



Project Completion Report

**Phase 1 - Vegetation Resources Inventory (VRI)
Photo Interpretation and Digital Map Production
of
TFL 18**

Prepared By:

FDI Forest Dimensions Inc.

Signoff: _____

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1. Introduction

A Phase 1 Vegetation Resources Inventory (VRI) was conducted for the entire TFL 18 in 2008. Information contained in the TFL 18 VRI Strategic Inventory Plan (VSIP), March 2005 and the VRI Photo Interpretation Project Implementation Plan (VPIP), September 2007 formulated the need and requirements for completion of this inventory.

A Request for Proposal for the Phase 1 VRI of TFL 18 was issued by Canadian Forest Products Ltd., Vavenby Division on December 21, 2007. The project was subsequently awarded to FDI Forest Dimensions Inc. in January 2008 and was completed by January 2009.

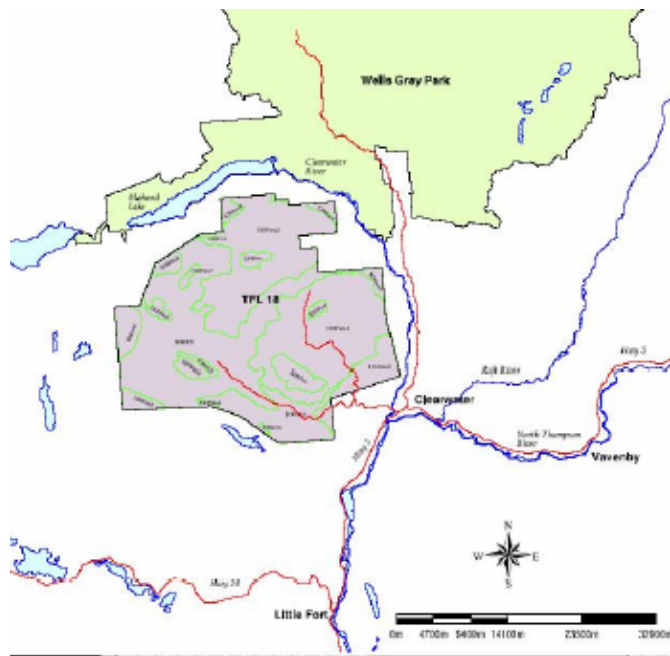
The objectives of the VRI for TFL 18 are to improve on the existing inventory, provide more detailed information on the noted inventory issues in section 1.1 of the VPIP, and overall improvement of forest management and strategic planning – TFL 18 VPI, 2007.

This is to be accomplished by: Better estimates of current and future timber supply, better information of Balsam residual stands, classification of non forested polygons, volume and productivity of deciduous leading stands, MPB. The past inventory was completed in 1991-94 by Reid Collins Forest Resource Consultants. This inventory was actually just a retro-fit of an older inventory completed in 1974 with the addition of ground observations with measurements run along transect lines. An inventory audit conducted by the Ministry of Forests in 1997 indicated that the accuracy of the mature and immature components of the current inventory were statistically acceptable. However, it was also determined that non-forested polygons did not meet provincial standards. Therefore, it was decided to bring the inventory up to current VRI standards, to map the mountain pine beetle devastation as well as other infestations, and to get better information on the residual balsam stands.

Funding for the VRI of TFL 18 was provided through the Forest Initiative Account (FIA).

2. Project Area Description

TFL 18 is located in south central British Columbia west of the Thompson River and is administered by the Vavenby Division of Canadian Forest Products Ltd. The TFL is a contiguous unit covering 74,542 hectares and is characterized by rolling terrain situated on a high elevation plateau ranging from 516 meters to 1,989 meters in elevation. There are three biogeoclimatic zones within the TFL including the Interior Cedar Hemlock (ICH) Zone, the Sub-Boreal Spruce (SBS) Zone and the Engelmann Spruce Subalpine Fir (ESSF) Zone.



Map from J.S. Throver report. Growth & Yield of Residual Balsam Stands on TFL 18, 2003.

TFL 18 covers portions of 10 BCGS map sheets including: 92P068, 92P069, 92P070, 92P078, 92P079, 92P080, 92P088, 92P089, 92P090 and 92P099.

3. Personnel

The project manager for the project was Jerry Stenberg, RPF and certified VRI photo interpreter. Jerry is the general manager of Forest Dimensions and is an inventory forester with over 35 years of experience in forest classification in BC. Andy Little was the project supervisor as well as the senior photo interpreter on the project. Kela Auger was the other photo interpreter and both of these classifiers have years of experience interpreting forest vegetation types in southern BC.

