 2.3 Comply with provincial reporting requirements

2.5 Forest Health and Pest Management

Forest health is dynamic, and forest health agents are a natural component in forested ecosystems, and can be important to forest renewal and plant succession. Pests however can have large impacts on timber quality and production. Our forest management goal is the maintenance of a healthy forest condition. Our forest health program includes the prescription and implementation of protective or suppressive treatments to anticipate and prevent insect, disease and mammal damage to reforested areas and young stands. Silviculture regimes that address species composition and vigour will be used to help prevent large scale impacts and create stands that are less susceptible to forest health agents. Forest practices will be regularly evaluated as they relate to forest health. The health of the community forest will be monitored annually and pest problems will be treated as necessary to maintain stand quality and productivity.

A current list of forest health agents found throughout the Prince George Forest District that may pose forest health concerns for the community forest include:

Abiotic Agents - fire, drought damage, wind, frost injury, ice/snow/hail damage, and fire/mechanical/sunscald wounds

Bark Beetles - Mountain pine beetle (Dendroctonus ponderosae), Spruce beetle (Dendroctonus rufipennis), Douglas-fir beetle (Dendroctonus pseudotsugae), Ips beetle (Ips spp.), and western balsam bark beetle (Dryocoetes confusus)

Biotic Agents - moose, deer, voles, beaver and hare

Broadleaf Foliar Diseases - conifer-aspen rust (Melampsora albertensis), and aspen and poplar leaf and twig blight (Venturia macularis)

Canker Diseases - atropellis canker (Atropellis piniphila), hypoxylon canker (Hypoxylon mammatum), and sterile conk trunk rot of birch (Inonotus obliquus).

Defoliators - forest tent caterpillar (Malacosoma disstria), satin moth (Leucoma salicis), 2-year cycle budworm (Choristoneura biennis), and aspen skeletonizer (Phratora purpurea purpurea Brown)

Dwarf Mistletoe - lodgepole pine (Arceuthobium americanuni)

Root Diseases - tomentosus root rot (Inonotus tomentosus),

Stem Rusts - western gall rust (Endocronartium harknessii), stalactiform blister rust (Cronartium coleosporioides), and comandra blister rust (Cronartium comandrae)

Woody Tissue Feeders - white pine weevil (Pissodesstrobi), lodgepole pine terminal weevil (Pissodes terminalis), Warren's root collar weevil (Hylobius warrem), and northern pitch twig moth (Petrova albicapitana)

Management plans for particular forest health agents will be developed, when necessary, for specific geographic locations within a management unit.

2.6 Silviculture

The reforestation/silviculture goal of this plan is to produce biologically healthy forested stands within the legislated, post-harvest timeframe. Silviculture objectives will be driven by the current regulatory requirements as well as the need to proactively plan for healthy forested stands, and economically appropriate rotation ages. Current forest management policy focuses post-harvest silviculture efforts on establishment of free growing stands. Under this plan, silviculture investments will not only consider the need to produce good quality forest stands, but also considers the ecology and biology of any given area. For deciduous leading stands, natural regeneration is anticipated to produce sufficiently stocked stands post-harvest. Mixed species planting may occur when ecologically appropriate.

Innovative, incremental or enhanced silviculture prescriptions aimed at increasing timber quality and quantity will be considered.

We may also explore such things as research experiments and provenance trials that may help us use silviculture to go beyond traditional timber management objectives. These activities will be planned and implemented with input from qualified professionals and follow appropriate MOFR protocols.

2.7 Access

Road access exists on the periphery of the Salmon River unit, while a forest service road (FSR) passes through the northern Fyfe Unit. The internal portions of the CFA however are not well developed with some minor, secondary roads present. The Lheidli T'enneh will follow the standard practice of entering into road use agreements or joining road user groups to address joint use of these publicly owned roads.

The Lheidli T'enneh recognizes that there are special circumstances around the use of the FSRs that are in such close proximity to large residential areas. The Lheidli T'enneh and Canfor will participate in a road users group to address maintenance and safety on the access roads during periods of forest operations. The MOFR currently maintains both the Domano and Fyfe FSRs.

The transfer of road permits from other licensees to Chunzoolh Forest Products Limited may occur, depending upon each party's vested interest in the road and applicable access structures. The transfer of road permits will be reviewed on a case by case basis when the use of a particular road will be necessary for community forest activities. New road construction will be guided by current regulations and policy at the time of road development.

2.8 Cultural Considerations

With respect to cultural use and considerations the intent is to respect cultural resources during the pursuit of timber production activities. Communication with the Lheidli T'enneh community, through representatives appointed to oversee the management agreement, will identify cultural concerns to be addressed in planning stages.

Unless otherwise requested, proposed road and block development will be referred to the Nazko First Nation and the West Moberly First Nation using standard referral packages.

3. Botanical Forest Products

The Community Forest K1N will not be harvesting or managing botanical forest products.

4. Consultation with other Forest Users

The following consultation measures will be taken to identify and consult with persons using the agreement area for purposes other than timber production.

1. The Lheidli T'enneh Band newsletter and website will be used to keep Band members up-to-date on community forest activities; regular Band meetings at the Resources Office will be used as an opportunity to request information, or provide comments and/or suggestions.

2. Referral packages will be used to keep trappers, guides, and future range tenure holders informed of community forest activities; an open phone line at the Resources Office and open houses, as necessary, will be opportunities for these tenure holders to provide their input. Information will also be provided on the Lheidli T'enneh website.

3. Referral packages and face-to-face meetings, as necessary, will be used to keep the Nazko and West Moberly informed of community forest development, and face-to face meetings will provide opportunities for neighbouring First Nations to provide comment and communicate any concerns.

4. The Band will maintain a community forest webpage on the Lheidli T'enneh website for world-wide access. Community members and local government can visit the website where community forest news and activities will be posted. Opportunities will be provided for the review of the Forest Stewardship Plan. Members of the public or local government can also reach the Forest Coordinator through the Resources Office.

5. Reporting

The Community Forest Agreement requires a strategy for annual reporting out to the community. To this end, there will be an annual update on the Lheidli T'enneh Community Forest provided at the Lheidli T'enneh annual general meeting, open to all community members. Attendees will be provided with an update on community forest activities over the previous year. The CFA's success in meeting its timber harvesting, environmental, social and economic management objectives will be reported on.

In regards to timber harvesting, there will be an update on cut control and how much of the allowable annual cut has been harvested, and a report of employment generated and revenues accrued from harvesting and related activities.

Reporting on environmental objectives will focus in particular on progress towards maintaining/conserving biodiversity values and stand structural diversity representation on the CFA.

Economic objectives have as their goal enhancing the existing forest resource. This is to be achieved through improved inventory and other information about the CFA, which in turn assists planning and effective management of the area. There will be annual reporting of inventory and mapping activities, research and analysis pertaining to the area.

6. Commitments

The primary resource management goal for the Lheidli T'enneh Community Forest Agreement (CFA) area is to capture the productive capacity of the community forest land base in order to provide sustainable financial support for the Lheidli T'enneh Nation. Management activities are intended to increase the value of the tenure.
Secondary resource management goals include minimizing non recoverable timber losses, and developing infrastructure to enable more intensive management of forest resources on the area for the long term.

Part B. Establishing the Annual Allowable Cut

THE FOLLOWIING SECTION WILL BE COMPLETED FOLLOWING THE COMMENT AND REVIEW PERIOD

1. Proposed Allowable Annual Cut

The primary goal for the Licence is to ensure a sustainable flow of timber to local sawmills and an even flow of revenue to the holder of the Licence. The results of the latest analysis are presented in the Timber Supply Analysis report that is appended to this document (Appendix 4). It demonstrates that the productivity of the area is sufficient to support a long term harvest level of 26,960 m^3/year.

2. Allowable Annual Cut Rationale

Provide a rationale for the proposed AAC.

3. Timber Supply Review

4. **RPF Declaration**

I Terry Lazaruk RPF #4100 declare that the TSR has met the requirements of section 6.02 (a)-(f) of the community forest agreement document

Signed ________________________________ Date__________________

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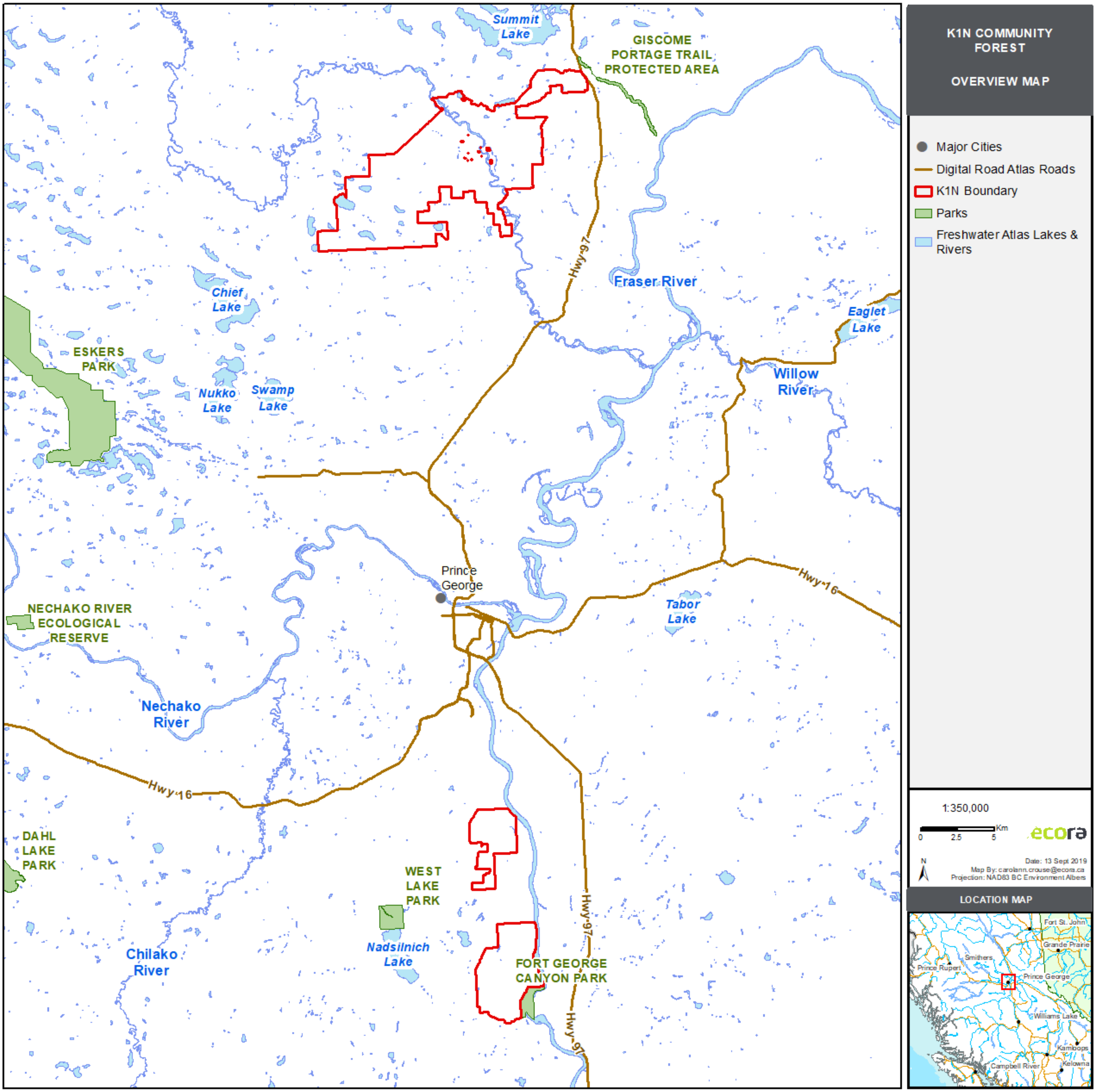
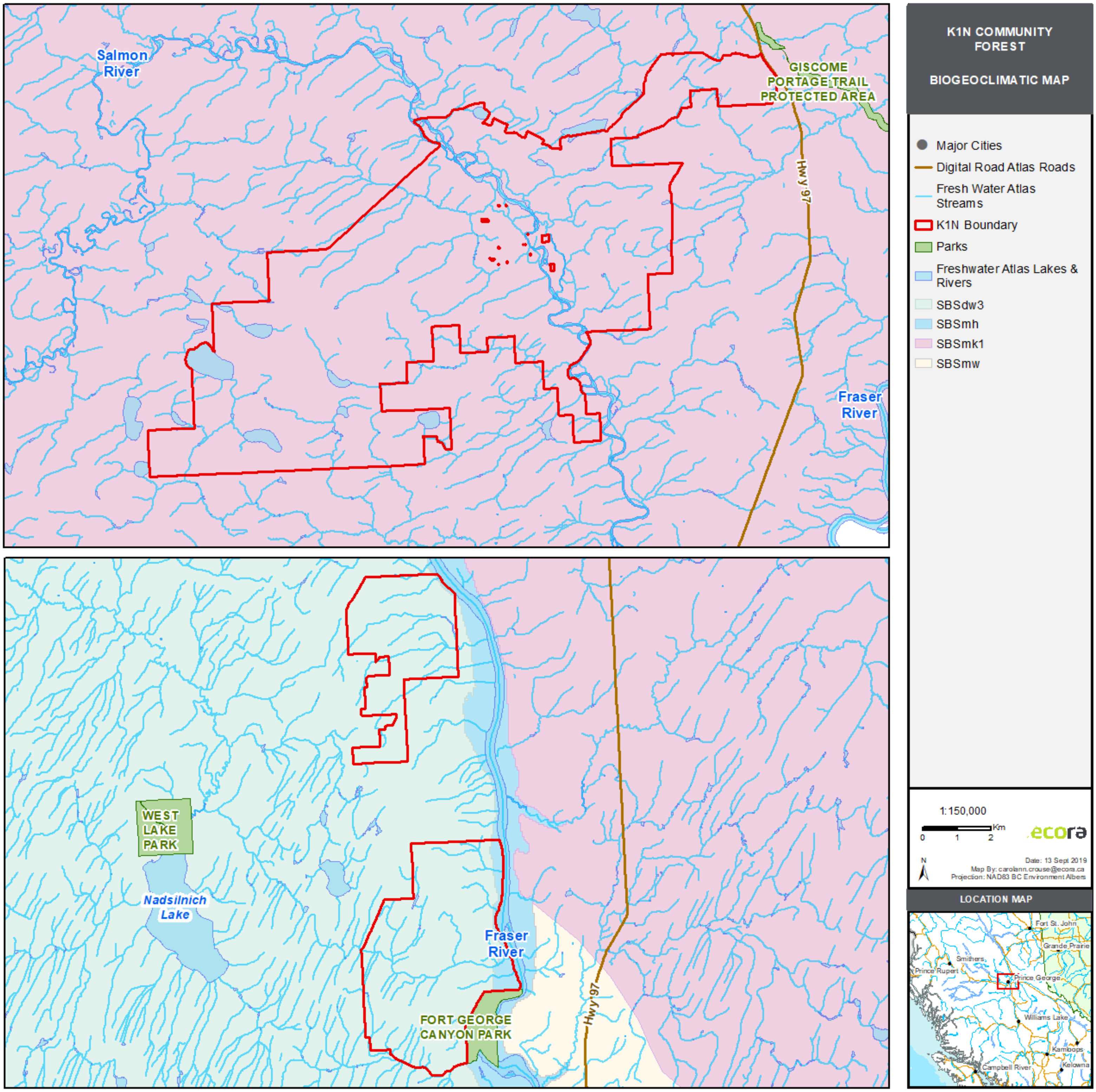
Appendix 1. Overview Map


K1N COMMUNITY FOREST
OVERVIEW MAP
Major Cities
Digital Road Atlas Roads
K1N Boundary
Parks
Freshwater Atlas Lakes & Rivers
1:350,000
Km
0 2.5 5
ecora
LOCATION MAP
Summit Lake
GISCOME PORTAGE TRAIL PROTECTED AREA
Chief Lake
ESKERS PARK
Nukko Lake
Swamp Lake
Fraser River
Eaglet Lake
Willow River
Hwy 97
Prince George
Tabor Lake
Hwy 16
NECHAKO RIVER ECOLOGICAL RESERVE
Nechako River
DAHL LAKE PARK
WEST LAKE PARK
Nadsilnich Lake
Chilako River
FORT GEORGE CANYON PARK

Appendix 2. Biogeoclimatic Overview Map


Salmon River
GISCOME PORTAGE TRAIL PROTECTED AREA
Hwy 97
Fraser River
WEST LAKE PARK
Nadsilnich Lake
Fraser River
FORT GEORGE CANYON PARK
Hwy 97
K1N COMMUNITY FOREST
BIOGEOCLIMATIC MAP
Major Cities
Digital Road Atlas Roads
Fresh Water Atlas Streams
K1N Boundary
Parks
Freshwater Atlas Lakes & Rivers
SBSdw3
SBSmh
SBSmk1
SBSmw
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ecora
Date: 13 Sept 2019
Map By: carolann.crouse@ecora.ca
Projection: NAD83 BC Environment Albers
LOCATION MAP

Appendix 3. Data Package

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Lheidli T'enneh Community Forest Agreement (K1N) Timber Supply Review Data Package

Presented To: Terry Lazaruk, RPF
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Dated: September 05, 2019

Ecora File No.: [FG-19-170-CFP]

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September 16, 2019

Version Control and Revision History

Version	Date	Prepared By	Reviewed By	Notes/Revisions
5.0	16 September 2019	Hui Yu Zheng	Terry Lazaruk	
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3.0	28 June 2019	Hui Yu Zheng	Terry Lazaruk	
2.2	25 June 2019	Hui Yu Zheng	Jay Greenfield	
2.1	21 June 2019	Hui Yu Zheng	Stacey Boks	
0.0	31 May 2019	Hui Yu Zheng	Jay Greenfield	

Limitations of Report

This report and its contents are intended for the sole use of Lheidli T'enneh Community Forest and Canadian Forest Products Ltd. and their agents. Ecora Engineering & Resource Group Ltd. does not accept any responsibility for the accuracy of any data, analyses, or recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Lheidli T'enneh Community Forest and Canadian Forest Products Ltd. and their agents. Any such unauthorized use of this report is at the sole risk of the user.

Table of Contents

List of Tables in Text

Acronyms and Abbreviations

AAC	Allowable Annual Cut
AC	Black Cottonwood
ALR	Agricultural Land Reserve
AOS	Aerial Overview Survey
AT	Trembling Aspen
BCLCS	British Columbia Land Classification Scheme
BEC	Biogeoclimatic Ecosystem Classification
BL	Subalpine Fir
Canfor	Canadian Forest Products Ltd.
CBST	Climate Based Seed Transfer
CDC	Conservation Data Centre
CFA	Community Forest Agreement
CFLB	Crown Forested Land base
CT	Commercial Thinning
DBH	Diameter at Breast Height
DIB	Diameter Inside Bark
EP	Paper Birch
ESA	Environmentally Sensitive Area
FDI	Interior Douglas-fir
FPPR	Forest Planning and Practice Regulations
GBST	Genetic Based Seed Transfer
K1N	Community Forest Agreement K1N
LRDW	Land and Resource Data Warehouse
LU	Landscape Unit
MFLNRO	Ministry of Forest, Lands, Natural Resource Operations
MOF	Ministry of Forests
MHA	Minimum Harvest Age
MHV	Minimum Harvest Volume
NDT	Natural Disturbance Type
PG	Prince George
PLI	Interior Lodgepole Pine
P2P	Perspective to Plan
RESULTS	Reporting Silviculture Updates and Land Status Tracking System
SB	Black Spruce
SIBEC	Site Index by Biogeoclimatic Ecosystem Classification
SPAR	Seed Planning & Registry Application
SRMP	Sustainable Resource Management Plan
TEM	Terrestrial Ecosystem Mapping
THLB	Timber Harvesting Land base
TIPSY	Table Interpolation Program for Stand Yields
TSA	Timber Supply Area
TSR	Timber Supply Review
VAC	Visual Absorption Capacity
VDYP	Variable Density Yield Prediction Growth and Yield Model
VEG	Visually Effective Green-up
VLI	Visual Landscape Inventory
VQO	Visual Quality Objectives
VRI	Vegetation Resources Inventory
WTP	Wildlife Tree Patch

1. Introduction

The Lheidli T'enneh Community Forest Agreement (CFA) K1N covers 12,998 ha located within the Prince George timber supply area (PG TSA) in east-central British Columbia. The Lheidli T'enneh First Nation has held the community forest agreement license since 2008. The Canadian Forest Products Ltd. (Canfor) manages and operates the community forest agreement for the Lheidli T'enneh First Nation.

Ecora Engineering & Resource Group Ltd. (Ecora) is working with Canfor to prepare information to assist the determination of a new allowable annual cut (AAC) for K1N. The PG TSA's AAC was set to 8,350,000 m^3/year in 2017. The current AAC for K1N is set at 28,000 m^3/year issued on June 1, 2010.

