TYPE 4 SILVICULTURE STRATEGY IN THE KAMLOOPS TSA

SITUATION ANALYSIS

Prepared for:

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November 2013

Attention Rick Sommer:

Subject: Type 4 Silviculture Strategy in the Kamloops TSA - Situation Analysis

Please find enclosed the report in support of the above-mentioned analysis. Please do not hesitate to call with any questions.

Yours Truly,

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1.0 INTRODUCTION

1.1 Context

The Kamloops TSA has been selected for a Type 4 silviculture strategy project, to provide tactical level direction for steering silviculture investment to help mitigate mid-term timber supply impacts created from the mountain pine beetle (MPB) epidemic. Ecora Natural Resource Group Ltd (Ecora) has been contracted by the MFLNRO to undertake the Type 4 silviculture strategy on the Kamloops TSA.

The Ministry of Forests, Lands and Natural Resource Operations (MFLNRO), Resource Practices Branch (RPB) has recognized the need to define clear timber objectives in the Kamloops TSA and ensure silviculture activities are consistent with objectives for all forest values.

The project plan of action is to:

- Identify present and emerging issues;
- Identify objectives and create targets;
- Create vision for timber and habitat supply;
- Create and implement silviculture plan to translate the vision into operational reality; and
- Allow for monitoring and iterative updates in the process.

This will be achieved by holding an inclusive kick-off meeting with a wide range of local and regional participants and utilizing expert's input to facilitate the inclusion of specific values. Ecora will facilitate this discussion and tie it all together in an optimization modelling environment that allows for the inclusion of the many complex and overlapping timber and non-timber resource values in the Kamloops TSA.

The main outcomes from this process are:

- **5-year silviculture investment plan** - spatial and at the tactical level to link strategic level planning to management level actions; and
- To identify, model and monitor the performance of important indicators on the landbase.

This 'situational analysis' document is the first of four documents to make up this Type 4 Silviculture Strategy for the Kamloops TSA:

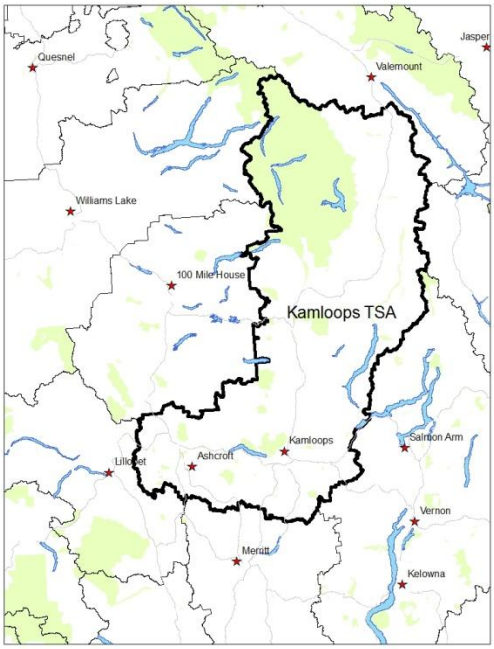
1. **Situational analysis:** describing the general situation for the TSA. PowerPoint slides that were presented at the initial meeting are included at the end of the document;
2. **Data Package:** describing the input data, information and assumptions;
3. **Analysis Report:** describing the modeling output and rationale; and
4. **Silviculture Strategy:** providing treatment options, targets and benefits.

2.0 SUMMARY OF CURRENT PLANS AND STRATEGIES

2.1 Kamloops TSA

Area

The Kamloops TSA is located in south center of interior BC covering a total area of 2.77 million hectares. Of this area, approximately 1.47 million hectares (or 53%) is classified as productive forest with around 1 million hectares designated as available for timber harvesting (68% of the productive forest).



Community

Within the TSA boundary, there are significant areas of private land, Indian reserves, tree farm licenses (TFLs) 35 and 18, Community Forests (CF), woodlots and First Nation Woodland Licenses (FNWL). There are many communities of considerable size throughout the TSA, generally located around the lower elevation lakes and rivers. Kamloops is the largest population centre and is located near the south of the TSA. There are multiple First Nations communities throughout the TSA.

Tree Species and Environment

The species composition and ecology of the TSA is varied and diverse, ranging from hot and dry grasslands in the south to rugged mountains with high precipitation in the north. Biogeoclimatic zones vary from Bunchgrass (BG) and Ponderosa Pine (PP) in the low-elevation valleys in the south to Engelmann Spruce-Subalpine Fir (ESSF) and Alpine Tundra (AT) on the northern mountains. Lodgepole pine, Douglas-fir, Spruce and forests cover the majority of the forested land base.

Land Use

The Kamloops Land and Resource Management Plan (KLRMP) (1995), provides direction for the management of Crown land and resources in the area. Forest planning and practices are guided by this plan in addition to other provincial level plans and legislation (FRPA-FPPR, GAR, FSPs). Draft spatial old growth management areas (OGMAs) were identified to help meet biodiversity requirements operationally.

2.2 Timber Supply Situation

Annual Allowable Cut

The annual allowable cut (AAC) has been regulated in the Kamloops TSA since 1981 (Figure 2.1). The AAC ranged from 2.35million m^3/year to a high of 4.35million m^3/year from 2004 - 2008 to address the current MPB epidemic and 2003 wildfire season.