Fieldwork was conducted in June 2008 by Andy Little and Murray Foubister who are both certified photo interpreters with a wealth of fieldwork and classification experience in the Clearwater District and surrounding areas. Digital mapping was completed by Darrell Roberts, digital mapping supervisor and John Smith, senior digital mapping technician.

All third-party quality assurance was provided by Jim Grace, RPF - VRI Inventory Forester, Southern Interior Forest Region.

Canfor Representative was Dave Dobi, Vavanby. and Dave Schwarz of Forsite Consultants – Salmon Arm BC

4. Air Photo Coverage / Format

Complete coverage of the TFL was provided with conventional, 1:20,000 color air photo scanned at 15 microns. Interpretation was done in Forest Dimensions' office in Victoria, BC via Intergraph SSK softcopy systems using tiff images. DiAP Viewer preset models were used by Jim Grace in MoFR Kamloops office to provide third-party QA of the polygon delineation and final attributing. Digital 23cm GSD imagery was flown the year (2006) before as an add on to a Lidar project for the TFL, with the intent to be used for this VRI project, but was found to be

unsuitable for VRI. Very little overlap for stereo, so was not even appropriate for large scale measurements.

5. VRI Assessment

The most recent inventory of TFL 18 was completed by Reid Collins Forest Resource Consultants in 1991-93. This was only a retrofit of a 1974 forest inventory and was not done to VRI standards. In 1997, LandSat imagery was used to update forest depletions. Therefore, it was determined that a new inventory to current VRI standards would improve on the existing inventory, provide more detailed information on management issues and facilitate overall improvement of forest management and strategic planning. The management issues and associated benefits for TFL 18 are detailed in the VSIP and VPIP that were prepared prior to approval for the VRI. <http://www.for.gov.bc.ca/hts/vri/reports&pub/index.html>

A summary of the main objectives of the VRI Phase I program as outlined in the September 2007 VPIP are to:

- Improve species composition
- Improve stand heights
- Improve stand structure identification, especially in residual balsam and conifer understory in MPB effected stands
- Improve harvest scheduling through information provided by the VRI (better estimates of current and future timber supply)
- Determine and capture change occurring because of the effect of MPB and other insect and disease factors
- Facilitate ongoing operational planning

6. VRI Phase 1 Photo Interpretation Process

This section describes the range of aspects related to the capture of the new photo interpreted inventory.

6.1 General Comments

All fieldwork and classification procedures were completed as per the current VRI standards and specifications. This was a softcopy project but a combination of high quality orthophoto prints as well as paper prints of the 1:20 000 color photos were used to facilitate fieldwork data collection.

6.2 Inventory Base Maps

The TRIM II base was used for the VRI in an Intergraph SSK softcopy environment.

6.3 Data Source Analysis

The original 1974 air photos were provided showing the original typing as well as the transect lines with ground observations with measurements established by Reid Collins during their 1991-92 retrofit. In addition the air photos and field tally sheets for the 45 ground observations with measurements collected during the 1993 TFL 18 - Inventory Assessment,(not the inventory audits), were also provided. All of the information and location of these transects and ground observations was transferred to working copies of the old FC1s and utilized by the interpreters during final attributing. No PSP or TSP plots were recorded on the FC1's provided. Actual "Inventory Audit" data from the 1996 TFL 18 - Inventory Audit, was not made available for this project. These original 1974 photos were returned to Canfor at completion of this project and the

1993 inventory assessment hardcopy data was returned to the Southern Interior Region, VRI Section.

6.4 Polygon Delineation

Polygon delineation along with photo height measurements was done in the softcopy environment. There are no woodlots, parks, protected areas or private land in the TFL.

Both terrain mapping and Terrestrial Ecosystem Mapping (TEM) mapping were available for use as a reference only for the final classification. Because of the extent of local field knowledge of both of the photo interpreters, this mapping provided very little benefit.

The target average polygon size determined by Canfor and MoFR to provide the necessary intensity for forest planning, analysis and management of the TFL was 10 hectares. The final polygon size of the completed VRI is 10.55 hectares, being very close to the targeted intensity. This included the inventory of all 74,542 hectares within the TFL boundary.

6.5 Field Calibration Data Collection

6.5.1 Sample Plan

A fieldwork sampling plan was completed following polygon delineation to provide 25 1-point ground calls, 25 3-point ground calls and 75 air calls. This plan was designed by the project supervisor and lead interpreter Andy Little to cover the entire area geographically along with good representation of all major forest types and sites within the project area. The fieldwork plan was discussed with Jim Grace (MoFR Kamloops) and then reviewed by Dave Dobi at Canfor's office in Vavenby prior to starting the fieldwork.