This data package documents the information sources and assumptions to be used in the base case timber supply analysis and to discuss potential sensitivity analyses. The assumptions used are based on the most recent *Prince George TSA Timber Supply Review Data Package* (MLFNRO, 2015), *Prince George Land Resource Management Plan*, *Sustainable Resource Management Plan* (SRMP) and the *Lheidli T'enneh Community Forest Agreement Type II Silviculture Strategy Data Package* (hereafter called The Silviculture Type II Data Package; Timberline, 2009) as well as the current management objectives for K1N.

2. Data Input

This section summarizes the data used to support this timber supply review (TSR). Over the last ten years, Canfor has committed to continue to improve the data available for the K1N land base. These improvements include:

- Terrestrial Ecosystem Mapping (TEM; 2008);
- Silviculture Strategy (2009);
- 2019 Community Forest vegetation resources inventory (VRI);
- Road class verification from photogrammetric measurements using the same aerial photographs for VRI; and
- Stream Classification.

2.1 Spatial Data

Table 2-1: provides a list of input data layers considered in the analysis.

Table 2-1: Data Sources

Description	Layer Name	Source	Vintage
K1N CFA Boundary	k1n_bdy	Ecora	2018
Landscape Units	lu	LRDW	2019
Planning Cells	pcell	Canfor	2018
Merged Biogeoclimatic Ecosystem Classification (BEC) Units	merged_bec	LRDW	2019
Ownership	own	LRDW	2019
Crown Tenure - Managed Licenses	ften_ml	LRDW	2019
BEC_v11	bec_v11	LRDW	2018
Environmentally Sensitive Areas	esa	MFLNRO	2018
Slope	slp_cls	MFLNRO	2018
Consolidated Cut Blocks	cons_blk	LRDW	2019
Canfor Blocks	cfp_blocks	Canfor	2019
Canfor Wildlife Tree Patch (WTP)	cfp_wtp	Canfor	2019
Roads	roads	Canfor	2019
Results Openings	rslt_blk	LRDW	2019
Visual Landscape Inventory (VLI)	vli	LRDW	2019
VRI	delin	Ecora	2019
Land Resource Management Plan Legal	lrmp_leg	LRDW	2019
Land Resource Management Plan Non-Legal	lrmp_nleg	LRDW	2019
FTEN Recreation Trails	rec_trl	LRDW	2019
Recreational Features Inventory	recfeat	LRDW	2019
Terrestrial Ecosystem Mapping	tem	LRDW	2016
Forest Health Factors	aos_fhf	DataBC	2019
Conservation Data Centre	cdc	LRDW	2018
Agricultural Land Reserves	alr	LRDW	2019
Streams	streams	LRDW	2019
Wetlands	wetlands	LRDW	2019
Lakes	lakes	LRDW	2019

2.2 Inventory Information

Ecora completed a review of the VRI covering K1N in January 2019. The study compared the Provincial 2003-vintage VRI with the 2019 VRI attributes to capture the changes to the land base. Based on the review, there was an underestimated coniferous component, an overestimated deciduous component, and an undescribed dead lodgepole pine component (Ecora, 2019). These vast differences resulted in K1N investing in a new VRI for the community forest.

Further, the new VRI has led to an increase in conifer volume, a decrease in deciduous volume, an overall live volume decrease (the impact was mostly on the deciduous component), and a better understanding of the conifer-deciduous ratio. The new VRI for K1N was completed by Ecora in 2019, and the results are summarized in Community Forest Agreement K1N Vegetation Resource Inventory Project Report (Ecora, 2019).

A multi-step polygon delineation process generated 1,369 polygons. The average polygon size was 9.5 ha, with an average polygon size of 9.6 ha for treed (≥ 10% crown closure) polygons. Polygon delineation and polygon attribution meet the current provincial VRI standards and procedures at the time of completion in 2019.

The work was completed in a virtual environment using DAT/EM Summit Evolution Lite v.7.1 softcopy software on an ESRI ArcMap 10.2 platform. The project used 25 cm ground scale distance four band (red, green, blue, and near-infrared) digital frame aerial photographs with an east-west orientation taken. These aerial photographs were taken in 2015 and were subsequently purchased by Canfor. The derived attributes have been projected to 2019 using Variable Density Yield Prediction (VDYP) model 7. All project phases included rigorous internal quality control processes.

The new VRI provides an updated forest inventory that incorporates comprehensive use of high-resolution false colour aerial photos, delineation reflecting the current distribution of vegetation cover, improved species composition estimates, the latest available Reporting Silviculture Updates and Land Status Tracking System (RESULTS) silviculture attribute data, photogrammetrically measured height values improving volume estimation, and an average polygon size that supports both timber supply analysis and operational planning activities.

2.3 Riparian Classification

Ecora conducted a riparian classification for K1N based on aerial imagery, Fresh Water Atlas data, and slope data. Stream classification was completed through photointerpretation with distance and slope references. Aerial photographs used in this classification process were the same images used for the VRI. Distance and slope were the main features used to assign classifications to streams. Assigned stream classes followed the criteria indicated in the Forest Planning and Practice Regulation (FPPR) Section 47.

In the classification process, all streams were broken into 100 m segments starting from each confluence. Each segment was assigned an average slope based on the elevation of its start and end points. Fish barriers were identified for segments where the slope is greater than or equal to 20% as stated in the *Fish-stream Identification Guidebook* (FPC,1998). Streams segments upstream of the fish barrier were automatically classified as non-fish-bearing and were assigned as S5 or S6 depending on the stream width. No buffers were applied to the S5/S6 at the timber supply level due to the physical limitations of this coarse classification method. Segments with an average slope of less than 20% were assigned with the appropriate stream classes by the average width of the active flood plain. The average width of the active flood plain was measured photogrammetrically in a virtual environment using DAT/EM Summit Evolution Lite v.7.1 softcopy software on an ESRI ArcMap 10.2 platform. Streams that were too narrow under the current image resolution were assigned as S4 when they originated from a fish-bearing stream or lake and did not have fish barriers along the channel up to the measured segment.

Lakes and wetlands were classified with the appropriate class based on the criteria stated in FPPR Sections 48 and 49. The riparian classes for lakes and wetlands were assigned under an automated process when the feature area met the FPPR classification size criteria. This riparian classification allowed for the proper designation of riparian buffers and provided an accurate representation of the riparian features at the timber supply level for K1N. It is recognized that photo interpreting stream classifications cannot be completed with 100% accuracy, and these classifications should be verified in the field prior to undertaking any management actions on the ground. However, this approach likely provides a reasonable estimation of the timber supply impacts of riparian features and represents a significant improvement over the aspatial percentages applied in the TSA.

2.4 Road Classification

The average road disturbance widths were determined for each road class using the aerial photographs from the VRI in a road class verification process. Twenty road width samples were randomly selected from each road class to obtain samples that were evenly distributed within the roaded land base of K1N, in order to accurately capture the total road disturbance surface of K1N.

2.5 Logging History

Logging history for the analysis was derived from VRI disturbance history, Canfor blocks, RESULTS, and consolidated cutblock data sets. VRI disturbance history was updated to January 2015; Canfor blocks were updated to May 2019; RESULTS and consolidated cutblock data were updated to January 2019. The end date of the operation was used when available. The majority of the land base had no logging history, while most of the areas with a logging history were harvested after 2010. The current age was updated by subtracting the log year from 2019, when log year was later than the reference year.

3. Land Base Classification

The crown forested land base (CFLB) is the forested land that meets the non-timber objectives; whereas, the timber harvesting land base (THLB) is defined as all productive forest expected to support timber harvesting within K1N. The CFLB was determined by excluding the non-community forest area, non-forested, non-productive areas, and existing roads from the K1N boundary. The THLB was determined by systematically removing categories of land that do not contribute to timber harvesting. Through this process, the gross area was systematically removed to establish both the CFLB and the THLB. The land base classification process classifies the gross area into three broad categories:

- **Non-Productive**: areas that are not managed by CFA K1N for forest values, non-forested and non-productive (unable to grow viable timber);
- **Productive Non-THLB or CFLB**: productive treed areas that are unlikely to be harvested for reasons such as inoperability or special environmental protections;
- **THLB**: productive land base that is expected to be available for timber harvest over the long-term.

Table 3-1: summarizes how the land base is classified, and Sections 3.1 to 3.16 details the assumptions and data used to arrive at the net removal area.

Table 3-1: Land Base Classification

Land Base Classification	Area (ha)	% of CFLB
Total Area	**12,998**	
Non-community Forest Agreement Area	4	
Non-forested and Non-productive	1,259	
Existing Roads, Trails and Landings	49	
CFLB	**11,686**	
Physical Inoperability	25	0.2%
Economical Inoperability	2,011	17.2%
Problem Forest Types	165	1.4%
Riparian	137	1.2%
Endangered Ecosystem	22	0.2%
Recreational Area	39	0.3%
Existing WTP	40	0.3%
Future Roads	54	0.5%
Stand-level Retention	913	7.8%
THLB	**8,280**	**70.9%**

3.1 Total Area

CFA K1N covers 12,998 hectares within the PG TSA. There are three parcels in K1N. The northern parcel is approximately 9,683 ha and is located north of Prince George, BC and immediately west of Highway 97. The two southern parcels are approximately 3,315 ha collectively and are located south of Prince George and directly west of the Fraser River.

3.2 Non-Community Forest Agreement Area

Land not administered by the K1N CFA license was removed from the CFLB using ownership codes. These included private lands and First Nations woodlot licenses. The net removal area occupied by the different types of ownership is summarized in Table 3-2.

Table 3-2: Non-CFA Ownership Types

Ownership	Description	Reduction (%)
40	Private Land	100
77	Woodlot License	100

3.3 Parks and Protected Area

There are no parks or protected areas overlapping K1N.

3.4 Non-Forest and Non-Productive Land

The British Columbia Land Cover Classification Scheme (BCLCS) was used to identify areas that are not forested such as rocks and water as well as vegetated, but non-treed polygons. These areas were excluded from the CFLB. Table 3-3 describes the non-forest and non-productive land classifications.

A TEM project was completed for K1N in 2008. TEM provides more detailed and accurate site series information for the land base. Table 3-4 shows the site series from TEM classified as non-productive. These areas are removed from the CFLB.

With confidence in the accuracy of the new VRI, only areas with a logging history that is more recent than the reference year were assumed to be forested or capable of supporting a forested stand. These areas were therefore not removed from the CFLB.

Table 3-3: Non-Forest and Non-Productive- VRI

BCLCS Levels	Description	Reduction (%)
Level 1= 'N'	Non-vegetated	100
Level 1= 'V' Level 2 = 'N'	Vegetated-non-treed	100

Table 3-4: Non-Forest and Non-Productive-TEM

BGC Variant	Site Series	Description	Reduction (%)
SBSdw3	Fl05	Drummond's willow - Bluejoint	100
SBSdw3	OW	Shallow Open Water	100
SBSdw3	Wm01	Beaked sedge - Water sedge	100
SBSdw3	Wm02	Swamp horsetail - Beaked sedge	100
SBSdw3	Wf01	Non-treed fen	100
SBSmk1	GB	Gravel Bar	100
SBSmk1	GP	Gravel Pit	100
SBSmk1	LA	Lake	100
SBSmk1	OW	Shallow Open Water	100
SBSmk1	PD	Pond	100
SBSmk1	RI	River	100
SBSmk1	RN	Railway Surface	100
SBSmk1	RZ	Road Surface	100
SBSmk1	Wb13	Shore sedge - Buckbean - Peat-moss	100
SBSmk1	Wf05	Slender sedge - Common hook-moss	100
SBSmk1	Wm01	Beaked sedge - Water sedge	100
SBSmk1	Ws04	Drummond's willow - Beaked sedge	100
SBSmk1	Ws50	Hardhack - Sitka sedge	100
SBSmk1	10	Scrub birch - Sedge (avoid logging)	100

3.5 Roads, Trails and Landings

Road buffer widths were determined from the average road disturbance width sampled from each road class as described in Section 2.4. The road buffer areas for the existing roads were removed from the CFLB according to the applied buffer widths described in Table 3-5.

Table 3-5: Road Buffer Width

Road Classification Type	Buffer Width (m)	Reduction (%)
Gravel Main	30	100
Operational	15	100
Spur	4	100
Temporary	5.6	100

3.6 Crown Forested Land Base

The K1N CFLB resulting from removing non-community forest, non-productive, non-treed areas, and existing roads, trails and landings from the gross area is 11,692 ha. This is the area that supports tree growth and can contribute to meeting non-timber objectives for seral stage distribution, visual quality objectives (VQOs), integrated resource management, and wildlife habitat requirements.

3.7 Physical Inoperability

Areas were considered inoperable where there were physical limitations to harvesting equipment or risk to the terrain. In this analysis, two attributes were assessed to determine the upper and lower bounds for operability: slope and terrain sensitivity.

The historical distribution of harvesting in different slope classes has been analyzed by the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO). The analysis indicates that the historical upper threshold for harvesting is a slope of 62%. For the purpose of defining operability, 60% slope was used as an upper bound in this analysis.

Environmentally Sensitive Area (ESA) mapping completed for TSR II identified areas of sensitive soils. Areas without a logging history, classified as ESA = 'S' (highly sensitive soils) were excluded from the THLB as shown in Table 3-6.

Table 3-6: Physical Inoperability Criteria

Logging History	Criteria	THLB Reduction (%)
No	ESA = 'S'	100
	Slope >60%	100

3.8 Economically Inoperable

The minimum economic operability threshold mimics the economically inoperable stand criteria in the Silviculture Type II Data Package (Timberline, 2009).

Table 3-7 describes the criteria used to exclude mature stands that are uneconomical from the THLB.

Table 3-7: Non-Economical Operability Criteria – Mature Stands

Logging History	Leading Species	Minimum Age (years)	Minimum Volume (m^3/ha)	Harvest System	THLB Reduction (%)
No	AT, EP	60	140	Conventional	100
	PLI	80	140	Conventional	100
	Other Conifer	80	140	Conventional	100

Deciduous leading volume was overestimated in the 2003 VRI. With the new 2018 VRI, these areas were reattributed according to the most recent VRI standard and procedures with photogrammetrically-measured heights using high resolution aerial photographs. The improvement in VRI has led to a decrease in live stand volume as well as a change in species composition in these stands. Therefore, stands below the minimum economic criteria were consequently excluded from the THLB. Only areas with log year more recent than the reference year were exempted because the new VRI would accurately capture the low volume stands only when the disturbance happened before the aerial photographs were taken.

Table 3-8 describes the criteria used to exclude immature stands that are expected to be uneconomical to harvest based on site index cut-off values calculated in Table Interpretation Program for Stand Yields (TIPSY). Area-weighted VRI age, height, site index and existing density were calculated for deciduous species (trembling aspen [AT] and paper birch [EP]), lodgepole pine (PLI), and other species (white spruce and Douglas-fir [FDI]). These ages and heights were then manually input into TIPSY and tested for a range of site index values to determine the cut-off site index at which the stand would not reach the minimum harvestable volume within the 250-year window. This approach prevented the netdown process from excluding too much immature area from the THLB, as area-weighted values can not capture the entire range of site conditions.

Table 3-8: Non-Economical Operability Criteria – Immature Stands

Logging History	Leading Species	Maximum Age (years)	Minimum Site Index	Harvest System	THLB Reduction (%)
No	AT, EP	60	13	Conventional	100
	PLI	80	9	Conventional	100
	Other Conifer	80	6.5	Conventional	100

3.9 Problem Forest Types

Problem forest types are stands that are physically operable and/or exceed the non-productive site index threshold but are not currently utilized or have marginal merchantability and are considered uneconomic. Table 3-9 details the problem forest types that were removed from the land base during the PG TSA TSR V analysis. These stands types were excluded from the THLB.

Table 3-9: Problem Forest Types Criteria

Leading Species	THLB reduction (%)
Non-commercial deciduous (AC)	100
Black Spruce (SB)	100

3.10 Riparian

Ecora completed a digital riparian classification for K1N in the data assembly process in order to assign the proper buffer width for riparian features. The classification methodology is described in Section 2.3. The riparian reserve zone and riparian management zone for streams, wetlands, and lakes were addressed based on Sections 47, 48 and 49 in FPPR respectively. For each classification, an effective buffer width was calculated by adding the riparian reserve zone width to the product of the riparian management zone width and the minimum basal area retention percent. The effective buffer widths for existing water features were removed from the THLB regardless of logging history. Buffer widths are presented in Table 3-10.

Table 3-10: Riparian Buffer Width

Feature	Riparian Class	Riparian Reserve Zones (m)	Riparian Management Zone (m)	Minimum Basal Area Retention (%)	Effective Buffer Width (m)	THLB reduction (%)
Rivers and Streams	S1-B	50	20	20	54	100
	S2	30	20	20	34	100
	S3	20	20	20	24	100
	S4	0	30	10	3	100
Wetlands	W1	10	40	10	14	100
	W3	0	30	10	3	100
Lakes	L1-B	10	0	10	10	100
	L3	0	30	10	3	100

3.11 Endangered Ecosystems

To determine endangered ecosystems, the BC Conservation Data Centre (CDC) data layer was overlaid on the K1N land base. A red-listed ecosystem named 'Hybrid White Spruce/Ostrich Fern' was identified on the land base through the process.

CDC is a member of NatureServe, a global network of Conservation Data Centres and equivalent programs, covering all states and provinces, and many other countries. These programs share common methodologies for collecting and managing information, which allows them to pool data for conservation assessment and planning across geopolitical boundaries. The primary functions of the BC CDC are to compile a list of species and ecosystems that occur in BC, assess conservation status ranks, map known locations, and publish the data and information (CDC, 2019).

A conservation status rank (red, blue, or yellow list) is assigned to each species and/or ecosystem to help set conservation priorities. A red-listed species or ecosystem is any species or ecosystem that is at risk of being lost (extirpated, endangered or threatened). A blue-listed species or ecosystem is any species or ecosystem that is of special concern. A yellow-listed species or ecosystem is any species or ecosystem that is at the least risk of being lost (CDC, 2019).

The Hybrid White Spruce /Ostrich Fern ecosystem is restricted to the Sub-boreal Spruce (SBS) mh biogeoclimatic zone located on either side of the Fraser River and stretching from the South of Prince George to the South of Quesnel. Due to the high risk associated with losing this ecosystem, it was removed from the THLB regardless of logging history. Table 3-11 shows the gross area and THLB reduction of this ecosystem.

Table 3-11: Rare Ecosystem

Description	THLB reduction (%)	Gross Area (ha)
Hybrid White Spruce/Ostrich Fern	100	95

3.12 Recreational Areas

Forest Tenure Recreation Sites and Trails layers were used to identify active recreational areas. There were no provincially recognized recreational features found in the K1N boundary. In the Silviculture Type II Data Package, Fort George Canyon Trail was buffered and removed from the THLB (Timberline, 2009). Considering the current active status of the trail and the fact that it is also located in a high recreationally sensitive polygon, a 50 m buffer was applied to the trail, and the area was excluded from the THLB.

3.13 Wildlife Tree Patches

Canfor has provided the WTP data associated with existing blocks in K1N. All mapped WTPs were removed from the THLB regardless of logging history.

3.14 Future Roads

Existing roads occupy 51 ha of the gross area in K1N, providing access to 4,511 ha of THLB. This accessibility ratio was determined by assuming that roads allow access to a 500 m buffer on either side from the road centerline. The 500 m buffered THLB is referred to as the accessible THLB. Based on this assumption, existing roads represent 1.14% of the accessible THLB. Additional roads will be constructed to access K1N. An estimated 54 ha of future roads will provide access to the currently inaccessible areas of K1N. These areas were therefore excluded from the THLB.

3.15 Stand-level Retention

Stand-level retention refers to the unharvested areas associated with cutblocks. The retention estimate includes areas occupied by riparian retention, WTP retention, and retention for the protection of forest values including archaeological features, site-specific habitat features, and any red or blue-listed species as mentioned in TSR V.

The total stand-level retention aspatial reduction percent was determined from an analysis on retention practices conducted by the MFLNRO documented in PG TSR V, which estimated the aspatial reduction to be 12.1% (MFLNRO, 2015). In this analysis, existing WTP, riparian retention for larger stream classes as well as endangered ecosystems have already been addressed in a spatially explicit manner. These areas represent 2.2% of the THLB. Based on the 12.1% total aspatial retention, additional future stand-level retention of 9.9% is applied to the THLB as the final step in the netdown process. This area will account for future WTP, riparian retentions and the protection of forest values.

3.16 Other Considerations

There are no old growth management areas, ungulate winter range, wildlife habitat areas, fish-sensitive watersheds, parks or protected areas, agriculture development areas or settlement reserve areas within K1N.

4. Current Forest Management Assumptions

4.1 Forest Cover Constraint

Resource management zones are grouped areas that support the non-timber resource requirements. Each resource management zone has forest cover objectives which are applied to the sub-sets of the land base. These assumptions are consistent with the *Prince George TSA Timber Supply Review Data Package* (MFLNRO, 2015) and the Prince George Land and Resource Management Plan.