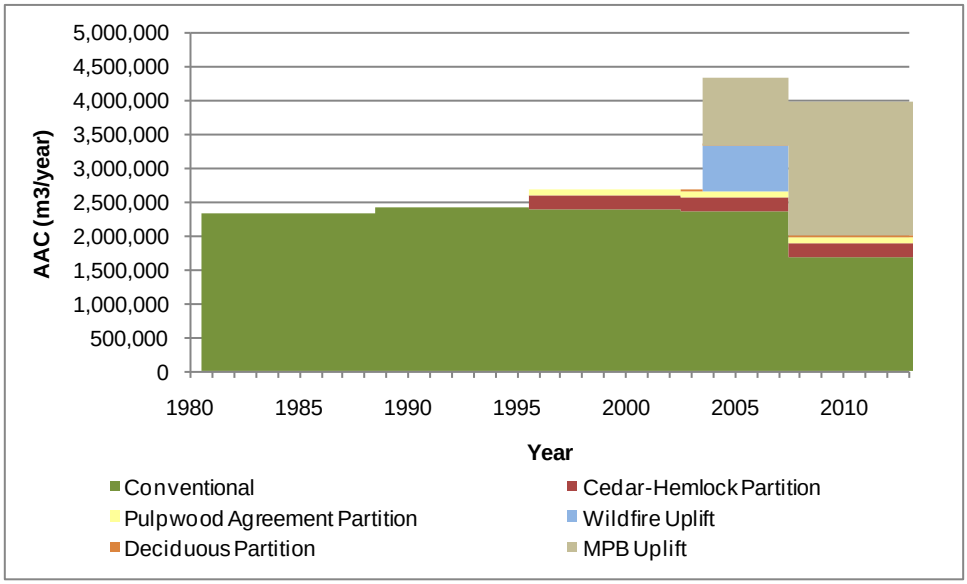


Figure 2.1: Mid-term Timber Supply Forecasts

In June 2008, the AAC was set at 4million m^3/year including partitions for pine and non-pine species as listed in Table 2.1.

Table 2.1: Current AAC Partition

Partition	AAC (m3/year)
Non-pine partition*	1,700,000
Pine stands	1,994,000
Cedar/Hemlock stands	200,000
Pulpwood Agreement 16	86,000
Deciduous outside PA16 (in Headwaters)	20,000
Total	4,000,000

*Stands predominated by Douglas-fir, spruce or balsam

Mountain Pine Beetle

The current mountain pine beetle (MPB) epidemic has affected an estimated 723 million m^3 or 53% of the merchantable pine volume province wide (Walton, 2013). In the Kamloops TSA, an estimated 28.9million m^3 (or 49% of the mature pine volume) has

been affected (Walton, 2013). Figure 2.2 shows the volume of red-attack on the Kamloops TSA THLB (data adapted from Table 1 in Walton, 2013).

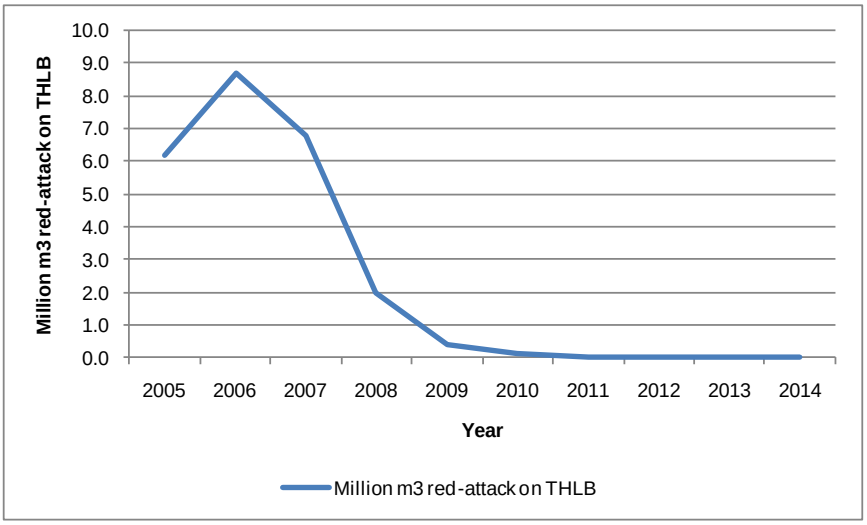


Figure 2.2: Volume of Red-attack (Kamloops TSA THLB)

Mid-Term Timber Supply

The most recent timber supply analyses in Kamloops TSA include:

- Kamloops TSA Mountain Pine Beetle Horizontal Initiatives Project (Type 2 Silviculture Analysis) (Timberline, 2007 – Ecora's analysis team);
- 2007 Timber Supply Review (TSR). The timber supply analysis work for this TSR was based on the above project; and
- 2001 TSR (B.C. Ministry of Forests, July 2001).

Mid-term basecase timber supply forecasts in these 3 analyses vary between 1.8 and 2.2 million m^3/year (Figure 2.3).

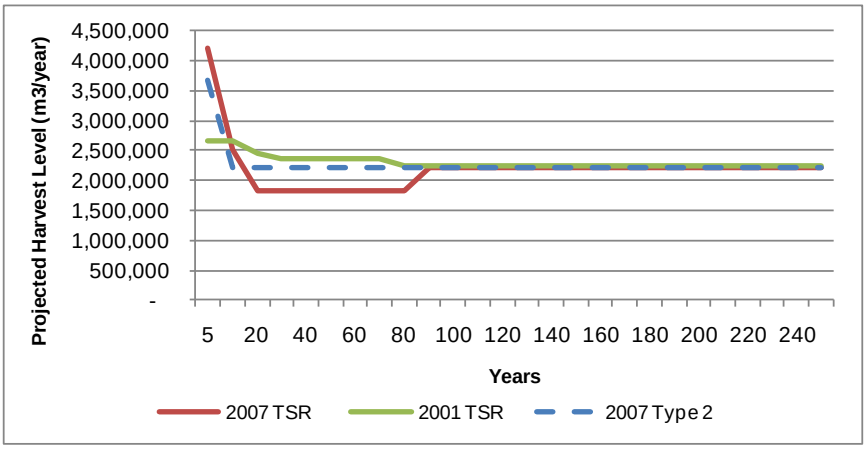


Figure 2.3: Mid-term Timber Supply Forecasts

Other projects that have been completed on Kamloops TSA that will feed into the Silviculture Strategy process include:

- Kamloops risk analysis: this project started with a 1980 forest cover inventory and scheduled human and natural disturbances until a starting point of 2012. This approach can be replicated in this analysis prior to forecasting the analysis from 2013 onwards.
- Kamloops Future Forest Ecosystems Scientific Council (FFESC) Project: this project provides a framework and strategy for forest management looking through the climate change lens. Considerable expertise and research has been done in the Kamloops TSA, which will provide a strong foundations for the working group to integrate climate change into the Silviculture Strategy analysis.

2.3 Timber Quality Situation

The overarching timber quality target is for at least 10% premium logs[1] (MOF, 1999), and Kamloops - specific premium definitions and timber targets may be defined as part of this process. At the initial meeting, Ministry representatives, silviculture experts and licensee representatives will all participate in a discussion on these definitions and targets.

2.4 Historic Silviculture Program

Historic levels of silviculture activities in the Kamloops TSA are shown in Figure 2.4. Since 1974, almost 300,000ha has been planted, 46,000ha brushed and 36,000ha juvenile spaced.

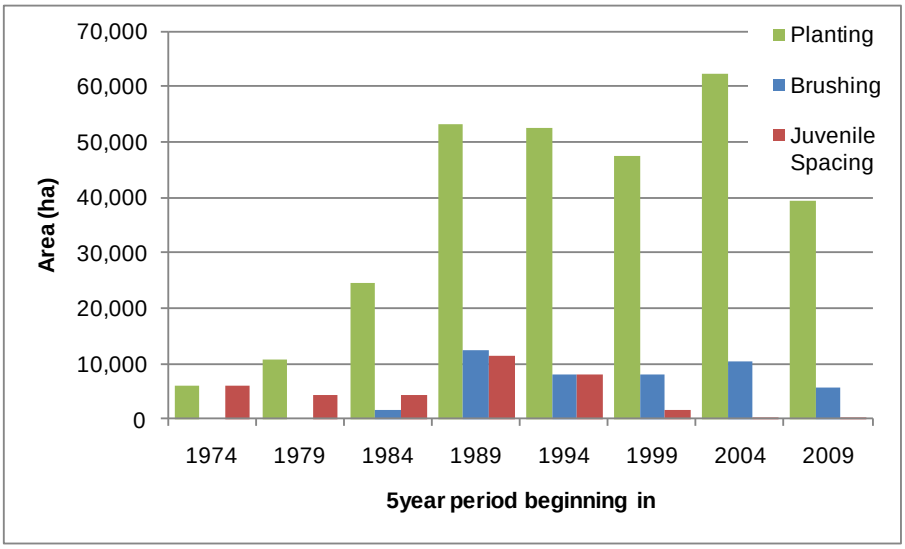


Figure 2.4: Historic Silviculture Program

[1] Premium quality logs have one or more of the qualities of: larger dimension, narrow ring width, high specific gravity, low taper, few or no knots, such that they are suitable for the production of high value forest products and therefore command higher than normal prices in a free market. Specifications will vary by tree species, demand and location (Incremental Silviculture Strategy For British Columbia, MOF 1999).

2.5 Biodiversity and Habitat Issues

The Kamloops TSA has many biodiversity and habitat resources that are directly managed and affected by the MPB epidemic and forestry operations. In timber supply, traditionally modeled resource management zones (RMZs) include:

- Community watersheds (CWS);
- Integrated resource management zones (IRM);
- KLRMP critical deer winter range (DWR);
- KLRMP critical moose winter range (MWR);
- Lakeshore management zones (LMZs);
- Mountain Caribou approved ungulate winter ranges (u-3-004 and u-3-005);
- Old growth management areas (OGMAs);
- Visual quality objectives (VQOs); and
- Wildlife habitat areas (WHAs).

For this project, modelling methodology, indicators and targets will be discussed and if necessary, augmented from the TSR modelling. As well, additional non-TSR resource modelling will be discussed and implemented if needed. Some initially identified issues are listed below; however more may be identified during the process:

- Timber:
  - Ecosystem restoration in low site areas
  - Facilitating harvest in low site/low volume areas (ITSLs)
  - New VRI with dead layer for MPB affected wood
  - Fibre flow- not just dimensional lumber
  - Economics
- Hydrology:
  - improve modelling (EDA/ECA);
  - over an extended landbase (not just CWS).
- Range modelling / forage supply;
- Ecosystem restoration;
- Forest health;
- Climate change;
- Wildfire;
- First Nations management regime and values;
- Road modelling;
- Carbon;
- Tree species diversity.