Modeling integrated resource management objectives will be accomplished using forest cover constraints.

4.2 Landscape-level Retention

Landscape-level old forest retention targets for K1N follow the *Order Establishing Provincial Non-Spatial Old Growth Objectives* (Old Growth Order) effective since June 30, 2004. Biodiversity emphases are assigned at a landscape unit (LU) level within each natural disturbance types (NDT). K1N falls within the SBS biogeoclimatic zone and is classified as NDT3 for the entire land base. The old forest retention percentages based on biodiversity emphasis are referenced from the Old Growth Order, in this case, all LUs need to retain a minimum of 11% of CFLB that are older than 140 years old. Old forest retention targets will be calculated for each LU according to the area distribution and target percentages as shown in Table 4-1. As such, the old retention target will be applied to each LU representing the CFLB area-weighted average old retention percent from the Old Growth Order.

The base case assumes a 2/3 reduction to the 11% in the old forest retention requirement for the LUs with a low biodiversity emphasis to address impacts on the timber supply. The effective old forest retention percent is 7.33% for these LUs. For intermediate and high biodiversity emphasis landscape units that do not have enough old forest to meet the old forest retention percent, stands in age class 7 (age 121-140) may contribute to meet the requirement as stated in the Biodiversity emphasis and old growth objectives point number 6 from the Old Growth Order.

Table 4-1: Old Forest Retention Criteria

Natural Disturbance Type	LU Names	Biodiversity Emphasis	BEC zone	Age of Old Forest	Percent Old Forest Retention Based on Biodiversity Emphasis
3	Crooked	Intermediate	SBS	>140yrs	>11
3	Slender	Low	SBS	>140yrs	>7.33
3	Prince	Intermediate	SBS	>140yrs	>11
3	Gregg	Low	SBS	>140yrs	>7.33

4.3 Patch Size Objectives

Recommendations for patch size distribution for cut and leave areas of each NDT are provided in the section "Temporal and spatial distribution of cut and leave areas" of the *Forest Practices Code Guidebook Biodiversity Guidebook* (Biodiversity Guidebook, 1995). K1N falls within NDT3. Past forest harvesting practices in this area produced a landscape pattern that is notably different from the natural pattern, as described in the Biodiversity Guidebook for NDT3. Dispersed medium-sized cutblocks and leave areas have resulted in a fragmented forest with few areas of extensive, contiguous forest.

The Biodiversity Guidebook recommends harvesting using large aggregated harvest units to closely simulate the natural pattern of a large fire and large unburned areas and to decrease the fragmentation of the landscape. Due to the size and the spatial distribution of the landscape units, it is more rational to manage for the recommended distribution of patch size by parcels in this analysis. As mentioned in Section 3.1, there are three parcels in K1N; the largest parcel in the north will be managed as one management unit to meet the patch size distribution. The two southern parcels will be managed as one unit due to their small area. Table 4-2 details the patch size distribution recommendations of a management unit. The patch size and percent CFLB in each management unit is referenced from Table 13 of the Biodiversity Guidebook (1995).

In this analysis, patch size objectives were not included in the base case.

Table 4-2: Recommended Distribution of Patch Sizes for Stands in NDT3 (referenced from Table 13 of the Biodiversity Guidebook, 1995)

NDT	Patch Size (ha)	% CFLB in each Management Unit
3	250-1000	60-80
	40-250	10-20
	<40	10-20

4.4 Visual Quality Objectives

VQOs are designed to minimize the visual impacts of logging in the areas in which visual quality has been identified as an important value that requires specific management. A few VQO polygons exist within the community forest, primarily near the Fort George Canyon Trail. Visual quality is managed within these areas by restricting the proportion of the area that has not achieved a visually effective green-up (VEG) height at any particular point in time. The time to achieve VEG height is affected by several factors including the slope of the landscape, the height of adjacent trees and the rate at which individual trees grow.

To manage the visual impacts of harvesting on Crown land, the government delineates and classifies visually sensitive areas for scenic management as part of the VLI. In this timber supply analysis, visual modeling was implemented according to the *Procedures for Factoring Visual Resources into Timber Supply Analysis* (MOF, 1998).

Polygons selected to achieve VQOs were identified in the VLI and were classified based on their permissible visually effective disturbance level. Within these classifications, categories of visual absorption capacity (VAC) help define the maximum percent (%) alteration allowed on each VLI polygon. Where a VAC code was absent, the medium value of the maximum percent alteration was assigned to the VLI polygon. The numbers in Table 4-3 were applied to the clearcut method.

The maximum alteration percentage in plan view for each VLI polygon was calculated based on the assigned VQO and perspective to plan(P2P) ratio. For example, a maximum 7% alteration was assigned to a VLI polygon classified as 'Partial Retention', which was then multiplied by the P2P ratio depending on the average polygon slope. The VEG height was determined for each VLI polygon found in K1N based on a slope using the same methodology as summarised in Table 4-3.

A digital elevation model was used to derive an average slope for each VLI polygon. The P2P and VEG heights were derived for each VLI polygon based on the values in Table 4-4 and Table 4-5.

Table 4-3: Visual Quality Objective Criteria

VLI Number	Effective VQO	Area-Weighted Average Slope (%)	P2P Ratio	Max % Alteration (perspective View)	Max % Alteration (Plan View)	VEG Height (m)	CFLB (ha)	THLB (ha)	Max Alteration Area
1444	M	12.1	3.77	12.6	47.50	4.0	3.71	3.34	1.76
1427	PR	10.0	4.23	7.0	29.61	3.5	17.22	15.51	5.09
1631	PR	21.3	3.04	4.3	13.07	5.0	648.57	485.54	84.77
720	R	16.4	3.41	0.8	2.73	4.5	316.00	259.23	8.63

Table 4-4: VQO VEG Height Requirement and P2P Ratio

Category	Slope Classes (%)														
	0 -5.0	5.1 -10	10.1 -15	15.1 -20	20.1 -25	25.1 -30	30.1 -35	35.1 -40	40.1 -45	45.1 -50	50.1 -55	55.1 -60	60.1 -65	65.1 -70	70.1 +
VEG (m)	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	6.5	7.0	7.5	8.0	8.5	8.5	8.5
P2P	4.68	4.23	3.77	3.41	3.04	2.75	2.45	2.22	1.98	1.79	1.6	1.45	1.29	1.17	1.04

Table 4-5: VQO Assumptions

VQO Class	% Alteration by Visual Absorption Capability (Perspective View)		
	Low	Medium	High
Retention	0	0.8	1.5
Partial Retention	1.6	4.3	7.0
Modification	7.1	12.6	18.0

4.5 Agricultural Land Reserves

Agricultural land reserve (ALR) is a provincial land-use zone where agriculture is the priority use. There is a significant component of ALR overlapping K1N land base, particularly in the two southern parcels. In this analysis, ALR status areas have a one-time harvest opportunity in the planning horizon due to the difference in the long-term management objective.

5. Modeling Approach

5.1 Forest Estate Model

The spatial analysis will be conducted using the Patchworks spatial optimization model. Patchworks is a spatially explicit harvest scheduling optimization model developed by Spatial Planning Systems in Ontario. It is capable of developing spatially explicit harvest allocations that explore trade-offs between a broad range of conflicting management and harvest goals.

For this analysis, Patchworks will be formulated to maximize harvest volume while meeting all the required management objectives.

Harvest scheduling decisions are based on maximizing the harvest forecast over the long-term, subject to meeting non-timber and other management objectives on the land base. As such, there are no explicit harvest rules other than minimum merchantability limits applied to the model. All scenarios must maintain a sustainable growing stock level in the long term.

The model utilizes 5-year planning periods over a 250-year planning horizon.

5.2 Harvest Flow Objectives

The objective of the timber supply analysis is to determine the capacity of the K1N land base to sustain timber harvesting over the short, mid and long-term and to identify any risks to this flow resulting from uncertainty in the underlying data or assumptions. The analysis goes beyond a simple calculation of capturing the growth potential of the land base. The biological capacity of the forest to grow trees as well as non-timber requirements dictates the sustainable harvest level for a particular area. Within this, there are a number of alternative harvest flows possible. In this analysis, we will establish a harvest level that best meets the needs of K1N over a 250-year planning horizon and also examining alternative rates of harvest.

5.3 Silviculture System

The base case assumes a clearcut with reserves harvest system.

5.4 Utilization Levels

The merchantable timber specifications define the maximum stump height, minimum top diameter inside bark (DIB) and minimum diameter at breast height (DBH) by species and are used in the analysis to calculate the merchantable volume. The merchantable timber specifications are described in Table 5-1.

Table 5-1: Merchantable Timber Specifications

Leading Species	Minimum DBH (cm)	Maximum Stump Height (cm)	Minimum Top DIB (cm)
Pine	12.5	30	10.0
Aspen	17.5	25	10.0
Balsam and Spruce	17.5	25	10.0
Other species	17.5	30	10.0

5.5 Minimum Harvest Criteria

The base case will allow stands to be harvested once they have achieved a minimum of 140 m^3/ha. This will determine the minimum harvest age for each stand.

5.6 Unsalvaged Losses

Periodic natural disturbances caused by extreme weather, fire, or epidemic forest health factors can result in large volume losses if the impacted stands are not salvaged. These events are accounted for by averaging the recorded periodic volume losses over the recorded time frame to approximate an average annual volume loss. This volume is deducted from the growing stock each year in the timber supply model forecast.

Currently, K1N is in the post Mountain Pine Beetle salvage stage. For this period, the unrecovered losses estimates are derived from the pre-epidemic salvage estimates utilized in TSR II.

Spruce beetle was not included in the annual unsalvaged loss estimates in PG TSA TSR II. Based on the current Aerial Overview Survey (AOS) data for spruce beetle, there are minor impacts from spruce beetle in K1N. Table 5-2 summarizes the CFLB area impacted by spruce beetle in K1N. A sensitivity analysis will be conducted for K1N to model the changes in timber supply if the impacted area would increase one severity level. For example, areas in moderate severity will transition into high severity; low severity area will transition into moderate severity area, etc. Harvest priority will also be modeled around these AOS severities.

Table 5-2: Summary of Spruce Beetle Impact on CFLB in K1N

AOS Severity	CFLB (ha)
Trace	317
Low	255
Moderate	78
Total	650

The unsalvaged losses estimates from Table 5-3 are applied to the results of all timber supply scenarios.

Table 5-3: Summary of Annual Unsalvaged Loss Estimates (m^3/year) for K1N

Description	Region	THLB (ha)	Insects (m^3/yr)	Fire (m^3/yr)	Wind (m3/yr)	Total (m^3/yr)
Unrecovered volume post-pine salvage period	PG TSA (TSR V)	2,724,750	278,500	111,000	3,670	393,170
	K1N	8,280	846	337	11	1,194

6. Growth and Yield

6.1 Analysis Units

Natural existing analysis units are identified as VRI polygons that do not have a harvest history or have been harvested prior to 1987. Existing managed analysis units are stands younger than 32 years that have a recent harvest history. Future managed analysis units are the units existing stands transition to after being harvested in the timber supply model. Projected height, projected age, basal area, and species composition from the VRI are used to generate the yield tables for each polygon. These polygon-level yield tables are then carried into the timber supply model.

6.2 Natural Stand Yield Tables

Stand attributes from the VRI were used to generate the yield curves for each existing natural stand using VDYP 7. These polygon-level yield tables were then carried into the timber supply model. Due to the large size of the VDYP yield table, it is not feasible to include them in this data package. Digital versions of the yield tables can be provided.

6.3 Managed Stand Yield Tables

Growth and yield for all existing and future managed stands will be modeled with TIPSY v.4.3. The species compositions of the managed stands are shown in Table 6-1. Managed stand analysis units were defined using TEM site series as defined in the regeneration assumptions from Table 6-1.

Table 6-1: Base Case Planted Regeneration Assumptions

BGC variant	Site Series	Existing Leading Species	SP1	SP1%	SP2	SP2%	Planted or Natural	Initial Density	Regen Delay	Stem Distribution
SBS dw 3, SBS mh, or SBS mk 1	00,01,03,04, 05,06,07,08, or 09	SX	SX	80	PLI	20	P	1400	2	Managed
		AT	AT	95	SX	5	N	5000	7	Natural
		EP	SX	100			P (80)	1200	2	Managed
		EP	EP	100			N (20)	2000	7	Natural
		PLI	PLI	80	SX	20	P	1400	2	Managed
		BL	SX	100			P	1400	2	Managed
		FDI	PLI	80	FDI	20	P	1400	2	Managed

Regen delay for all planted components are 2 years based on the average time difference between the harvest end date and the planting completion date in the RESULTS silviculture data for K1N for the past 7 years. Regen delay for all naturally regenerated components are 7 years according to the maximum regen delay in Appendix D: Agreement K1N Regeneration and Free Growing Stocking Standards (K1N Stocking Standard) in *Forest Stewardship Plan Updated with Amendment 5* (2017). Regeneration species composition as well as initial density were provided by Canfor. Natural ingress will be applied for paper birch-leading stands since they naturally regenerate the stand post-logging. Density for this natural ingress is referenced from the target stocking standard of the preferred and acceptable species of the deciduous stands in the K1N Stocking Standard.

6.4 Genetic Gains

Genetic gain factors were applied during the compilation of future managed stand yield tables. The factors used by species are shown in Table 6-2. The base case follows the current best management practice which uses genetic gains calculated from the Seed Planning & Registry Application (SPAR) reports. In the subsequent sensitivity analyses, the following average genetic gain values were assessed: impacts on the timber supply when no genetic gain is applied, applying Canfor's provided genetic gain values, and Climate Based Seed Transfer (CBST) values.

Seed use by Canfor for K1N for the last ten years were retrieved from SPAR. The average genetic gain values were calculated through weighing the genetic worth by the seedling counts of each sowing year. According to RESULTS planting data, Canfor used only Class A seeds for K1N.

CBST refers to a seed transfer system based on climate, for the purposes of adapting to and mitigating the impacts of climate change (Spence & Zendal, 2018). Currently based on the *Chief Forester's Standards for Seed Use* (Standards; 2018), seed selection must comply with either the geographically based seed transfer (GBST) standards or the CBST standards. The GBST genetic gains are reflected in the SPAR report. In the April 2019 Amendment to the *Chief Forester's Standards for Seed Use*, it states that MFLNRO is transitioning from GBST to CBST, and that the full transition will finish as early as 2021. Therefore, it is critical to assess the impact of the CBST genetic gain on K1N's timber supply.

CBST genetic gain averages were calculated by extracting all CBST Areas of Use data from the CBST web application for the three BEC variants in K1N. Data with genetic worth lower than the SPAR genetic gain average was excluded, assuming CBST would only select seed sources that are superior than the GBST seed source. The average genetic gains of each species were used in the sensitivity analysis.

Table 6-2: Genetic Gain by Species for Future Managed Stands

Species	SPAR Genetic Gain (%)	Canfor Genetic Gain (%)	CBST Genetic Gain (%)
SX	26	26	27
PLI	13	6.5	16
FDI	27	27	29

6.5 Operational Adjustment Factors

Operational adjustment factors are consistent with the PG TSA TSR analysis; existing and future managed stands use operational adjustment factor 1 and operational adjustment factor 2 values of 15% and 5% respectively.

6.6 Site Productivity Estimates

The Lheidli T'enneh Community Forest completed a TEM project in 2007 which provided site series information for the entire K1N area. The provincial Site Index by Biogeoclimatic Ecosystem Classification (SIBEC) database, correlated with TEM site series will be used to provide site productivity estimates for each TEM polygons. SIBEC values from the leading site series and leading regenerated species will be used wherever possible. Inventory site index values will be area-weighted across the analysis unit where SIBEC values do not exist.

7. Sensitivity Analysis

Sensitivity analyses help quantify the degree to which uncertainty in the analysis might affect the resulting timber supply for the land base. The sensitivities listed in Table 7-1 will be considered in the analysis. This list may be refined in consultation with other stakeholders as the analysis is conducted.

Table 7-1: Potential Sensitivity Analysis Scenarios

Sensitivity	Range Tested	Scenarios
Minimum harvest age (MHA)	Assess the impacts of applying a minimum harvest age as opposed to minimum volume	Set MHA to 80 years
		Set MHA to 60 years
Yield assumption	Increase / decrease both managed and natural stand yields	Natural Stand Yield Tables +/- 10%
		Managed Stand Yield Tables +/- 10%
Minimum harvestable volume (MHV)	Assess the impacts of increasing and decreasing MHV	Increase MHV to 180 m^3/ha
		Decrease MHV to 120 m^3/ha
VQO	Assess the impact of altering VQO related penalties	Decrease VQO classification by 1 class (Partial Retention to Modification, etc.)
Different regeneration assumptions	Convert AT to SX leading	Regenerate AT leading stand to SX following initial harvest.
Commercial thinning (CT)	Assess the impact of commercial thinning for managed stands under 45 years old	Apply CT yield curves to coniferous managed stands with minimum 20 m^2 BA for <=45 years old with maximum 40% CT volume removal
Patch Size	Assess the change in harvest flow when applying patch size objectives	Apply patch size objectives
Genetic Gain	Assess the impacts of regenerating managed stands with different genetically modified stocks	No genetic gain curves
		SPAR genetic gain curves
		Canfor provided genetic gain values
		CBST genetic gain curves

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Appendix 4: Analysis Report

Lheidli T'enneh Community Forest Agreement (K1N) Timber Supply Review Analysis Report

Presented To: Terry Lazaruk, RPF
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Ecora File No.: [FG-19-170-CFP]

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v5	16 September 2019	Hui Yu Zheng	Terry Lazaruk	
v3	3 September 2019	Hui Yu Zheng	Jay Greenfield	
v1	16 July 2019	Hui Yu Zheng	Jay Greenfield	

Limitations of Report

This report and its contents are intended for the sole use of Lheidli T’enneh Community Forest and Canadian Forest Products Ltd. and their agents. Ecora Engineering & Resource Group Ltd. does not accept any responsibility for the accuracy of any data, analyses, or recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Lheidli T’enneh Community Forest and Canadian Forest Products Ltd. and their agents. Any such unauthorized use of this report is at the sole risk of the user.

Executive Summary

Canadian Forest Products Ltd. (Canfor) has initiated a timber supply review in support of an allowable annual cut (AAC) determination for the Lheidli T'enneh Community Forest Agreement (licence # K1N). This document describes the results of the recently completed timber supply review and should be viewed in conjunction with the detailed description of the data and assumptions provided in the Lheidli T'enneh Community Forest Agreement (K1N) Timber Supply Review Data Package (Ecora, 2019).

Through a landbase classification process, area is systematically removed from the gross landbase area to establish both the productive Crown forested landbase (CFLB) and timber harvesting landbase (THLB). The THLB for the analysis is calculated at 8,280 ha.

The base case timber supply analysis includes:

- A minimum harvest volume of 140 m^3/ha for conventional harvest systems;
- Meeting visually quality objectives and landscape-level old forest retention targets;
- A one-time harvest constraint on Agricultural Land Reserves (ALR);
- A 10% per decade step-down in harvest level starting from 42,900 m^3/yr;
- Genetic gain averages from Seed Planning and Registry Application reports on managed stands; and
- A sustainable long-term growing stock at 26,600 m^3/yr from year 55.

The base case harvest forecast is shown in Figure i and shows the harvest level starting at approximately 42,900 m^3/yr and gradually decrease to approximately 26,600 m^3/yr at year 55 for the remainder of the planning horizon. These values are net of non-recoverable losses.

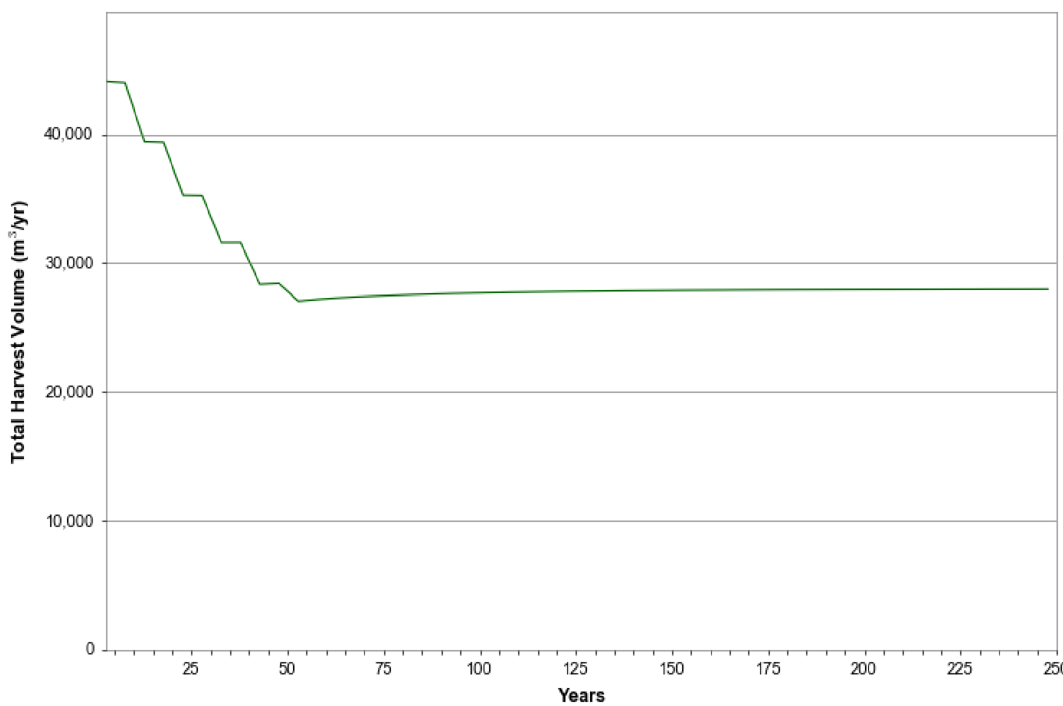

Figure i: Base Case Harvest Flow

Sensitivity analyses provide information on the degree to which uncertainty in the base case data and assumptions might affect the proposed harvest level for the landbase. A summary of the sensitivity analysis results and their variation from the base case are shown in Table i. In general, the sensitivities and the base case show that planting without genetically improved seeds has the largest impact on the total harvest level. Meanwhile, the largest impact on the short to mid-term harvest level occurs when the minimum harvestable age is increased. Individual sensitivities are discussed in detail in Section 4.

Table i: Average Harvest Level – All Scenarios

Sensitivity	Harvest Volume (1,000's m^3/yr)		% Change from the Base case	
	1 to 60	61 to 250	1 to 60	61 to 250
Base case	33.12	26.63		
Even Flow	26.81	26.83	-19%	1%
No ALR harvest constraints	34.16	27.72	3%	4%
Minimum harvestable age 40	32.43	26.76	-2%	0%
Minimum harvestable age 60	31.64	27.71	-4%	4%
Minimum harvestable age 80	26.79	27.48	-19%	3%
Minimum harvest volume 120 m^3/ha	33.08	26.66	0%	0%
Minimum harvest volume 180 m^3/ha	29.32	25.46	-11%	-4%
Natural stands yield curves + 10%	34.54	27.74	4%	4%
Natural stands yield curves - 10%	29.31	26.46	-11%	-1%
Managed stands yield curves + 10%	34.00	28.75	3%	8%
Managed stands yield curves - 10%	30.53	25.58	-8%	-4%
Lower Visual Quality Class by one class	33.88	27.54	2%	3%
Convert aspen to spruce stands	33.35	27.56	1%	3%
Block size limitation (>5 and <100 ha)	29.08	26.28	-12%	-1%
Block size limitation (>5 and <100 ha and max 10% of blocks in >5 and <15 ha)	28.87	26.45	-13%	-1%
No genetic gains	28.67	24.21	-13%	-9%
Canfor's provided genetic gain	32.47	26.49	-2%	-1%
Climate-Based Seed Transfer genetic gain	33.41	26.72	1%	0%

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Acronyms and Abbreviations

AAC	Allowable Annual Cut
ALR	Agricultural Land Reserve
AT	Trembling Aspen
BA	Basal Area
BEC	Biogeoclimatic Ecosystem Classification
BL	Subalpine Fir
Canfor	Canadian Forest Products Ltd.
CFA	Community Forest Agreement
CFLB	Crown Forested Land Base
CT	Commercial Thinning
EP	Paper Birch
FDI	Interior Douglas-fir
K1N	Lheidli T'enneh Community Forest Agreement
LTHL	Long Term Harvest Level
LTNFN	Lheidli T'enneh First Nations
MAI	Mean Annual Increment
MFLNRO	Ministry of Forests, Lands and Natural Resource Operations
MHA	Minimum Harvestable Age
MHV	Minimum Harvest Volume
MSYT	Managed Stand Yield Table
NSYT	Natural Stand Yield Table
PG	Prince George
PLI	Interior Lodgepole Pine
RESULTS	Reporting Silviculture Updates and Land Status Tracking System
SBS	Sub-boreal Spruce Biogeoclimatic Zone
SI	Site Index
SX	Spruce Hybrid
SIBEC	Site Index by BEC Site Series
TASS	Tree and Stand Simulator
TEM	Terrestrial Ecosystem Mapping
THLB	Timber Harvesting Land Base
TIPSY	Table Interpolation Program for Stand Yields
TSA	Timber Supply Area
TSR	Timber Supply Review
VQO	Visual Quality Objectives
VQC	Visual Quality Class
VPH	Volume Per Hectare
VRI	Vegetation Resources Inventory

1. Introduction

The Lheidli T'enneh Community Forest Agreement (CFA) (Licence # K1N) covers 12,998 ha located within the Prince George timber supply area (PG TSA) in east-central British Columbia. The Lheidli T'enneh First Nation (LTNFN) has held the community forest agreement license since 2008. The current allowable annual cut (AAC) for K1N is set at 28,000 m^3/year, with the AAC issued on June 1, 2010.

Canadian Forest Products Ltd. (Canfor) manages and operates the CFA for the LTNFN and has contracted Ecora Engineering & Resource Group Ltd. (Ecora) to prepare a timber supply review to assist the determination of a new AAC for K1N.

The purpose of this analysis report is to document the results of modelled scenarios in support of the new AAC determination. This analysis report should be viewed in conjunction with the recently completed Lheidli T'enneh Community Forest Agreement (K1N) Timber Supply Review Data Package (the Data Package; Ecora, 2019) which describes the input data and assumptions used in this analysis.

2. Landbase Description

The CFA is split into two units: The Salmon Unit (one parcel of 9,683 ha) in the Salmon River area north of Prince George and west of Highway 97, and Fyfe Unit (two parcels totalling 3,315 ha) south of Prince George and west of the Fraser River. Figure 2-1 illustrates the geographical location of K1N licence area relative to the City of Prince George.

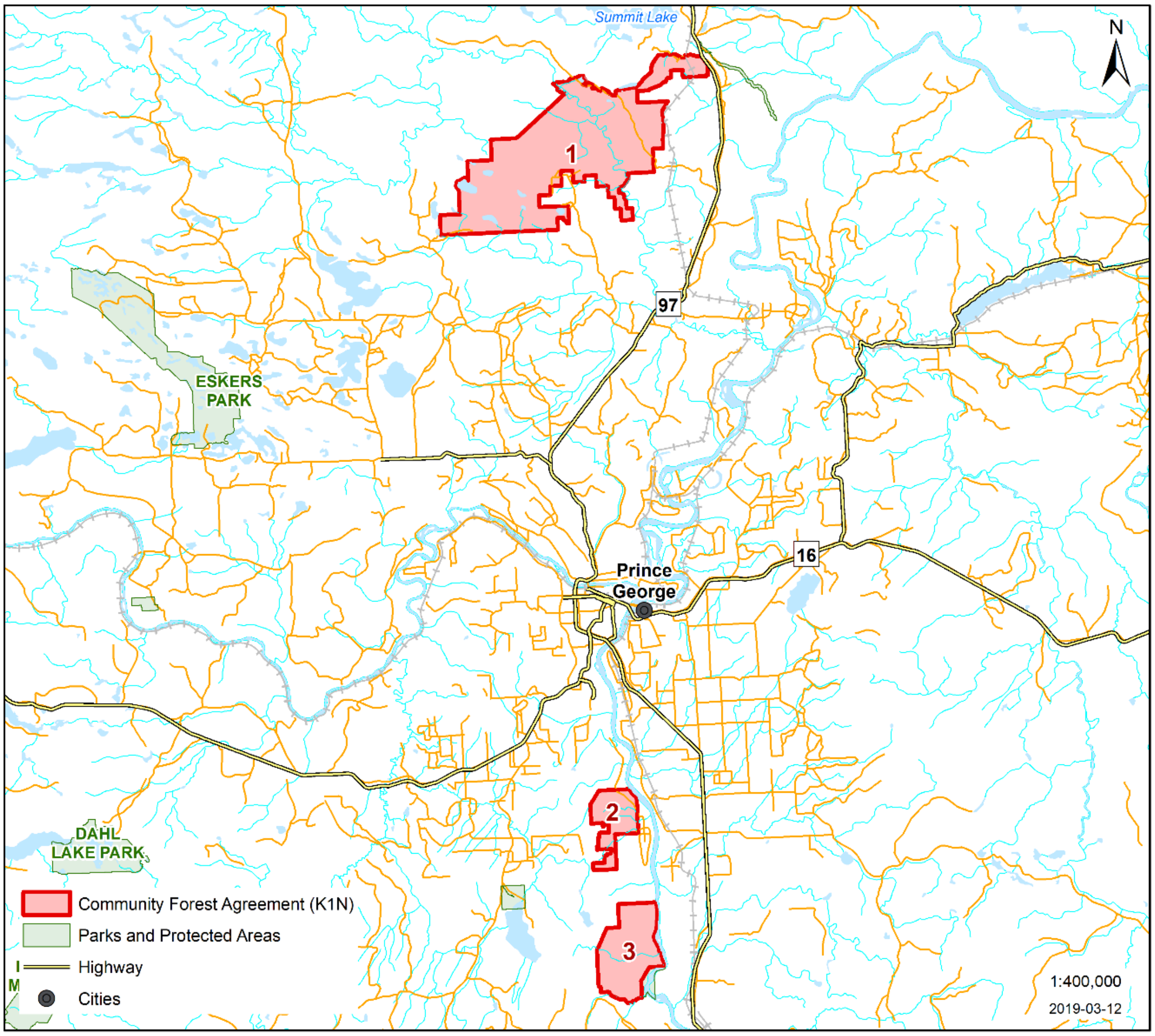

Figure 2-1: Community Forest Agreement K1N Licence Area

2.1 Landbase Classification

The landbase classification process begins with the total area of K1N and removes area in a stepwise fashion according to the classification criteria detailed in the Data Package (Ecora, 2018). Through this process, area is systematically removed to establish both the Crown forested landbase (CFLB) and the timber harvesting landbase (THLB). Table 2-1 summarizes the area removed under each classification to reach a THLB of 8,280 ha.

Table 2-1: Landbase Classification

Land Base Classification	Area (ha)	% of CFLB
Total Area	**12,998**	
Non-community Forest Agreement Area	4	
Non-forested and Non-productive	1,259	
Existing Roads, Trails and Landings	49	
CFLB	**11,686**	
Physical Inoperability	25	0.2%
Economical Inoperability	2,011	17.2%
Problem Forest Types	165	1.4%
Riparian	137	1.2%
Endangered Ecosystem	22	0.2%
Recreational Area	39	0.3%
Existing Wildlife Tree Patch	40	0.3%
Future Roads	54	0.5%
Stand-level Retention	913	7.8%
THLB	**8,280**	**70.9%**

2.2 Leading Species

The CFLB includes both the THLB and the productive non-THLB. Figure 2-2 shows the leading species within the CFLB divided into THLB and non-THLB. The THLB is predominantly spruce-leading (SX). Spruce leading stands represent 50% of the THLB, followed by aspen (AT) at 24%, paper birch (EP) at 9%, lodgepole pine (PLI) at 8%, subalpine fir (BL) 6%, and interior Douglas fir (FDI) at 3%.

Ecora completed a new Vegetation Resources Inventory (VRI) for the K1N licence area using 2015 aerial photography in 2018, including a report comparing the 2003 vintage-VRI to the 2018 VRI (Ecora 2018). One of the key findings from the VRI report is that the total deciduous volume and spruce volumes have shifted, respectively, from 52% and 32% in the 2003 VRI to 33% and 55% in the 2019 VRI. Note that this analysis report only uses Rank 1 data from the VRI; whereas, the VRI report compares all layers.

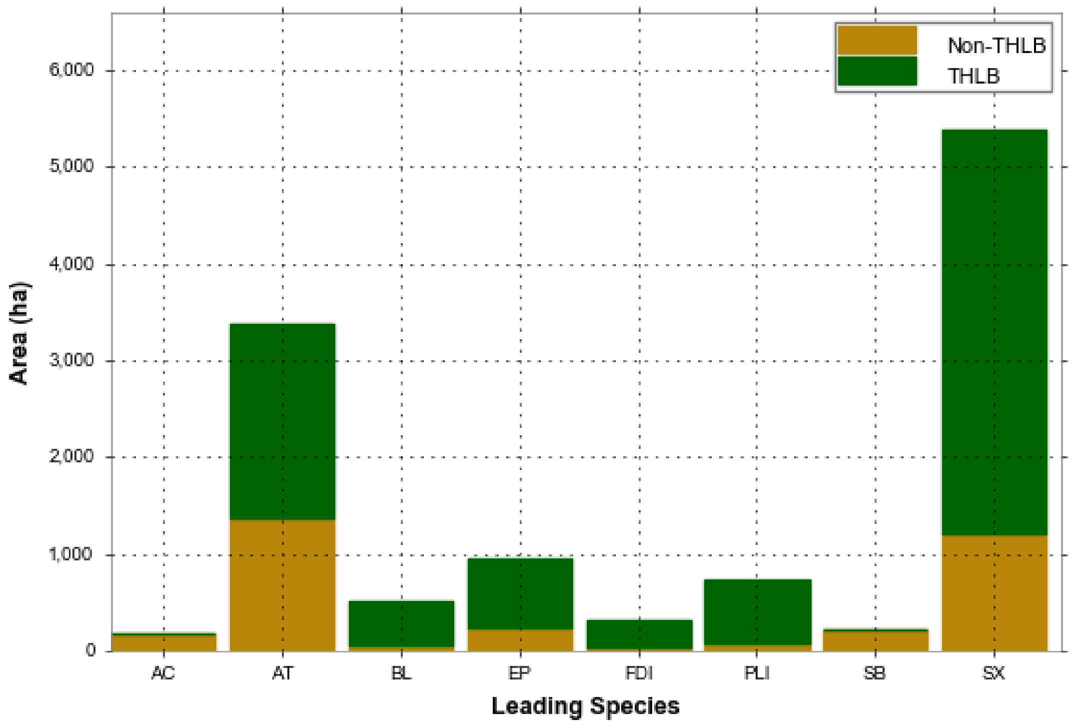

Figure 2-2: Leading Species Summary

2.3 Logging History

Logging history for the analysis is derived from VRI disturbance history, Canfor blocks, Reporting Silviculture Updates and Land Status Tracking System (RESULTS), and consolidated cutblock data sets. VRI disturbance history was updated to January 2015; Canfor blocks were updated to May 2019; RESULTS and consolidated cutblock data were updated to January 2019.

Figure 2-3 summarizes the THLB and non-THLB by the decade of harvesting activities. The earliest logging on the K1N landbase dates back to the 1950s. Harvest activities peaked in the 2010s in response to the Mountain Pine Beetle infestation, representing 11% of the THLB. Approximately 6,270 ha (76%) of the THLB remains unharvested.

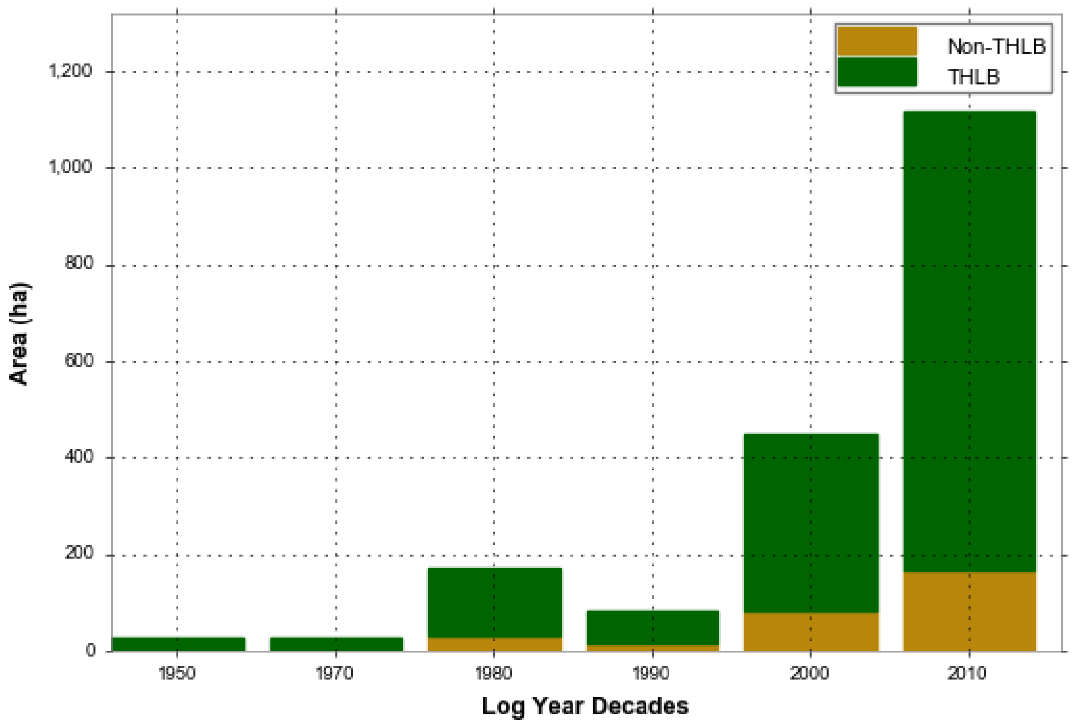

Figure 2-3: Harvest Decade Distribution

2.4 Age Class Distribution

The analysis uses an age updated to December 31, 2018. Figure 2-4 shows the current age class distribution. Table 2-2 lists the range of age each age class represents. The majority of the THLB is in age class 5 and above, reflecting an infrequent disturbance history. Harvesting activities in the 2010s places 14% of the THLB in age class 1. There is a shortage in age classes 2,3 and 4 as shown in Figure 2-4. Overall, the landbase is composed of primarily mature timber that can meet the timber and non-timber objectives.

Table 2-2: Age Class and the Represented Range

Age Class	Range of Age
1	0 to 20
2	21 to 40
3	41 to 60
4	61 to 80
5	81 to 100
6	101 to 120
7	121 to 140
8	141 to 250
9	251+

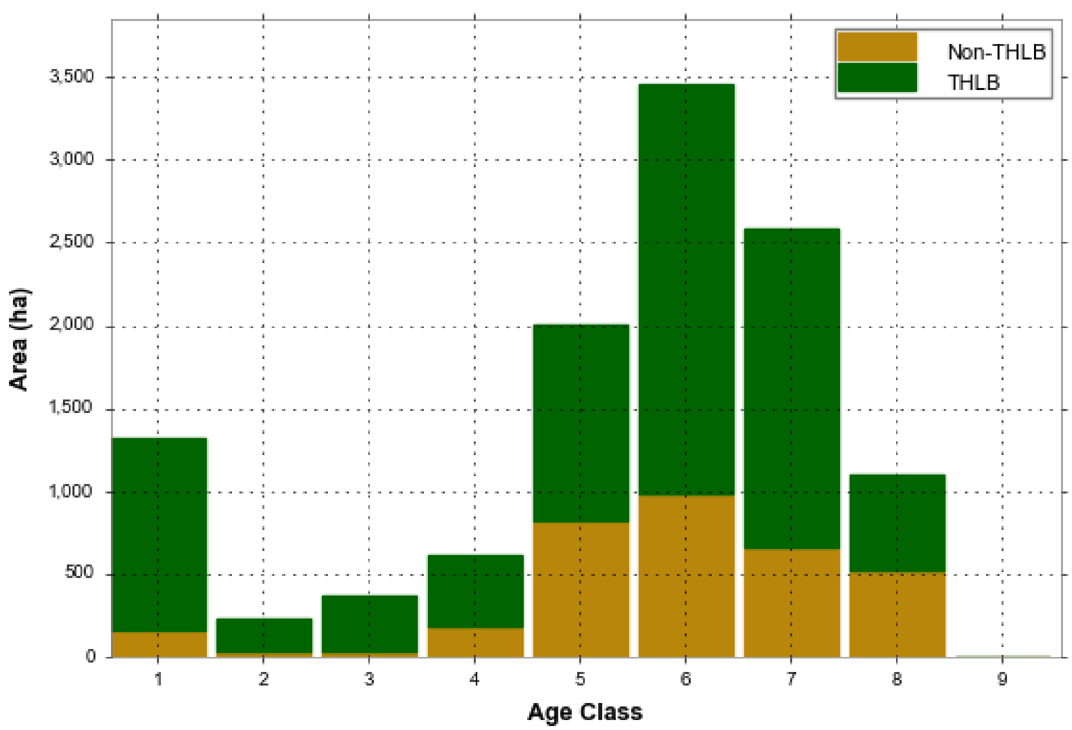

Figure 2-4: Initial Age Class Distribution

2.5 Site Index

Inventory site index (SI) values are used to estimate natural stands' productivity, while SI values from the Site Index by Biogeoclimatic Ecosystem Classification (SIBEC) database estimate the productivity of managed stands. In this analysis, inventory SI values are primarily used to generate natural yield curves and are also used when SIBEC estimates are not available for managed yield curves. SIBEC values are intended to capture forest management practices that increase forest productivity such as planting and spacing. Figure 2-5 and Figure 2-6 show the inventory SI and SIBEC distributions in K1N respectively, with values rounded to the nearest 3 m.