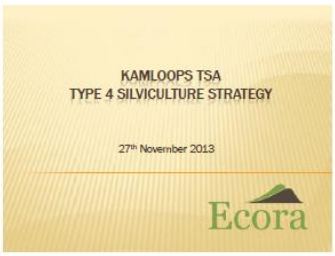
2.6 Opportunities for Silviculture

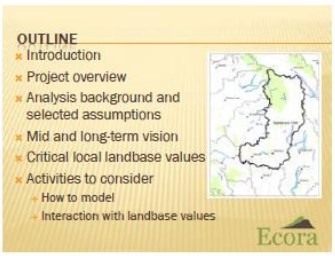
Treatments that may be modeled on the landbase include:

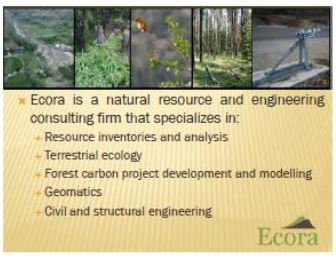
- Clear-cut harvesting (MPB salvage/non-MPB);
- Partial-cut harvesting;
- Fertilization;
- Reforestation planting (rehab);
- Spraying for insect control;
- Range cut-blocks;
- Ecosystem restoration;

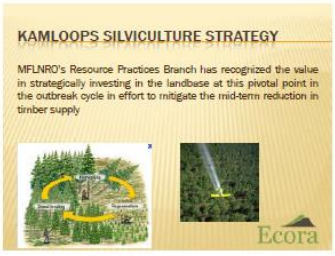
- Fuel management.
- Tree improvement; and
- Salvage of low volume/low value stands (ITSL program).

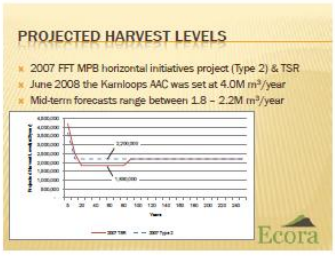
3.0 SITUATION ANALYSIS POWERPOINT PRESENTATIONS

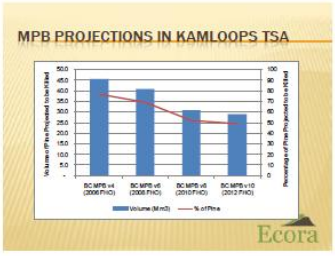


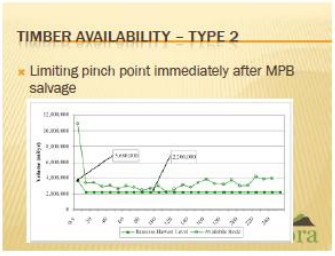


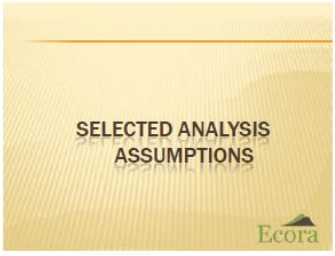


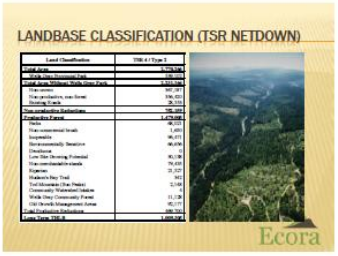


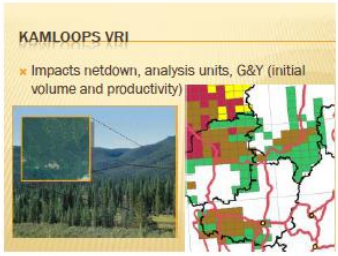


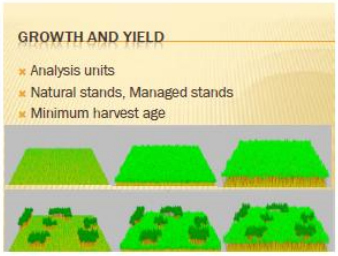


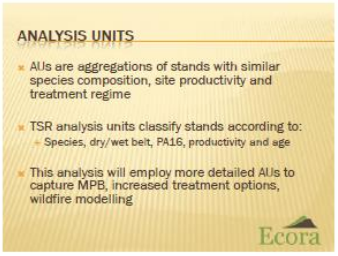


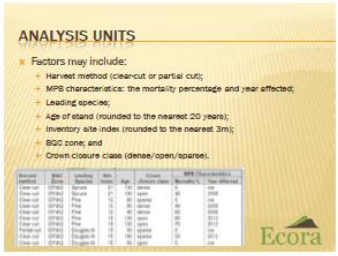


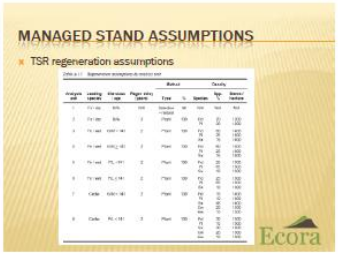

LANDBASE CLASSIFICATION (TSR NETDOWN)
Ecora

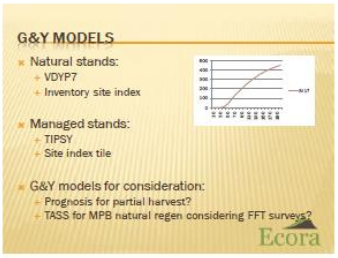

KAMLOOPS VRI
Impacts netdown, analysis units, G&Y (initial volume and productivity)

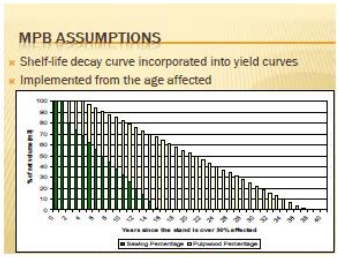

GROWTH AND YIELD
Analysis units
Natural stands, Managed stands
Minimum harvest age

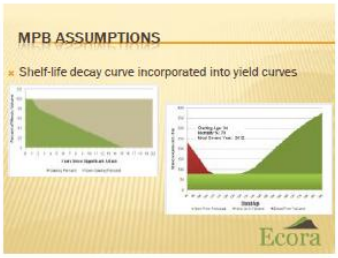

ANALYSIS UNITS
AUs are aggregations of stands with similar species composition, site productivity and treatment regime
TSR analysis units classify stands according to:
Species, dry/wet belt, PA16, productivity and age
This analysis will employ more detailed AUs to capture MPB, increased treatment options, wildfire modelling
Ecora