Figure 2-5 shows the inventory SI distribution for K1N with the majority of the THLB between 17 and 22 m.

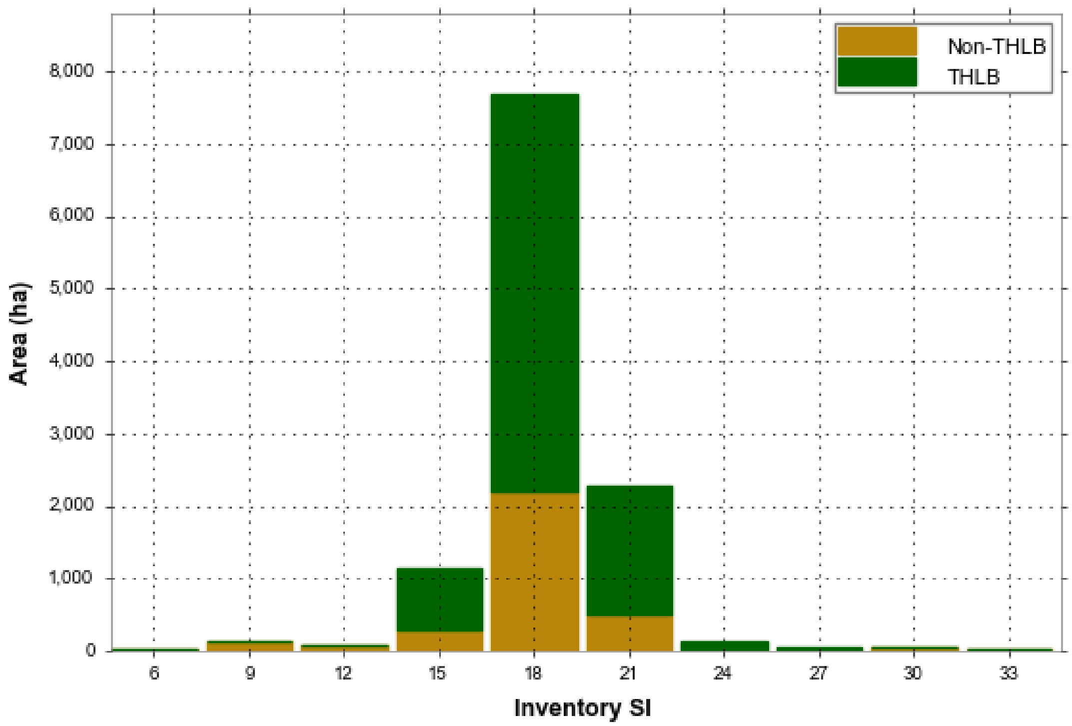

Figure 2-5: Inventory Site Index Distribution

Terrestrial Ecosystem Mapping (TEM) across the landbase facilitates the use of SIBEC estimates as measures of managed stand productivity. Figure 2-6 shows the distribution of SIBEC values across the CFLB. Most of the THLB SIBEC values range from 17 to 22 m. The SIBEC estimates are slightly higher than the inventory SI, as more CFLB falls within the SI 21 range compared to the inventory SI distribution. This is because most of the stands are still natural; therefore, SIBEC estimates did not accurately capture the increase in forest productivity associated with managed stands.

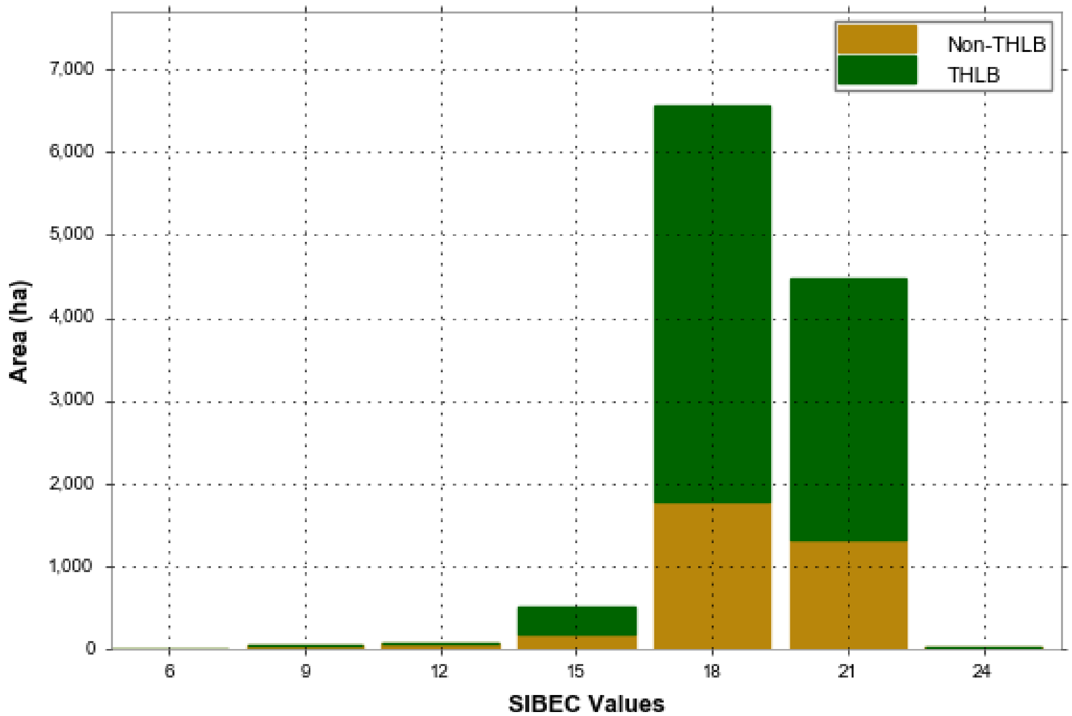

Figure 2-6: SIBEC Distribution

2.6 Biogeoclimatic Ecosystem Classification

K1N biogeoclimatic ecosystem classification (BEC) variants include Sub-Boreal Spruce (SBS) mk1 (Moist Cool Mossvale), SBS dw3 (Dry Warm Stuart), and SBS mh (Moist Hot) as shown in Figure 2-7. The climate of SBS is mild continental with average temperatures ranging from 13 °C in the SBS mk1 to 16 °C in SBS mh and mean annual precipitation ranging from 500 mm on low lying areas to 950 mm on mountainous terrain (BC Forest Research Branch, 1993).

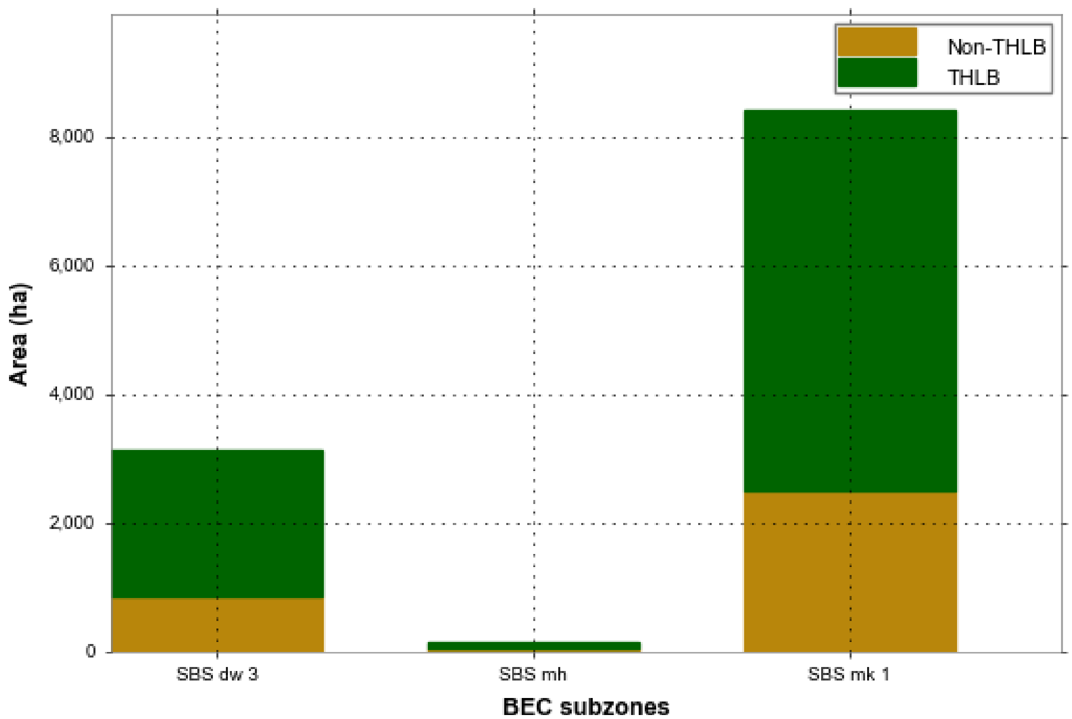

Figure 2-7: BEC Subzones

2.7 Volume Classes

Figure 2-8 displays the volume per hectare characteristics of the CFLB rounded into 100 m^3/ha classes. Table 2-3 lists the range of volume in each volume class. 50% of the THLB falls within volume class 200, and 25% falls within volume class 300. This reflects the overall low site productivity of the landbase. The large deciduous component in the natural stands is also a contributing factor to this lower volume profile.

Table 2-3: Volume Class and the Represented Range

Volume Class	Range of Volume (m^3/ha)
0	0 to 49
100	50 to 149
200	150 to 249
300	250 to 349
400	350 to 449
500	450 to 549

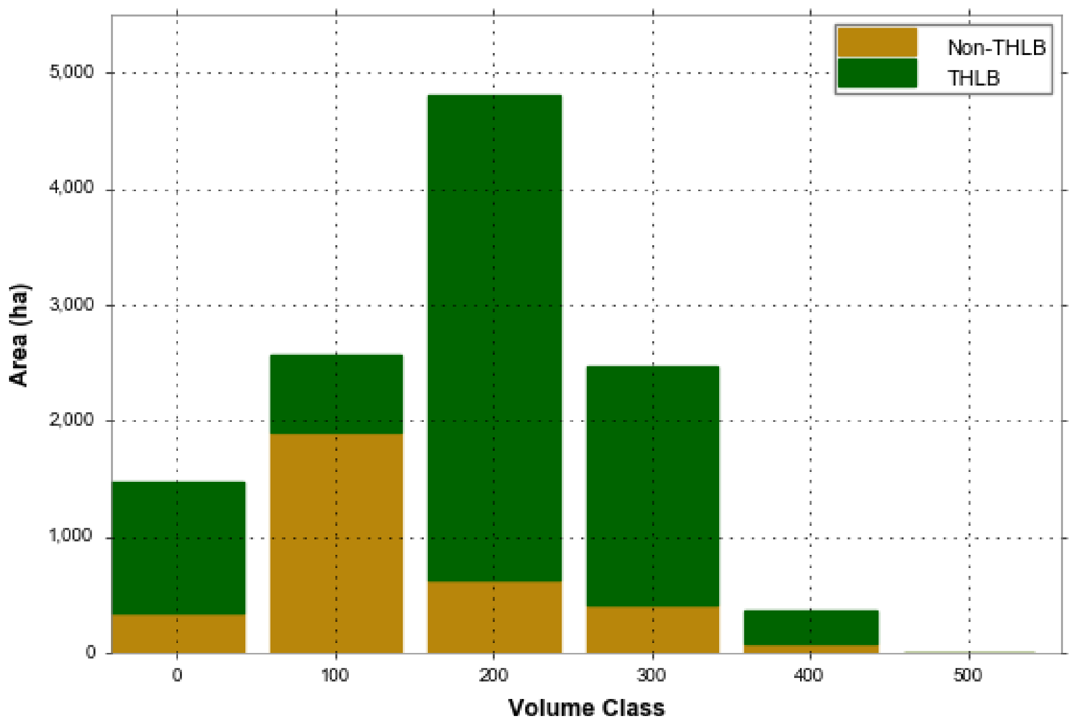

Figure 2-8: Volume Class Distribution

3. Base Case Timber Supply Analysis

The base case is the best representation of "current management" of K1N. It contains the data and assumptions that, combined, form the best estimate of timber supply for the landbase. Recognizing that uncertainty exists in both data and assumptions, sensitivity analyses are undertaken to attempt to quantify the impact of this uncertainty on the overall harvest level for the K1N CFA.

This section presents the results of the base case timber supply analysis and provides background information on different aspects of the timber supply. The base case and all sensitivity analyses have been carried out using the forest estate model Patchworks. This model is set up to maximize harvest volume subject to the constraints needed to effectively manage the non-timber resources. All harvest levels are reported for total volume net of non-recoverable losses (1,194 m^3/yr) and include both conifer and deciduous volume. The forest estate model uses five-year planning periods over a 250-year planning horizon.

3.1 Harvest Forecast

Harvest volumes for each scenario have been summarized as average values for each planning period. Figure 3-1 and Table 3-1 show the average harvest level over the first decade at 42,900 m^3/yr, with harvest levels decreasing by 10% every decade until the harvest level reaches approximately 26,600 m^3/yr. The base case follows a stepdown harvest target because 1,097 ha of THLB are designated as Agricultural Land Reserve (ALR), which has a one-pass harvest constraint. Therefore, after the ALR becomes unavailable for harvest, the total annual harvest volume remains relatively constant for the remainder of the planning horizon.

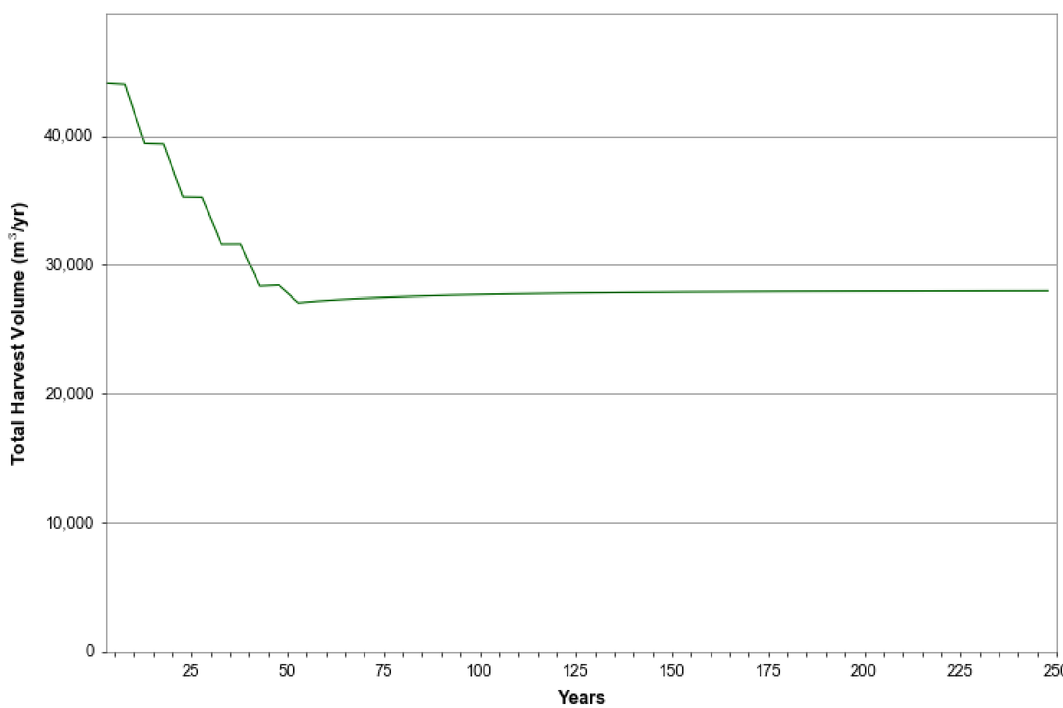

Figure 3-1: Base Case Harvest Flow

Table 3-1: Base Case Average Annual Harvest Levels

Years	Base Case (m^3/yr)
1 to 10	42,850
11 to 25	36,840
26 to 60	28,740
61 to 250	26,630

3.2 Base Case Harvest Characteristics

The total THLB growing stock with managed and natural stand breakdown is shown in Figure 3-2. The initial total growing stock of 1,499,010 m^3 decreases rapidly in the first 40 years as old natural stands are harvested. The total growing stock reaches the lowest level at years 40 through 50, where a majority of the existing natural growing stock will have been harvested and much of the future managed stands will not have reached the minimum harvest volume yet. Additionally, the 1,097 ha of ALR stands are not regenerated and therefore do not contribute to future growing stock level. Harvesting is most constrained at this point, and this represents the "pinch point" in the harvest schedule. As more productive managed stands reach maturity, the growing stock begins to incline and eventually balance with the harvest level at year 75 and remain relatively constant until the end of the planning horizon. This future trend indicates that the proposed harvest level is sustainable. Natural growing stock remains at on average 19% of the total growing stock from year 50 to 250. This is mainly due to the natural component of future stands, specifically, aspen stands. It is also worth mentioning that 50 ha of natural stands in the THLB are never harvested by the end of the planning horizon due to these stands never reach the minimum harvest volume.

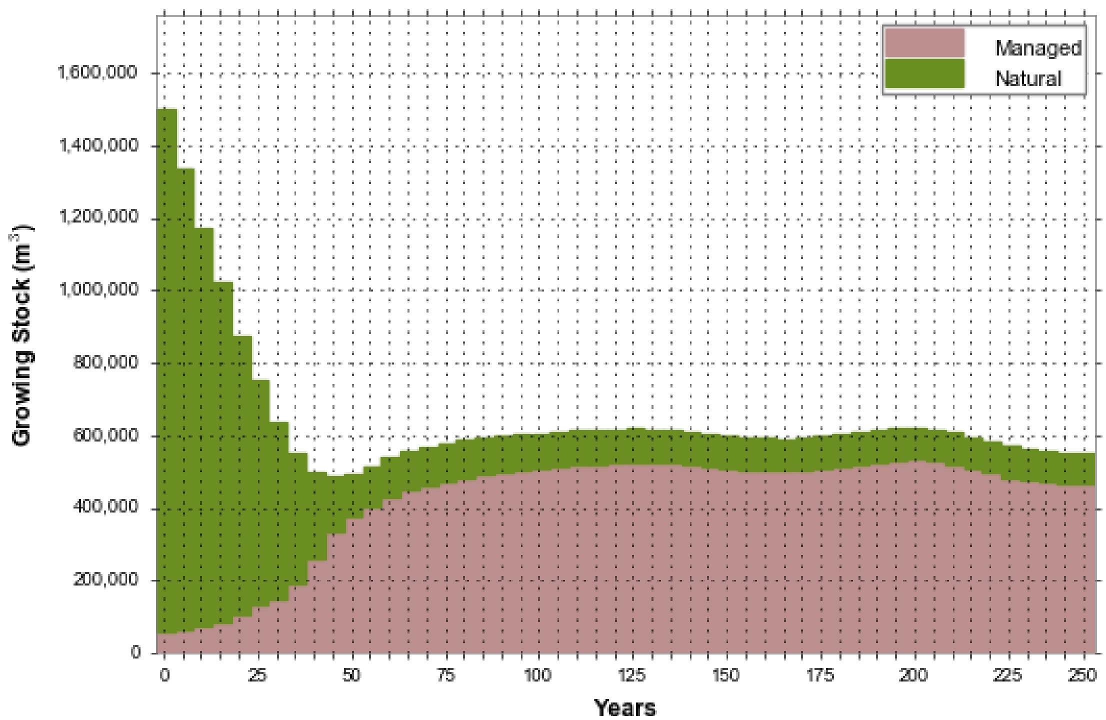

Figure 3-2: Total Growing Stock

Figure 3-3 shows the distribution and transition of the harvest volume between natural and managed stands. For the first 50 years, harvesting is almost exclusively in natural stands as shown in Figure 3-4. At year 50, harvesting begins to transition into mostly managed stands as existing natural stands and ALR stands are harvested. The managed stand volume percentage oscillates between 90% to 75% of the total harvest level for the rest of the planning horizon. This is mainly because the deciduous stands are naturally regenerated in future stands.

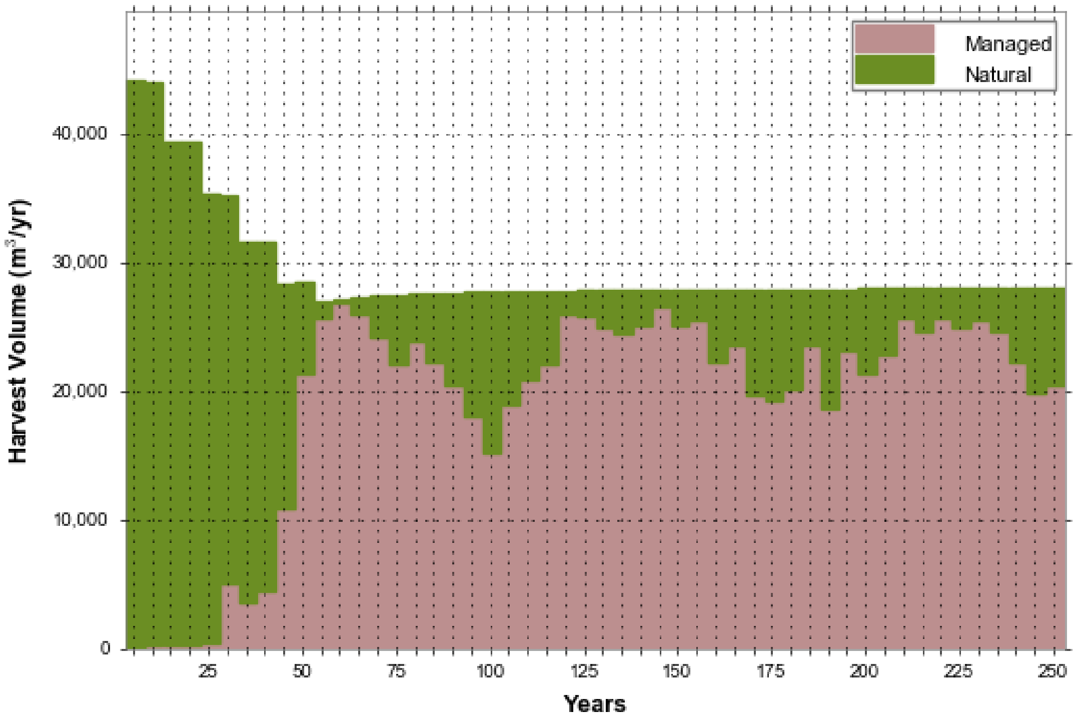

Figure 3-3: Harvest Volume by Natural and Managed Stands

Figure 3-4 shows the change in average harvest age of the base case for 250 years of planning periods. Initially, the average harvest age starts at 128 years for the first 40 years, while the harvest profile is made up exclusively by natural stands. As harvesting transitions into younger and more productive managed stands after year 40, the average harvest age drops to 70 years. The treatment age in the base case was determined as the age of the stand when it reaches 95% of the mean annual increment and at the same time exceeds the minimum harvest volume. After this age, the stand slows down in growth and volume increase becomes more gradual. Therefore, average harvest age for managed stands are lower than the natural existing stands.

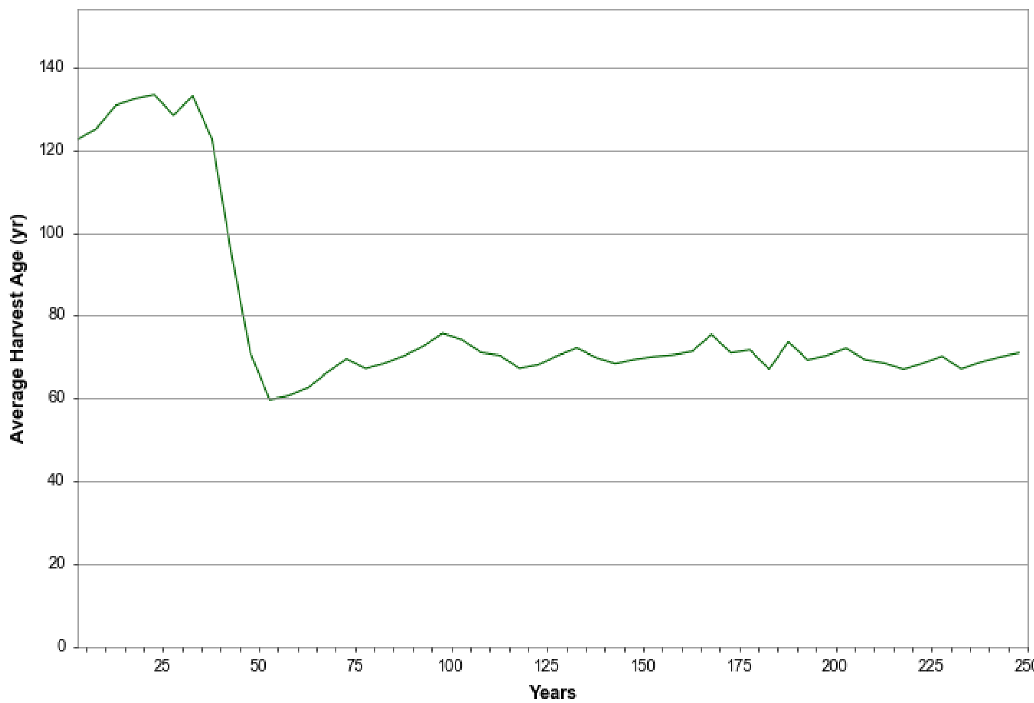

Figure 3-4: Average Harvest Age

The average harvest volume per hectare (VPH) is low initially, averaging at 208 m^3/ha for the first 5 years as shown in Figure 3-5. This is because the model is set out to convert the low volume natural existing stands with high site productivity into productive managed stands as fast as possible. As these stands are harvested, harvesting shifts to high volume but medium to low site productivity stands. The average harvest VPH at this point climbs steadily to 328 m^3/ha at year 45. After this point, harvesting transitions into primarily managed stands, the average harvest VPH oscillates between approximately 280 m^3/ha and 250 m^3/ha for the remaining planning horizon.

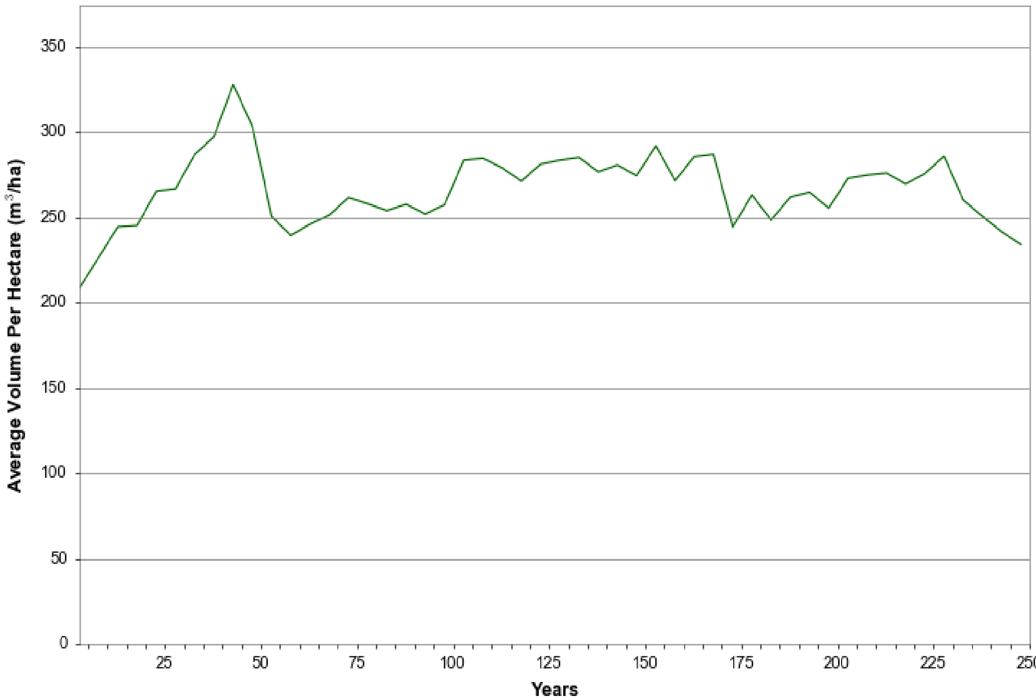

Figure 3-5: Average Harvested Volume per Hectare

Figure 3-6 shows the harvest volume by leading species. As described in Section 2.2, the THLB is primarily composed of spruce-leading and deciduous-leading stands, which make up the majority of the harvest profile. Under the current regeneration practice, harvested stands in K1N are replanted with species compositions similar to what was there before. Deciduous stands are naturally regenerated; therefore, the deciduous to coniferous ratio of the harvest profile stays relatively unchanged for the entire planning horizon.

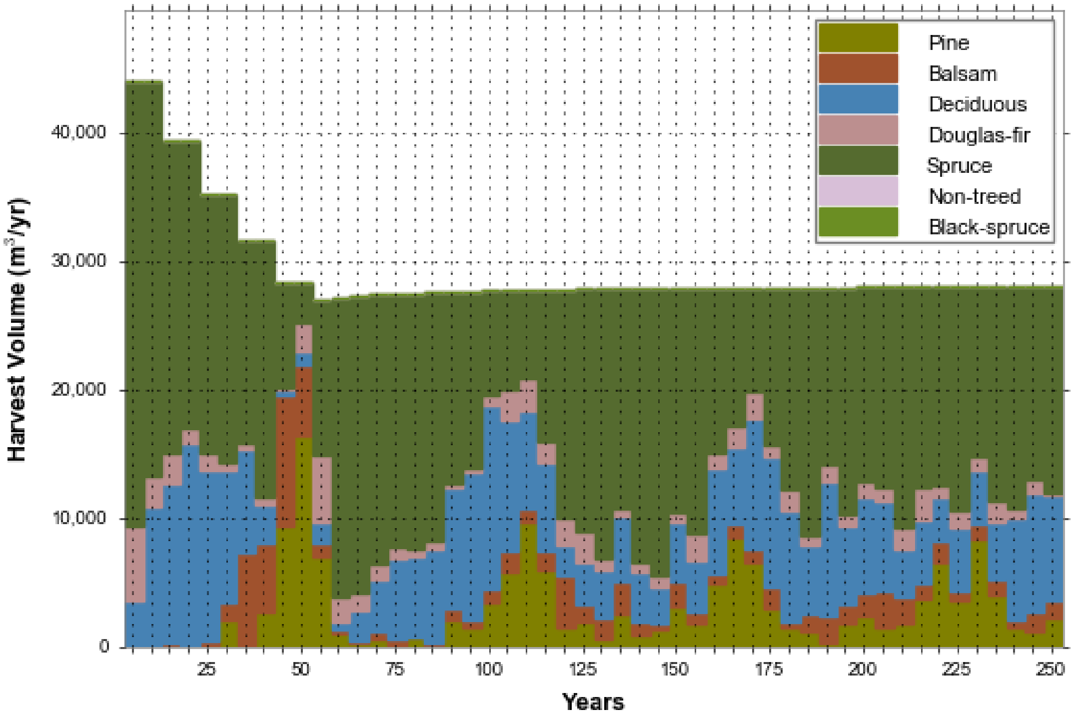

Figure 3-6: Harvest by Leading Species

Figure 3-7 shows the harvest volume by conifer and deciduous volume. The pattern of coniferous to deciduous ratio of the harvest flow remain consistent throughout the planning horizon oscillating between 60% to 90% of the total harvest volume for coniferous volume and from 10% to 40% for deciduous volume.

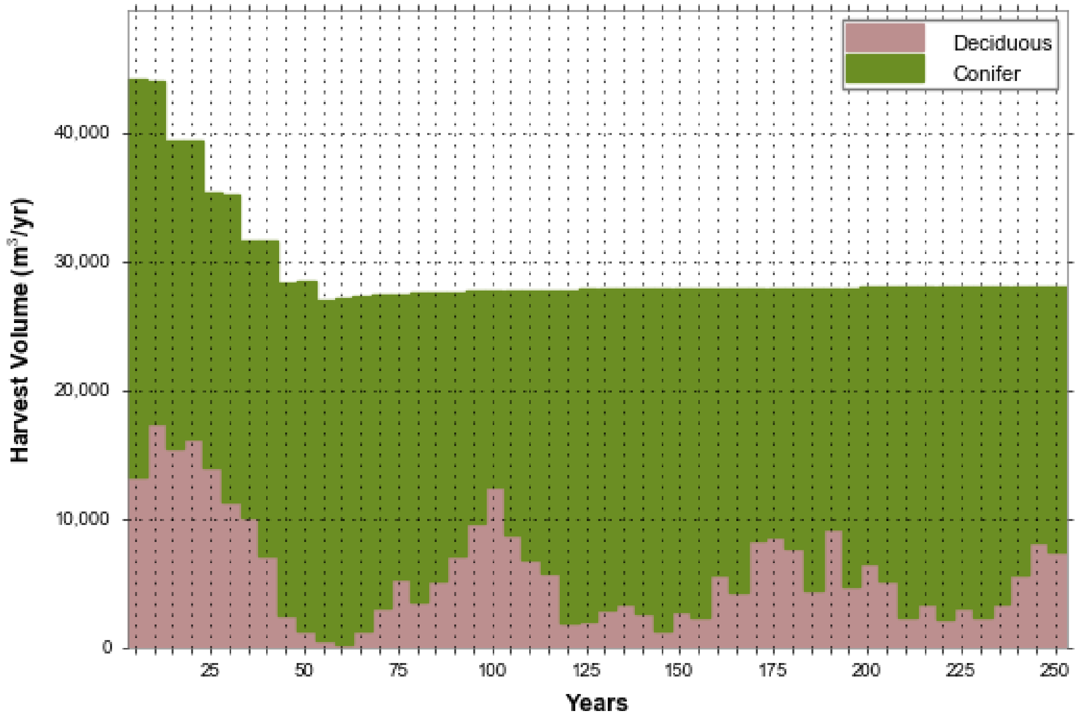

Figure 3-7: Harvest by Deciduous and Coniferous

3.3 Age Class Distribution

The age class graphs in Figure 3-8 display the changing age class distribution of K1N over the 250-year planning horizon. Initially, the THLB is mainly composed of stands in age classes 5 to 7 (i.e. 81 to 140 years old). This age class distribution supports the step-down harvest flow of the base case because the high initial harvest volume would transition these older natural existing stands into more productive managed stands sooner as shown in Year 10 of Figure 3-8. As time progresses, the model modifies the age class distribution, while managing the transition from old natural stands to young managed stands. The non-THLB areas remain in older age classes, reaching age class 9 by the final periods of the planning horizon. Eventually, the THLB portion of the landbase shares a balanced distribution of area in age classes 1 through 4, with a very small amount of forested landbase in age classes 5 to 7. This is because the average harvest age is younger for managed stands (70 years) as oppose to natural existing stands (128 years) while older stands are retained to meet the non-timber objectives.

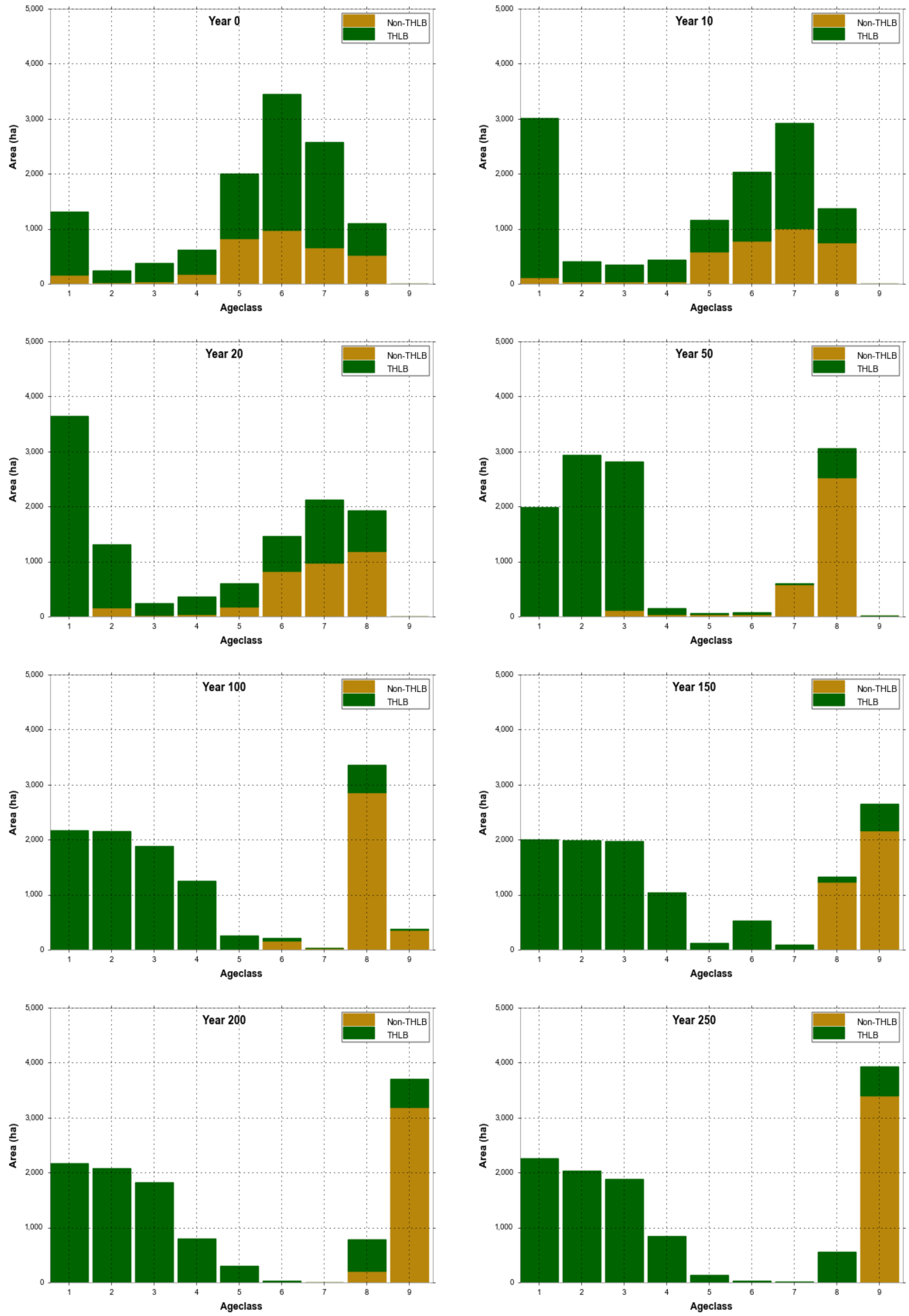

Figure 3-8: Age Class Distribution

3.4 Alternative Harvest Flow

An even harvest flow scenario tests the highest level that the long-term harvest level (LTHL) is able to reach. This scenario acts as a guidance for the LTHL of the base case in a step-down harvest flow. Figure 3-9 shows the harvest flow comparison of the base case and the even flow scenario. Table 3-2 shows the average harvest volume between the two. The base case allows the model to harvest stands in the ALR and older age classes faster compared to the even flow scenario.

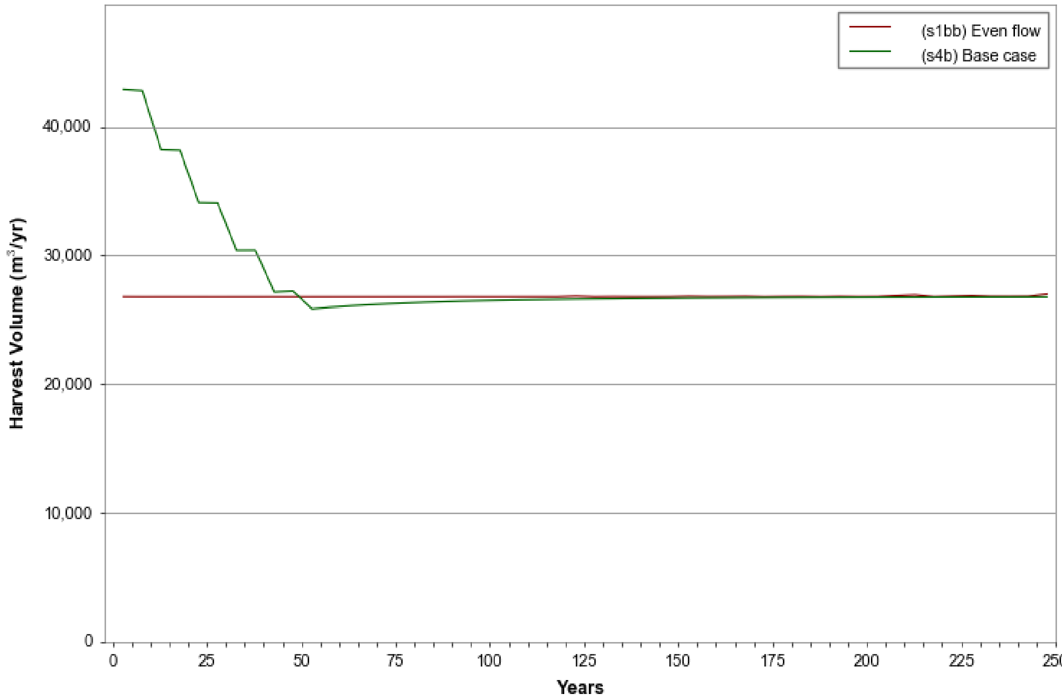

Figure 3-9: Alternative Harvest Flow – Even Flow

Table 3-2: Alternative Harvest Flow – Even Flow

Years	Base Case (m^3/yr)	Even Flow (m^3/yr)	% Change from Base Case
1 to 5	42,900	26,810	-38%
6 to 10	42,800	26,810	-37%
11 to 25	36,840	26,810	-27%
26 to 60	28,740	26,810	-7%
61 to 250	26,630	26,830	1%

4. Sensitivity Analysis

Sensitivity analysis provides information on the degree to which uncertainty in the base case data and assumptions might affect the proposed harvest level for the landbase. The magnitudes of the change in the sensitivity variable(s) reflect the degree of risks associated with a particular uncertainty – a very uncertain variable that has minimal impact on the harvest forecast represents a low risk. By developing and testing a number of sensitivity issues, it is possible to determine which variables most affect the results and make management decisions based on these uncertainties.