ANALYSIS UNITS
Factors may include:
Harvest method (clear-cut or partial cut);
MPB characteristics: the mortality percentage and year affected;
Leading species;
Age of stand (rounded to the nearest 20 years);
Inventory site index (rounded to the nearest 3m);
BGC zone; and
Crown closure class (dense/open/sparse).
Ecora


MANAGED STAND ASSUMPTIONS
TSR regeneration assumptions
Ecora


G&Y MODELS
Natural stands:
VDYP7
Inventory site index
Managed stands:
TIPSY
Site index tile
G&Y models for consideration:
Prognosis for partial harvest?
TASS for MPB natural regen considering FFT surveys?
Ecora


MPB ASSUMPTIONS
Shelf-life decay curve incorporated into yield curves
Implemented from the age affected
Sawlog Percentage
Pulpwood Percentage


MPB ASSUMPTIONS
Shelf-life decay curve incorporated into yield curves
Ecora

LANDBASE VALUES AND GOAL SETTING

PATCHWORKS

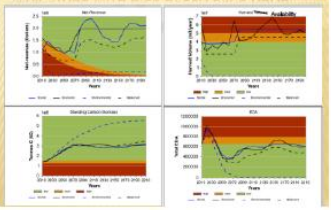
- Spatially Explicit Optimization Model
- Ideal for balancing multiple objectives across extended time horizons
- Spatial capability creates a link between strategic objectives and operational reality
- Well-suited for examining trade-offs between multiple competing objectives (i.e. pine salvage versus retention).

STRATEGIC FOREST MANAGEMENT PLANNING

- Identify objectives
- Create targets

"If you don't know where you are going any road will get you there" Lewis Carroll (born 1832)

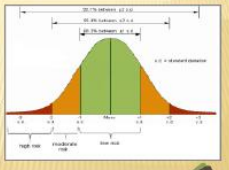
INDICATORS WITH RISK BASED BACK-DROP



RISK RATINGS- SD APPROACH

Close to 'ideal' is low risk

Risk increases as difference from 'ideal' increases



POSSIBLE INDICATORS

- Timber- volume and product objectives
- TSR RMZs (CWS, deer, lakeshore management, caribou, visuals, WHAs etc)
- Economics
- Hydrology- EDA, H50
- Wildfire hazard
- Forest health hazard (MPB, Douglas-fir beetle, Spruce beetle)
- Range supply
- Tree species diversity
- Harvesting the profile (terrain, economics, visuals?)
- Road density
- First Nations values

TIMBER VALUE

TIMBER – HARVEST AND LANDBASE

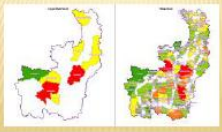
- Timber volume – targets?
- Species diversity – targets?
- Value – piece size
- Cost
- Harvest profile:
  - Terrain
  - Economics
  - Visuals
- Premium logs?

TSR/KLRMP RMZS

- Community watersheds (CWS);
- Integrated resource management zones (IRM);
- KLRMP critical deer winter range
- KLRMP critical moose winter range (MWR);
- Lakeshore management zones (LMZs);
- Mountain Caribou approved ungulate winter ranges;
- Old growth management areas (OGMAs);
- Visual quality objectives (VQOs); and
- Wildlife habitat areas (WHAs).

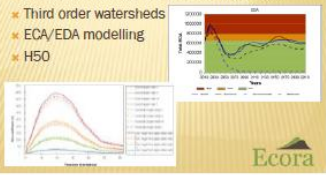
HYDROLOGY

- Currently- only community watershed rules modeled in TSR
- Could build on May 2012 Kamloops TSA Watershed Risk Analysis



HYDROLOGY

- Lots of community watersheds in the TSA
- Third order watersheds
- ECA/EDA modelling
- H50

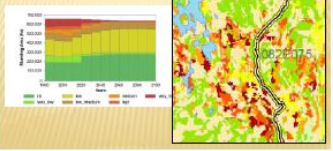


FOREST HEALTH

- Hazard/risk ratings:
  - Mountain pine beetle
    - Hazard rating = Pine per * Age F * Density F * Location F
  - Douglas-fir beetle
    - Hazard Rating = Fd per * Age F* Diam F * Growth F
  - Spruce beetle
    - Hazard Rating = 10 * ((Spruce per * Quality F * Age F * Location F * Stand density equation) ^ 0.5

FOREST HEALTH

- Model hazard over time
- Spatially located



WILDFIRE HAZARD

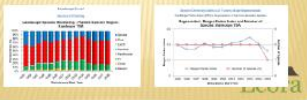
- Wildfire hazard
- Interaction with ecosystem restoration
- Community wildfire interface
- Try to include wildfire hazard in the forest estate modelling so it is able to be used for decision support

WILDFIRE

- Last time:
  - Simplified modelling
  - Assign FBP system fuel types
  - Summarized fuel types
- This time:
  - Do better- build upon this
  - Assign hazard associated with each fuel type

TREE SPECIES INDICATORS

- species targets by BEC subzone level
- monitor species diversity
- pre-/post harvest species mixes
- Berger-parker index
- Reporting could follow "Species Monitoring Report May 2012"

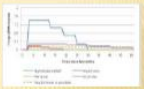


RANGE SUPPLY

- Range agreements have a target forage by pasture
- Measured in animal unit months (AUMs)
- Forestry significantly impacts forage supply
- Provide foundation to reasonably incorporate range into the planning process

RANGE SUPPLY

- Forage growth is modelled post harvest (by BGC)
- Alternative management by out-block type:
  - Type 0: current management - no forage enhancement & standard tree stocking
  - Type 1 and 2: forage out-block – moderately increase forage activities with standard tree stocking
  - Type 3: silvo-pasture out-block – high forage production with reduced timber production (~75% fewer trees)
  - Type 4: forage out-block - conversion to permanent forage production



ROAD DENSITY

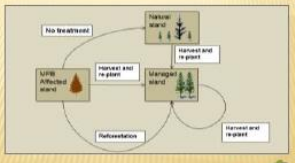
- Patchworks can incorporate road networks
- Apply costs associated with roads dynamically
  - construction
  - maintenance
  - hauling costs
- Send volume to explicit mills
- Calculate and control road density e.g. by watershed or in grizzly bear habitat

GO TO BRYCE'S PPT ACTIVITIES TO CONSIDER

ACTIVITIES FOR CONSIDERATION

- Clear-out harvesting
- Selection harvesting
- MPB salvage harvesting
- Rehab (planting non-harvested MPB stands)
- Fertilization
- Ecosystem restoration
- Brushing impeded stands
- Defoliator spraying program

SAMPLE ACTIVITIES ON MPB STAND



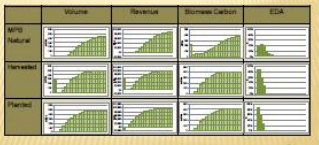
MPB AFFECTED STAND

A MPB affected stand can be harvested if it is:
- on the THLB; and
- > minimum harvest volume.

A MPB affected stand can be planted if it is:
- on the THLB; and
- not harvested.

- cost of planting is applied (e.g. $2,681/ha);
- the value and cost of harvesting is calculated;

HOW ACTIVITIES ARE MODELLED



FERTILIZATION

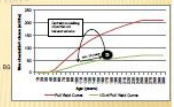
FERTILIZATION

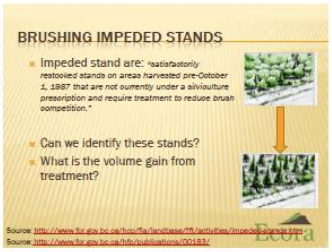
A stand is suitable to be a candidate for fertilization if it is:
- Douglas-fir or spruce leading;
- Non-MPB affected;
- Site index >= 15; and
- On the THLB.

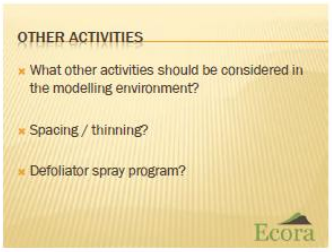
- cost of fertilization is $450 /ha;
- no harvesting for 10 years after treatment;
- growth response realised from fertilization implemented (10 m^3/ha for spruce and 12 m^3/ha for Douglas-fir)

SELECTION HARVESTING

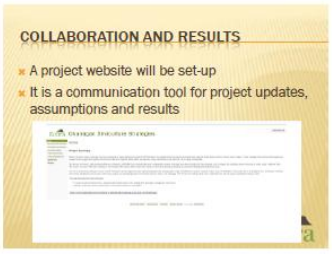
TSR assumptions:
- Fir dry selection
  - Douglas-fir leading
  - BGC: PPxh, IDFxh, IDFxw, IDFdk1,IDFdk3, BG
- Fir dry small patch
  - Douglas-fir leading
  - BGC: IDFdk2 & MSdk
  - excluding Sx, Hw, Cw, Bl & Pl 2nd species
- 40/30% removed on the first/second past
- 30year return interval
- Approx 100,000ha / 1M ha THLB (10% of THLB)



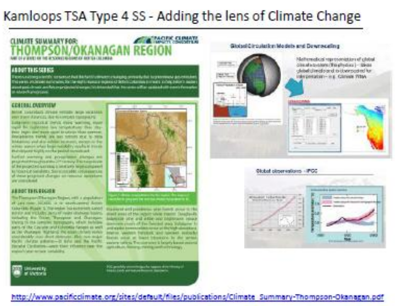

BRUSHING IMPEDED STANDS
Impeded stand are: "satisfactorily restocked stands on areas harvested pre-October 1, 1987 that are not currently under a silviculture prescription and require treatment to reduce brush competition."
Can we identify these stands?
What is the volume gain from treatment?
Source: http://www.for.gov.bc.ca/hvo/fia/landbase/ffl/activities/impeded.average.htm
Source: http://www.for.gov.bc.ca/hfp/publications/00183/
Ecora

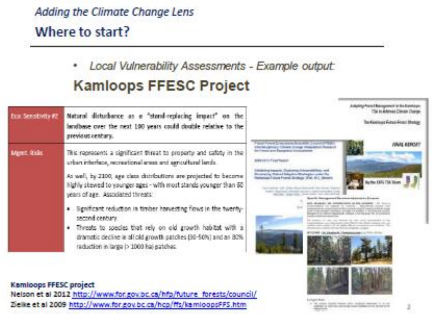

OTHER ACTIVITIES
What other activities should be considered in the modelling environment?
Spacing / thinning?
Defoliator spray program?
Ecora

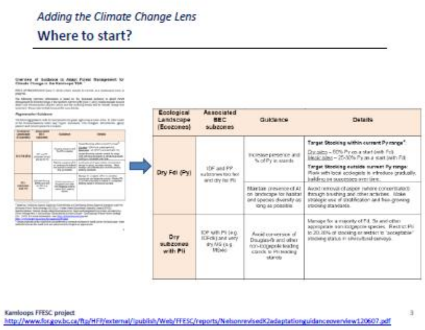

CARBON NEWS FROM CHINA – CARBON?
Shanghai Daily
Focus of Doha climate talks
US, EU resist Doha pleas for more emission cuts
Potential huge for China to go 'green'