Each sensitivity listed in Table 4-1 is modelled as its own scenario to test the impact of changing a variable from the base case. The impacts are measured against the base case scenario. The reported results shown in the following sections display the total harvest level net of non-recoverable losses.

Table 4-1: Sensitivity Analysis Scenarios

Sensitivity	Range Tested	Scenario Description
ALR	Assess the impact of removing the ALR one-pass harvest constraint	Link yield curves to regular future stand yield curves
Minimum harvestable age (MHA)	Assess the impacts of applying a minimum harvestable age as opposed to a minimum harvest volume	Set MHA to 80 years
		Set MHA to 60 years
Yield assumption	Increase / decrease both managed and natural stand yields	Natural Stand Yield Tables (NSYT) +/- 10%
		Managed Stand Yield Tables (MSYT) +/- 10%
Minimum harvest volume (MHV)	Assess the impacts of increasing and decreasing MHV	Increase MHV to 180 m^3/ha
		Decrease MHV to 120 m^3/ha
Visual quality objectives (VQO)	Assess the impact of altering VQO-related penalties	Decrease Visual Quality Classification by 1 class
Different regeneration assumptions	Convert AT to SX-leading	Regenerate AT-leading stand to SX following initial harvest
Cutblock size limits	Assess the impacts of applying a cutblock size constraint	Set cutblock size >5 ha and <100 ha
		Set cutblock size >5 ha and <100 ha and maximum 5% cutblock size with 5 to 15 ha
Genetic Gain	Assess the impacts of regenerating managed stands with different genetically modified stocks	No genetic gain curves
		Canfor provided genetic gain values
		Climate-based Seed Transfer genetic gain curves

4.1 Agricultural Land Reserve

Figure 4-1 shows the harvest flow of the base case (i.e. s4b) and the no ALR harvest constraint scenario (s0b). There are currently 1,097 ha of THLB in the ALR. In the base case, stands in the ALR are not permitted to be harvested again after the first rotation. The no ALR scenario will meet the same non-timber objectives as the base case with the exception that the ALR harvest constraint does not apply. Therefore, stands in the ALR are treated as regular stands, and will be available in all future rotations. The total harvest volume of the no ALR scenario is on average 2,440 m^3/yr higher than the base case. Table 4-2 lists the total harvest volume and the percent differences of the base case and the no ALR scenario. The no ALR scenario is on average 4% higher in total harvest volume compared to the base case.

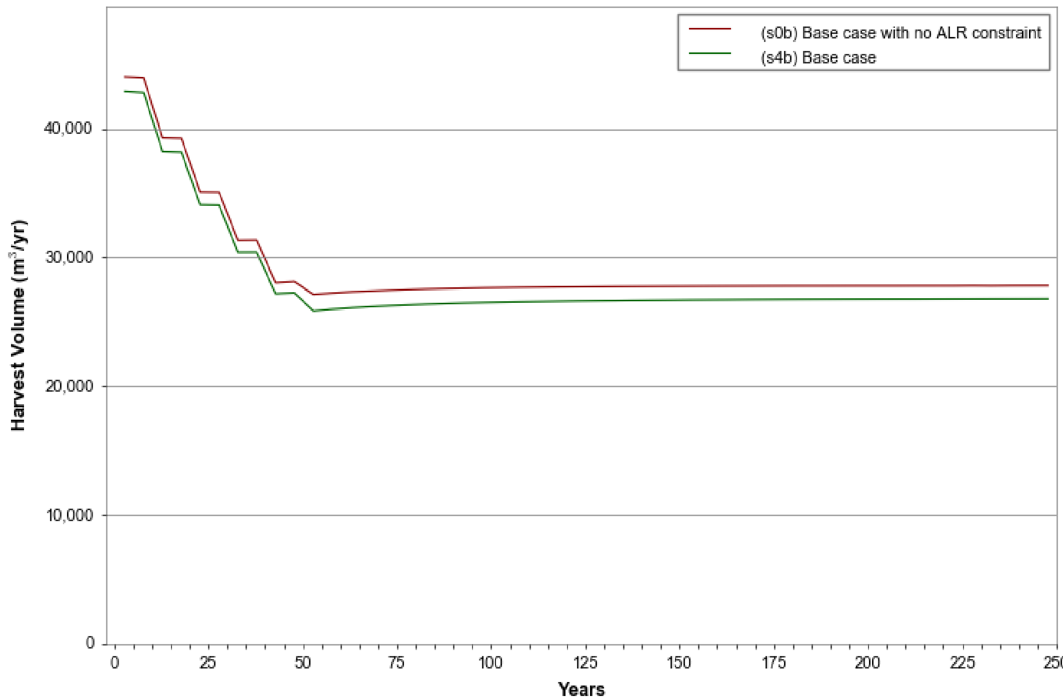

Figure 4-1: Without ALR Harvest Restriction

Table 4-2: No ALR Harvest Restriction Total Harvest Volume and Percent Difference

Years	Base Case (m^3/yr)	No ALR (m^3/yr)	% Change
1 to 10	42,850	43,975	3%
11 to 25	36,840	37,880	3%
26 to 60	28,740	29,760	4%
61 to 250	26,630	27,720	4%

4.2 Minimum Harvestable Criteria

Minimum harvestable criteria provide the timber supply analysis with operational and economic feasibility. MHA and MHV are often used independently or together when establishing the minimum harvestable criteria.

MHA controls the earliest age at which a stand could be harvested in the model. In the base case, MHA is based on the age in which a stand achieves the MHV, which is 140 m^3/ha. In the MHA scenarios, MHAs are absolute for all stands. If a stand has reached 95% of the mean annual increment (MAI) before or at the MHA and have also exceeded the minimum harvest volume, then the earliest harvest age will be the MHA. Otherwise, it will be harvested at the age at which the stand exceeds 95% of the MAI and the minimum harvest volume. The MHA is set at 40 years, 60 years, and 80 years.

MHV also controls the earliest harvestable age of a stand by setting the treatment age to the age at which the stand reaches the MHV. Similar to MHA criteria, the treatment age is set to the age when the stand reaches 95% of the MAI and the MHV. If a stand does not reach 95% of the MAI before or while it reaches the MHV, then the treatment age will be set to the age at which the stand reaches 95% of the MAI. The MHV is set to 120 m^3/ha and 180 m^3/ha to compare with the base case.

These scenarios examine the impacts of increasing and decreasing the MHV and MHA. Increasing the MHV/MHA means that the model has less flexibility around scheduling stands for harvest. Conversely, decreasing the MHV/MHA allows for more flexibility in the model and can result in increased harvest levels.

Figure 4-2 shows the harvest flow of scenarios with different MHAs compared to the base case. Table 4-3 shows the total harvest volume between different time periods of these scenarios with the base case. The base case has the highest total harvest volume.

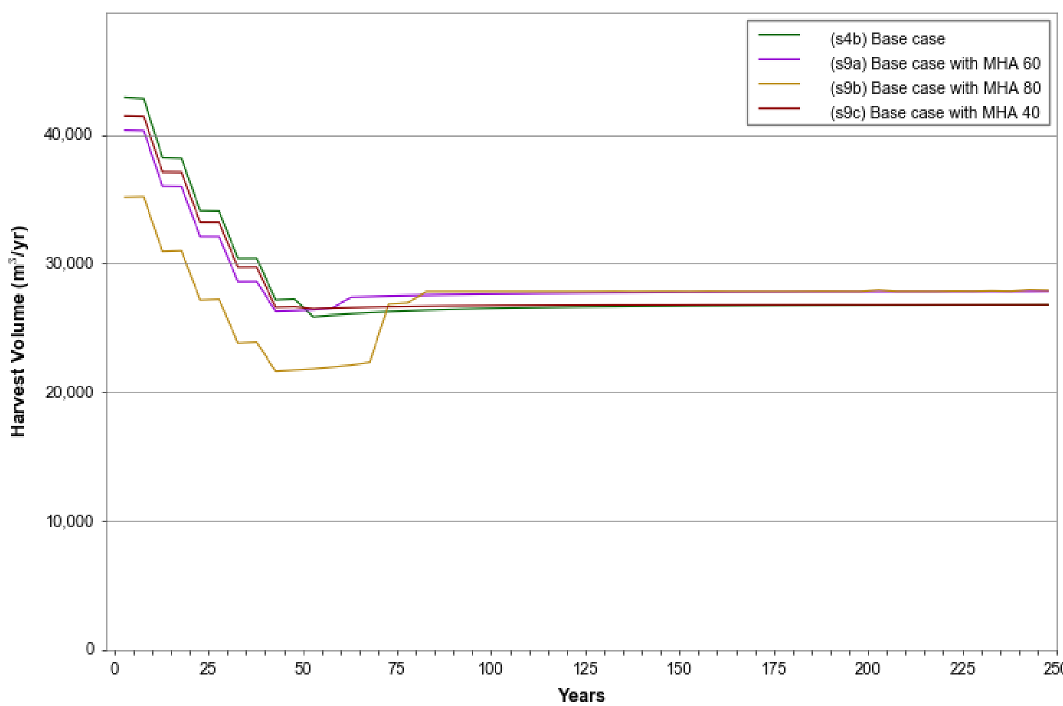

Figure 4-2: Minimum Harvestable Age

Table 4-3: Minimum Harvestable Ages Total Harvest Volume and Percent Difference

Years	Base Case (m^3/yr)	MHA 40 (m^3/yr)	Change (%)	MHA 60 (m^3/yr)	Change (%)	MHA 80 (m^3/yr)	Change (%)
1 to 10	42,850	41,445	-3%	40,340	-6%	35,170	-22%
11 to 25	36,840	35,800	-3%	34,690	-6%	29,700	-24%
26 to 60	28,740	28,410	-1%	27,840	-3%	23,150	-24%
61 to 250	26,630	26,760	0%	27,710	4%	27,480	3%

As shown in Figure 4-2 and Table 4-4, by having MHA criteria, the total harvest level is lowered. This means a portion of the landbase can reach the MHV and 95% of the MAI earlier than the specified MHA, even when the MHA is at 40 years. The percent change in harvest level between the base case, MHA 40, and MHA 60 scenarios is not significant. However, the MHA 80 scenario is 19% lower than the base case in the first 60 years; whereas, the MHA 40 and MHA 60 scenarios are only 3% and 6% lower respectively.

By decreasing the MHV to 120 m^3/ha, there is no change to the harvest level because the base case's average harvest VPH is higher than the MHV. Conversely, increasing the minimum harvest volume by 40 m^3/ha decreases the harvest level by 6% on average for the entire planning horizon. This suggests that a significant component of the landbase has an average harvest VPH between 140 m^3/ha and 180 m^3/ha.

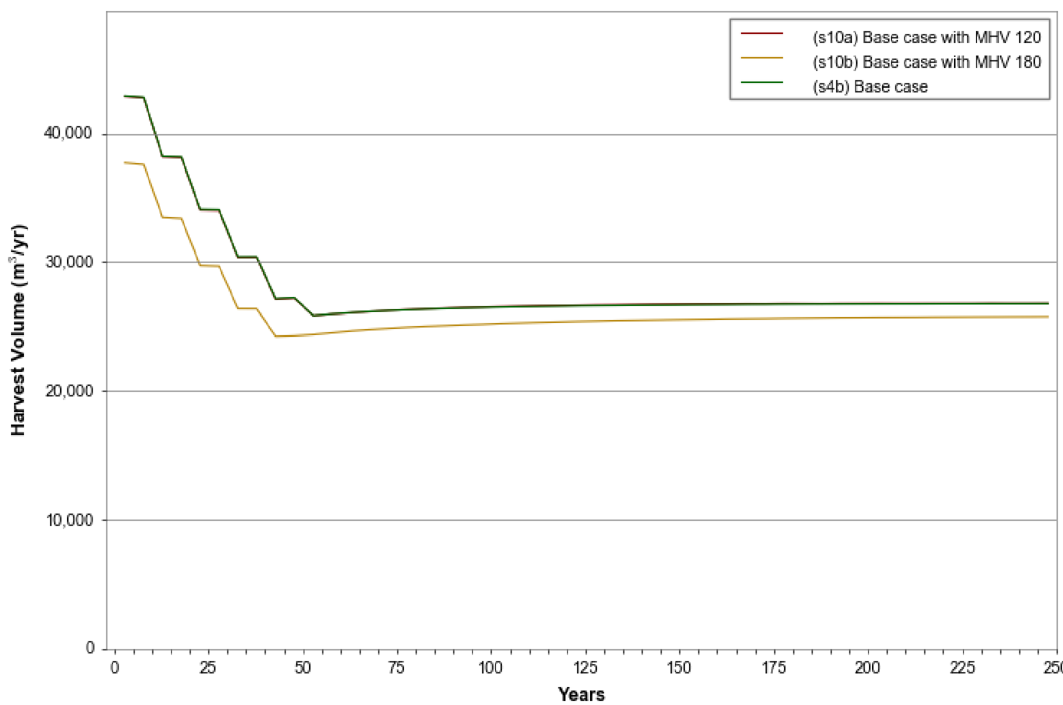

Figure 4-3: Minimum Harvest Volume

Table 4-4: Minimum Harvest Volume Total Harvest Volume and Percent Difference

Years	Base Case (m^3/yr)	MHV 120 (m^3/yr)	MHV 120 Change (%)	MHV 180 (m^3/yr)	MHV 180 Change (%)
1 to 10	42,850	42,810	0%	37,650	-14%
11 to 25	36,840	36,790	0%	32,210	-14%
26 to 60	28,740	28,710	0%	25,700	-12%
61 to 250	26,630	26,660	0%	25,460	-5%

4.3 Yield Assumptions

Sensitivity analyses around natural and managed stand yields help us understand the degree to which uncertainty in yield models and assumptions may affect the short, mid and long-term harvest forecast for the K1N landbase.

Figure 4-4 and Table 4-5 show the impact of increasing and decreasing natural stand yield tables (NSYT) by 10%. Decreasing the initial growing stock by 10% has a 13% impact on the initial harvest level (first 60 years) and 1% in the LTHL. Conversely, when NSYT are increased by 10%, the model shows only an additional 4% in harvest volume on average for the entire planning horizon.

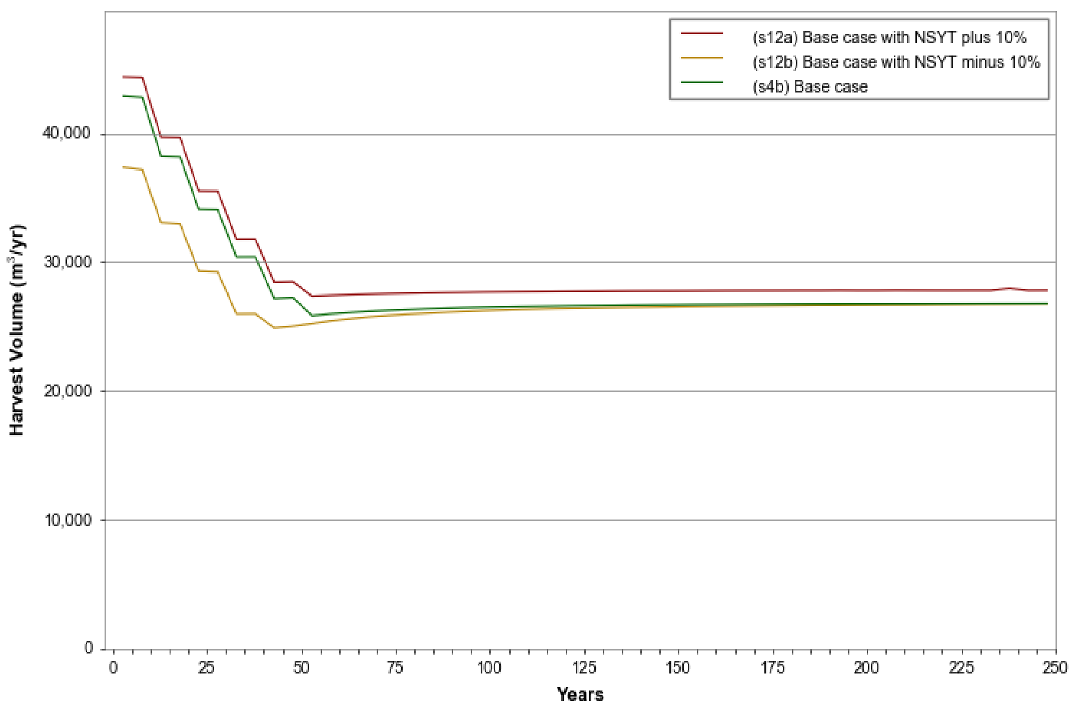

Figure 4-4: Natural Stands Yield Curves

Table 4-5: NSYT Total Harvest Volume and Percent Difference

Years	Base Case (m³/yr)	NSYT +10%		NSYT -10%	
		(m³/yr)	% Change	(m³/yr)	% Change
1 to 10	42,850	44,350	3%	37,280	-15%
11 to 25	36,840	38,310	4%	31,780	-16%
26 to 60	28,740	30,120	5%	25,980	-11%
61 to 250	26,630	27,740	4%	26,460	-1%

Figure 4-5 and Table 4-6 show the impact on timber supply if managed stand yield tables (MSYT) are increased and decreased by 10%. Decreasing managed stand yields decreases the harvest level by 9% in the first 60 years while also decreasing the LTHL by 4%. When the managed stand yields are increased by 10%, there is a 7% increase in the LTHL, and only a 3% increase in the first 60 years harvest level because natural stand makes up the majority of the harvest volume in the first 50 years of the planning horizon.

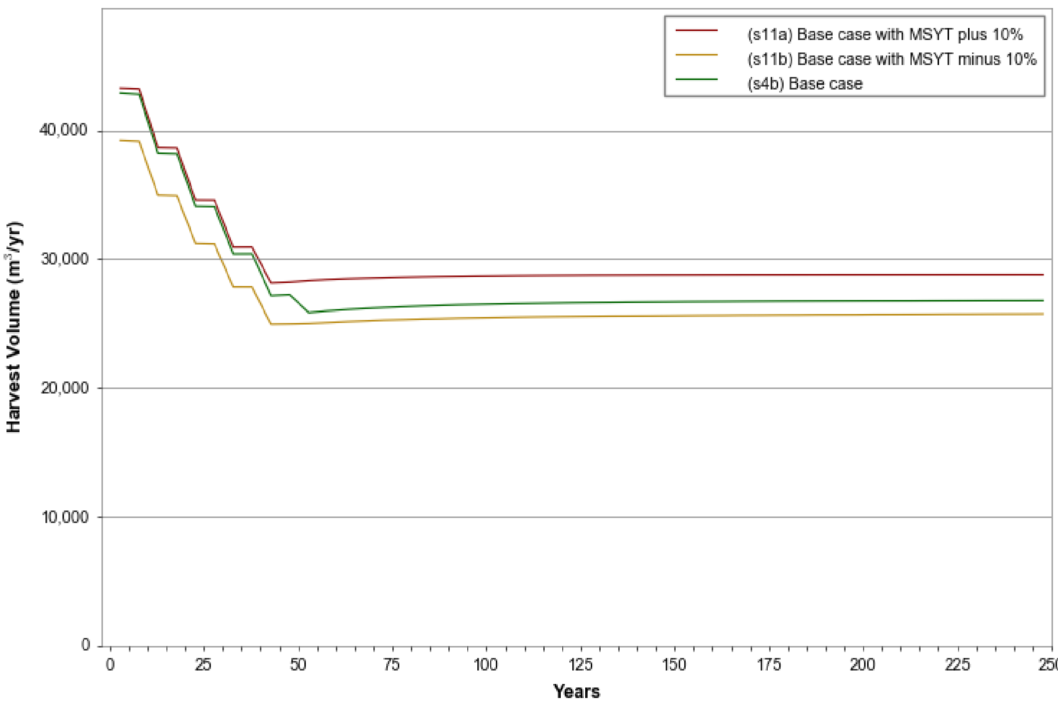

Figure 4-5: Managed Stands Yield Curves

Table 4-6: MSYT Total Harvest Volume and Percent Difference

Years	Base Case (m³/yr)	MSYT +10%		MSYT -10%	
		(m³/yr)	% Change	(m³/yr)	% Change
1 to 10	42,850	43,250	1%	39,175	-9%
11 to 25	36,840	37,310	1%	33,710	-9%
26 to 60	28,740	29,940	4%	26,690	-8%
61 to 250	26,630	28,750	7%	25,580	-4%

4.4 Visual Quality Objectives

The visual quality class (VQC) assigned to a visual landscape inventory polygon has been lowered by one class to assess the impact on timber supply in K1N. This means a visual landscape inventory (VLI) polygon with VQC in Partial Retention has been lowered to Modification to allow more harvesting. Figure 4-6 and Table 4-7 shows the impact on harvest level when the VQC is lowered.