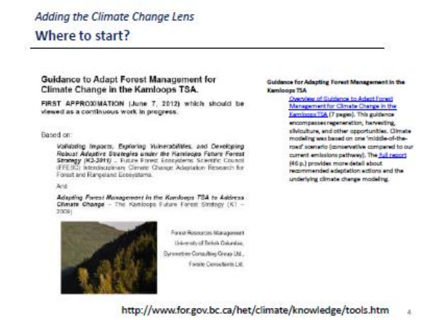

COLLABORATION AND RESULTS
A project website will be set-up
It is a communication tool for project updates, assumptions and results

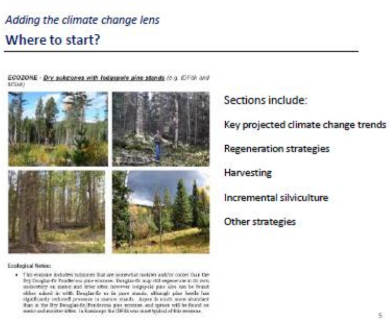

Thank you
Kelly Sherman, RPF
Krysta Giles-Hansen, RPF
Ecora

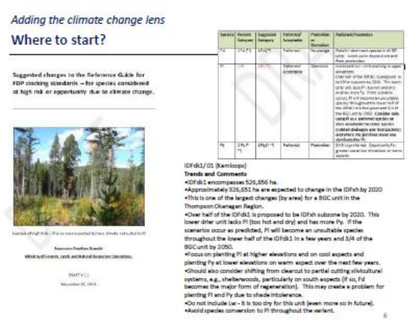

Kamloops TSA Type 4 SS - Adding the lens of Climate Change
CLIMATE SUMMARY FOR:
THOMPSON/OKANAGAN REGION
Global Circulation Models and Downscaling
http://www.pacificclimate.org/sites/default/files/publications/Climate_Summary-Thompson-Okanagan.pdf

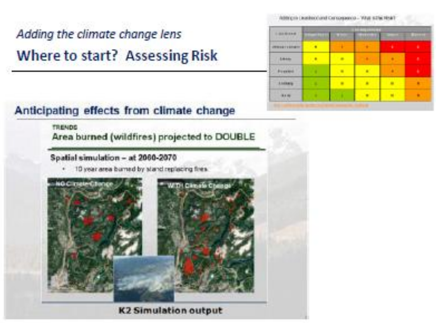

Adding the Climate Change Lens
Where to start?
Local Vulnerability Assessments - Example output:
Kamloops FFESC Project
Natural disturbance as a "stand-replacing impact" on the landbase over the next 100 years could double relative to the previous century.
This represents a significant threat to property and safety in the urban interface, recreational areas and agricultural lands.
Kamloops FFESC project
Nelson et al 2012 http://www.for.gov.bc.ca/hfp/future_forests/council/
Zielke et al 2009 http://www.for.gov.bc.ca/hcp/ffs/kamloopsFFS.htm


Adding the Climate Change Lens
Where to start?
Ecological Landscape (Ecozones)
Associated BEC subzones
Guidance
Details
Dry Fdi (Py)
Dry subzones with Pli
Kamloops FFESC project


Adding the Climate Change Lens
Where to start?
Guidance to Adapt Forest Management for Climate Change in the Kamloops TSA.
FIRST APPROXIMATION (June 7, 2012) which should be viewed as a continuous work in progress.
Guidance for Adapting Forest Management in the Kamloops TSA
http://www.for.gov.bc.ca/het/climate/knowledge/tools.htm


Adding the climate change lens
Where to start?
Sections include:
Key projected climate change trends
Regeneration strategies
Harvesting
Incremental silviculture
Other strategies


Adding the climate change lens
Where to start?
Suggested changes to the Reference Guide for FDP stocking standards – for species considered at high risk or opportunity due to climate change.
IDFdk1/01 (Kamloops)
Trends and Comments


Adding the climate change lens
Where to start? Assessing Risk
Anticipating effects from climate change
Area burned (wildfires) projected to DOUBLE
Spatial simulation – at 2000-2070
K2 Simulation output

Tree Improvement in the Kamloops TSA

Jack Woods
Program Manager,
Forest Genetics Council of BC
SelectSeed Ltd.

FGC Forest Genetics Council of British Columbia

Perspective on genetic resources

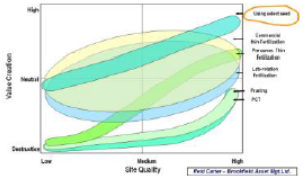
- Forests, and all values that flow from forests, depend upon a gene pool

What is genetic resource management in forestry?