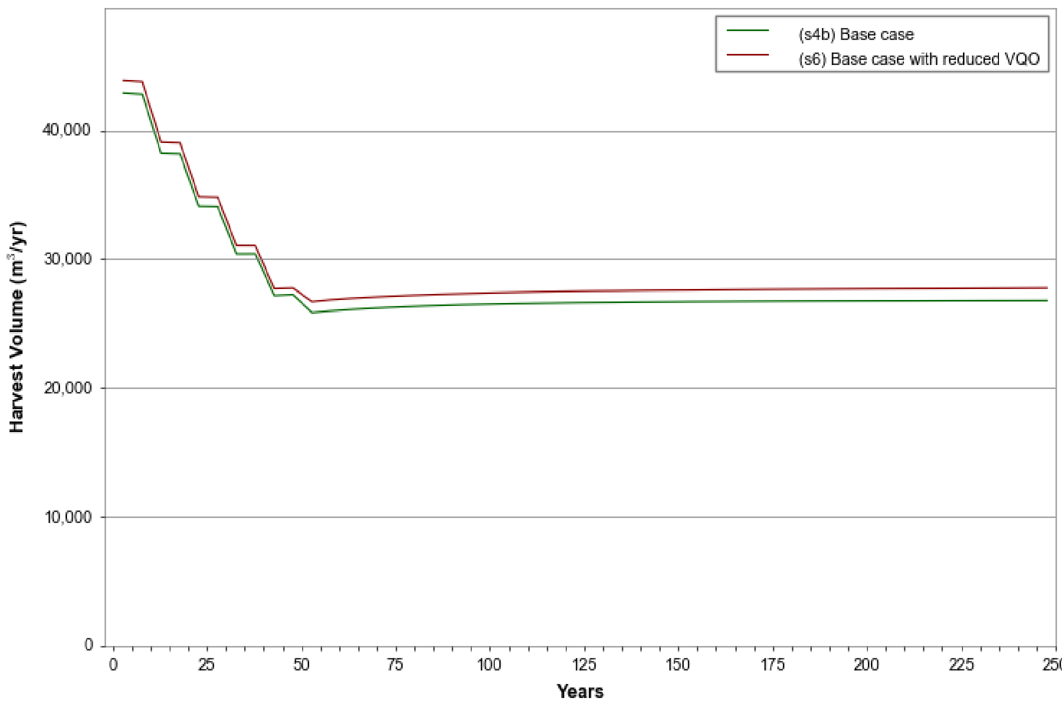

Figure 4-6: Harvest Volume of Reduced VQO Requirement

Table 4-7: Harvest Volume of Reduced VQO Requirement

Years	Base Case (m^3/yr)	Lowered VQO (m3/yr)	% Change
1 to 10	42,850	43,810	2%
11 to 25	36,840	37,650	2%
26 to 60	28,740	29,420	2%
61 to 250	26,630	27,540	3%

By lowering the VQC by one class, the harvest level increased by 2% for the first 60 years, and 3% for the LTHL. The impact is not significant because there are only four VLI polygons in K1N, which account for only 9% of the THLB, and the VQC of these polygons are not very restrictive.

4.5 Regeneration Assumption

Sensitivity in timber supply when converting natural aspen-leading stands into managed spruce-leading stands is assessed. Figure 4-7 and Table 4-8 show the change in harvest level of converting aspen to spruce stands. There is no change in harvest level in the first 45 years. From year 45, the harvest level of the aspen to spruce scenario is 3% higher than the base case. This is because the harvesting has transitioned to managed stands completely at this point.

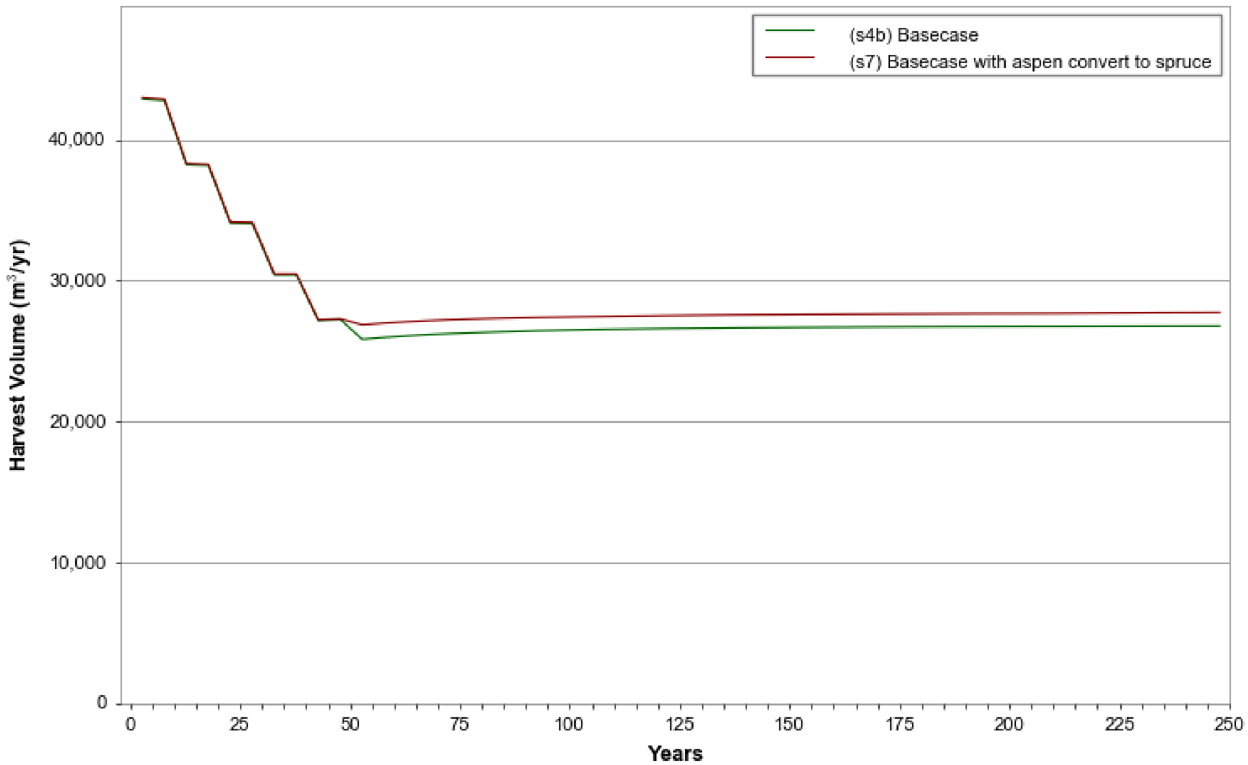

Figure 4-7: Harvest Volume with Deciduous to Coniferous Conversion

Table 4-8: Harvest Volume of Converting Aspen (AT) to Spruce (SX) Leading Stands

Years	Base Case (m^3/yr)	AT to SX (m3/yr)	% Change
1 to 10	42,850	42,955	0%
11 to 25	36,840	36,920	0%
26 to 60	28,740	29,080	1%
61 to 250	26,630	27,560	3%

4.6 Cutblock Size Limit

Impacts to harvest level from limiting cutblock sizes are assessed. Scenario 13a (s13a) limits the cutblock size to >5 and <100 ha, and Scenario 13b (s13b) further limits harvesting to a maximum of 10% of cutblocks with size between 5 to 15 ha in addition to no cutblocks with size >5 ha or >100 ha. Both s13a and s13b's harvest levels are noticeably lower than the base case, with -14% and -15% lower harvest volumes respectively for the first 60 years. The LTHL for these scenarios is only 1% lower than the base case, suggesting that after the landbase has transitioned into mainly managed stands, block size limitations are no longer constraining the harvest level.

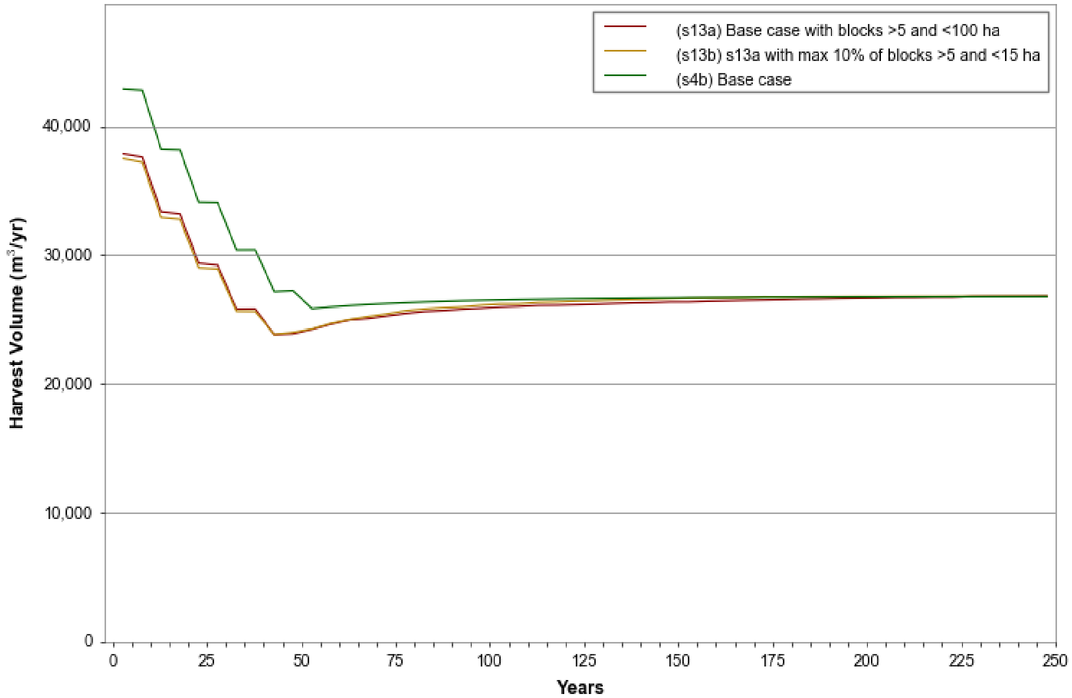

Figure 4-8: Harvest Volume of Cutblock Size Restriction

Table 4-9: Harvest Volume of Cutblock Sizes Restriction

Years	Base Case (m^3/yr)	Block >5 and <100 ha		Blocks >5 and <100 ha and Max 10%	
		(m^3/yr)	% Change	(m^3/yr)	% Change
1 to 10	42,850	37,745	-13%	37,360	-14%
11 to 25	36,840	31,990	-15%	31,580	-17%
26 to 60	28,740	25,360	-13%	25,290	-14%
61 to 250	26,630	26,280	-1%	26,450	-1%

4.7 Genetic Gains

Genetic gains from planting Class A seeds can be a potential source of uncertainty. Three scenarios test the impacts of assuming genetic gains variations. This range is tested by applying zero genetic gains, Canfor's provided genetic gain percentage, and genetic gain of seed sources selected with the Climate-based Seed Selection Tool (CBST) to managed yield curves modelled in Table Interpolation Program for Stand Yields (TIPSY). The base case uses genetic gain values calculated from the Seed Planning and Registry Application (SPAR) report. The lack of genetic improvements has a significant impact on the landbase as managed stands take longer to become available for harvest. This trend is demonstrated in Figure 4-9 and Table 4-10. No genetic gain reduces the harvest level of the first 60 years by 16% and 10% for the LTHL compared to the base case. Canfor's provided genetic gain value is lower than the genetic gain calculated form the SPAR report; as expected the harvest level is 1 to 2% lower than the base case. CBST allows the licensees to plant with seed sources that will better adapted to the changing climate of a specific BEC variant. The genetic gain of CBST seed sources are even higher than the SPAR report, leading to a 1% increase in harvest level for the entire planning horizon compared to the base case.

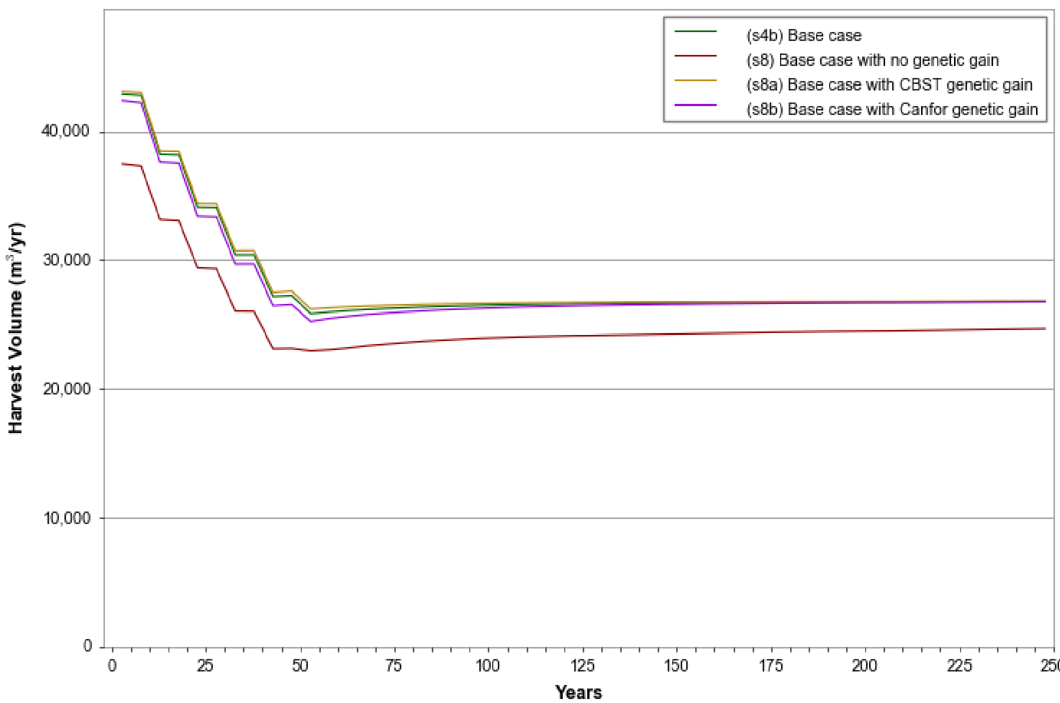

Figure 4-9: Harvest Levels of Genetic Gain Variations

Table 4-10: Average Annual Harvest Levels – Genetic Gain Variations

Years	Base Case (m^3/yr)	No Genetic Gain (m^3/yr)	Change (%)	Canfor Provided Genetic Gain (m^3/yr)	Change (%)	CBST Genetic Gain (m^3/yr)	Change (%)
1 to 10	42,850	37,380	-15%	42,290	-1%	43,055	1%
11 to 25	36,840	31,880	-16%	36,180	-2%	37,110	1%
26 to 60	28,740	24,810	-16%	28,080	-2%	29,070	1%
61 to 250	26,630	24,210	-10%	26,720	-1%	26,720	0%

4.8 Commercial Thinning

A commercial thinning (CT) scenario was considered while planning for this timber supply analysis. However, it was dropped due to the scope of area in which CT treatment can be operationalized. For a stand to be eligible for CT treatment, it must be less than or equal to 45 years old, with a maximum 40% VPH removal limit and a minimum residual basal area (BA) of 20 m^2/ha. With these thinning criteria, only stands with high enough site index can be considered for CT treatment. In addition, the stands cannot be regenerated with deciduous species to be considered for thinning. A minimum site index was generated for spruce and pine leading stands from Tree and Stand Simulator (TASS) version 3 based on the above criteria. The minimum total BA of a stand needs to be at least 33 m^2/ha at or before age 45 for a stand to be able to retain a minimum residual BA of 20 m^2/ha during a 40% volume removal. A series of TASS curves are generated for pure spruce and pine stands with an initial planting density of 1400 trees per hectare and different site index values. A minimum of 21 m in site index (SIBEC for managed stands) was determined for both spruce and pine stands. With these criteria, the total area of potential CT stands was summarized. Only 411 ha (5%) of THLB out of 8,280 ha are eligible for CT treatment. Given the limited CT candidate stands, impact on the timber supply from CT treatment would be small. Therefore, the CT scenario was excluded from this analysis. However, some work has been conducted to look at expanding the CT candidate criteria. Should this happen there may be a larger benefit of a CT program on K1N.

5. Discussion

The role of the base case in timber supply analysis is to present the set of data and assumptions that best reflects current management, harvest forecast and the best representation of timber supply available on the K1N landbase over the next 250 years. The base case scenario demonstrates the potential harvest forecast based on the timber and non-timber objectives.

This timber supply analysis for K1N is consistent with the assumptions and methodology used to complete the Lheidli T'enneh Community Forest Agreement Type II Silviculture Strategy (Timberline, 2009) and the Prince George Timber Supply Area Timber Supply Review (TSR V) (MFLNRO, 2015). Additionally, the 2019 timber supply analysis for K1N assumes no regeneration activity on ALR after harvest.

The estimated THLB for K1N at the time of when the last timber supply review was completed (March 2009) was 9,161 ha, which is 881 ha (10%) more than the calculated THLB for this analysis. The primary reasons for the change in THLB are with the new VRI data, more area is classified as non-forested, non-productive, economically inoperable, and non-commercial. In addition, more areas are retained as endangered ecosystems, recreational areas, wildlife tree patches, future roads, and reserved for stand-level retention. The new THLB results in a higher estimated short-term (first 60 years) harvest level (40,850 m^3/yr) than the current AAC of 28,000 m^3/yr and a lower LTHL (26,960 m^3/yr) due to the ALR harvest constraint. This is primarily due to the fact that the remaining THLB is more productive and has a higher component of conifer volume.

Table 5-1 shows a summary of the harvest impacts of each scenario relative to the base case and the percentage of how much that scenario varies from the base case.

Table 5-1: Summary of Analysis Results

Sensitivity	Harvest Volume (m^3/yr)		% Change from the Base case	
	1 to 60	61 to 250	1 to 60	61 to 250
Base case	33,120	26,630		
Even Flow	26,810	26,830	-19%	1%
No ALR harvest constraints	34,160	27,720	3%	4%
Minimum harvestable age 40	32,430	26,760	-2%	0%
Minimum harvestable age 60	31,640	27,710	-4%	4%
Minimum harvestable age 80	26,790	27,480	-19%	3%
Minimum harvest volume 120 m^3/ha	33,080	26,660	0%	0%
Minimum harvest volume 180 m^3/ha	29,320	25,460	-11%	-4%
Natural stands yield curves + 10%	34,540	27,740	4%	4%
Natural stands yield curves - 10%	29,310	26,460	-11%	-1%
Managed stands yield curves + 10%	34,000	28,750	3%	8%
Managed stands yield curves - 10%	30,530	25,580	-8%	-4%
Lower Visual Quality Class by one class	33,880	27,540	2%	3%
Convert aspen to spruce stands	33,350	27,560	1%	3%
Block size limitation (>5 and <100 ha)	29,080	26,280	-12%	-1%
Block size limitation (>5 and <100 ha and max 10% of blocks in >5 and <15 ha)	28,870	26,450	-13%	-1%
No genetic gains	28,670	24,210	-13%	-9%
Canfor's provided genetic gain	32,470	26,490	-2%	-1%
Climate- Based Seed Transfer genetic gain	33,410	26,720	1%	0%

A step-down harvest pattern can best accommodate the management objectives of K1N mainly because of the high natural to managed stand ratio and the significant portion of the THLB in the ALR. The base case can support a higher harvest level without compromising the long-term sustainable harvest level. The step-down harvest pattern of the base case allows for a faster transition from natural stands to more productive managed stands, and a sustainable LTHL can be reached sooner by harvesting the ALR stands earlier in the planning horizon. All this is accomplished while maintaining all the non-forest objectives defined for the land base.

The scenario that assesses the use of a minimum harvestable age of 80 years has the largest impact on the initial harvest forecast (-19%). Despite this reduction, the estimated LTHL remains higher than the even flow harvest level. On the other hand, increasing natural yield curves by 10% has the greatest benefit on the harvest forecast (4%) than its counterpart scenario. This provides relief to the "pinch point" in the merchantable growing stock that limits the sustainable harvest level.

Assumptions around decreasing the minimum harvestable criteria do not cause a large impact to the harvest forecast because currently the majority of the THLB are already mature and have exceeded the minimum harvestable criteria. Meanwhile the managed stands tend to reach the maximum MAI relatively sooner than the natural stands; and reach the MHV close to the age when they reach the maximum MAI.

As harvesting in natural stands transitions into managed stands after year 50, changes in MSYT would impact the LTHL more than changes in MSYT. Increases in MSYT and converting aspen-leading to spruce-leadings stands would lead to an increase in LTHL in K1N. Meanwhile, changes in minimum harvestable criteria would also impact the LTHL more than the short to mid-term harvest levels.

This timber supply analysis indicates that the base case harvest level is sustainable and suitable for the CFA licence K1N, after considering the results of the sensitivity analyses.

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