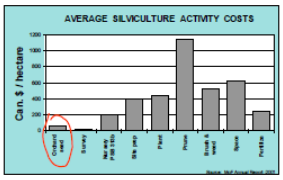
- Understanding natural genetic diversity
- Managing seed transfer
- Genetic conservation
- Breeding and selection
- Seed production
- Climate change response

To be discussed

Tree improvement is an economic activity undertaken worworldwide

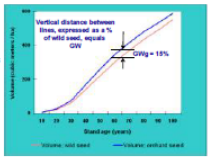


Positive NPV because of low per ha cost



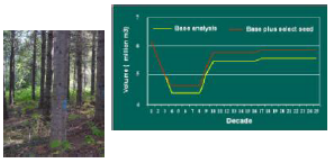
Genetic gains are quantified as a GENETIC WORTH (GW)

- GWg is genetic worth for growth
  - Stem volume production over wild seed at a age 60 years (80 for SA)
  - Expressed as a % of wild stand volume
  - Also GWr for pest resistance and GWw for wood quality



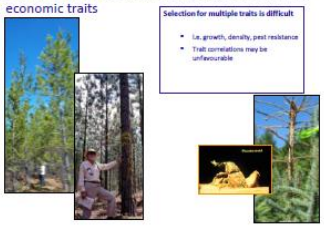
Class A seed can impact timber supply in the mid-term

- Impact depends upon inventory age-class profile
- Protocols in G & Y models and TSR



Tree breeding starts with testing offspring from selected parent trees

Selection of "best" trees in progeny tests based on economic traits



Orchards produce seed from selected parent trees

Silvicultural and genetic options work together to improve stand yield and quality

- Typical traits for genetic selection
  - Growth rate
  - Wood quality
  - Pest resistance
  - Stem form and branching
- Silviculture options
  - Controlling stand density influences log quality
  - Fertilization can improve growth
  - Etc.

Genetic solutions are not the best solutions for some traits

Species with breeding programs and seed orchards in BC (Kamloops TSA)

- Interior
  - Interior (hybrid) spruce
  - Lodgepole pine
  - Douglas-fir
  - Western white pine
  - Western larch
  - Ponderosa pine
- Coast
  - Douglas-fir
  - Western redcedar
  - Sitka spruce
  - Western white pine
  - Western hemlock
  - Yellow cedar

Seed orchards in BC

- 105 orchards
- 11 species
- 15 sites (licensee, private, MFLNRO, SelectSeed – co-op)
- Produce over about 66% of the seed used provincially

Seed production forecasts are available for all seed planning units

- Unique species, seed zone, elevation (i.e. Sx, Thompson Okanagan 1300-2100m)
- Produced by Forest Genetics Council
- On Tree Imp. Branch website

http://www.for.gov.bc.ca/hti/speciesplan/index.htm
(search on Tree Improvement Branch species plans)

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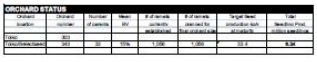

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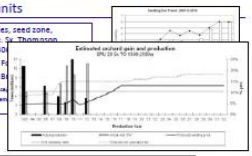
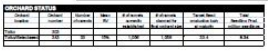
(search on Tree Improvement Branch spec

Seed production forecasts available for all seed planning units

- Unique species, seed zone, elevation (i.e. Sx, Thompson Okanagan 130
- Produced by F
- On Tree Imp. B

http://www.for.gov.bc.ca/
(search on Tree Improve





Seed planning units relevant to the Kamloops TSA

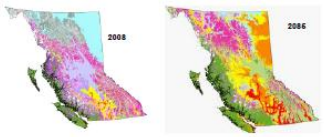
Douglas-fir Thompson Okanagan Nelson Caribou Transition Quesnel Lakes	**Spruce** Thompson Okanagan Nelson Prince George	**Larch** Nelson
Lodgepole pine Thompson Okanagan Prince George	**White pine** Kootenay / Quesnel	**Ponderosa pine** Southern Interior

Genetics is fundamental to climate-change adaptation

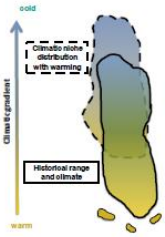
- Trees are genetically adapted to past climates
- Many climate-change issues in forests are due to a mis-alignment with local climate at both the species level and the genetic population level
  - Pests
  - Drought
  - Growth phenology
  - Cold hardiness
  - Vulnerability to snow

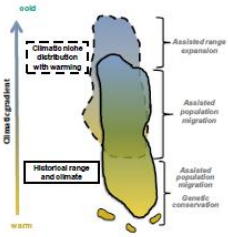
Natural migration rates of tree populations are not expected to keep up with climate change

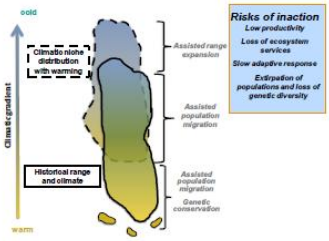
Trees species can Adapt, Migrate, or Die
(Aitken et al., 2008)

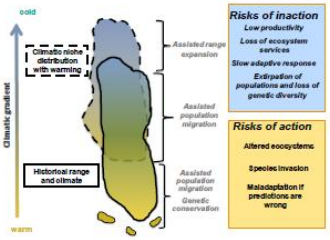


Hamann and Wang. 2006. Ecology 87: 2773-286

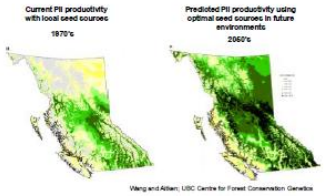






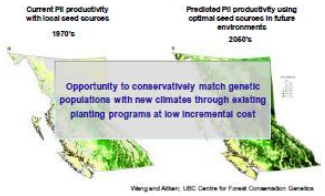


But all is not doom and gloom



Wang and Aitken, UBC Centre for Forest Conservation Genetics

But all is not doom and gloom



Wang and Aitken, UBC Centre for Forest Conservation Genetics

Choice of seed will become increasingly critical to stand performance

- Local seed will be less optimal
- Choices will happen at the
  - Species level first
  - Population level second (choosing the right seedlots)
- Knowledge is key
  - Climate modeling (ClimateWNA – UBC)
  - Characterizing tree population (seedlot) performance using climatic parameters
- Seed transfer standards will provide guidance
  - Significant work underway