6.5.2 Candidate Stand Criteria

To adequately address the VRI objectives described in the VPIP and VSIP the following types were targeted for fieldwork:

- stands having complex species composition
- second growth types
- spruce-balsam stands
- height class 2-3 lodgepole pine stands
- lodgepole pine stands having mountain pine beetle attack
- deciduous-coniferous mixes
- deciduous stands with possible coniferous in-growth
- stands not previously sampled

6.5.3 Data Collection

All ground calls and air calls locations were selected under stereo viewing in softcopy including extents and direction of air calls. The fieldwork data points were then plotted on orthophotos and the GPS location was pre-determined for each air call to assist in helicopter navigation to the correct air call position. GPS co-ordinates were recorded in the field at the center point of each ground call. The final position of all field calibration points was then digitized from the field orthophotos. Each air call was flown with 2 certified photo interpreters with the person in the back seat recording the air call information on VRI air call forms. The air call information was keypunched at a later date in the office. Ground call data was entered in the field via digital data loggers and hard copies were later printed as a backup.

6.5.3.1 Air Calibration and Ground Calibration

77 air calls were completed with one classifier estimating tree specific data such stand structure,

species composition, scattered species, age, height, coniferous understory, basal area, density, snags as well as recent disturbances caused insects, disease, logging and windfall. The second classifier confirmed these estimates and also recorded pertinent ecological data, non-tree vegetated data such as shrub height, herb cover type and non-vegetated cover types. 25 1-point and 25 3-point ground calls were completed to current VRI specifications. In addition to the required standard parameters being measured or recorded, the amount of green, red and grey attacked trees was also recorded. Generally, 3-point ground calls were established in stands having several species or having complex stand structures.

6.5.3.2 Air Observations and Ground Observations

No formal air or ground observations were required but several informal observations were recorded on the orthophotos.

6.5.3.3 Data Description Format

All 1993 ground observations and the new air calls and ground calls are located in the digital data base that was delivered to MoFR. The extents and direction of all new air calls was also digitally captured. Digital and hard copies of all the new air calls and ground calls along with a copy of the field orthos was delivered to both MoFR and Canfor Vavenby Division.

A digital xls attribute list of all fieldwork with GPS co-ordinates was delivered to MoFR as required.

6.6 Attribute Estimation and Cover Descriptions

6.6.1 Final Attribution

All areas within the TFL were described with the required full VRI descriptions as per current VRI specifications. Each polygon received a text node and number linked to the .mdb database. Special attention was given to residual balsam stands that resulted from logging BS and SB stands back in the 1960's. As these stands comprise approximately 11 percent of the land base for the TFL, particular attention was made to correctly interpret their age as well as assigning a correct estimated site index. Many of the ground observations established by Reid Collins in 1991-92 were established in these stands to get better site indices. This additional site index information was also incorporated into the new VRI. Canfor also requested that we create more 2 layered stands in these IU balsam stands than would normally be described as a single layered stands with complex structure. This was also identified during the 3rd party QA process as not to VRI Standards. It was limited to the IU Balsam areas.

The polygon attribute information was entered into a digital medium by the interpreters using our in-house VegEdit software and then further validated by running it through MoFR VEGCAPS.

The polygons within the TFL on all 10 BCGS mapsheets were edge tied to each other. The TFL boundary formed a polygon boundary and no attempt was made to tie TFL polygons to adjacent TSA polygons.

6.6.2 Silviculture Information

The external boundaries of all openings and the location of all roads were confirmed with the new photography and adjusted as required. Non-treed types, non-vegetated types and wildlife tree patches were all delineated out within openings. Many roads were in the wrong location on the existing maps and had to be re-digitized. Internal lines within the openings were maintained as per instructions. However, incorporating the silviculture information into the new VRI was a challenge and took considerable more time and effort than budgeted. Canfor requested that we incorporate information from their GENUS database but this data and related mapping was very confusing. Most roads within the silviculture openings on the company maps were incorrectly mapped as separate polygons because the right-of-ways were less than 2.0 mm at 1:20 000.

Changing these roads to line symbology only left polygons in the same opening with very similar attributes. These then had to be amalgamated into fewer polygons which took considerable mapping time.

We also received RESULTS data for the openings and in most cases, Results was neither complete or correct. At Canfor's request, GENUS data was used wherever possible and RESULTS data only used where there was no GENUS information. RESULTS information was used for silviculture openings in areas belonging to Small Business. Free growing polygons were re-delineation and classified using any existing silviculture information as reference data as much as possible.

6.7 Digital Map Production

All digital mapping was completed as per current VRI mapping standards and specifications. All roads were delineated as a line feature on a separate layer. A variety of in-house and Ministry software was used on each map to node, vector clean, validate and compare each polygon. This ensured a clean map and a one-to-one match of attribute files to corresponding polygon numbers. All digital graphic files were delivered in single neat line format.

Edge matching of all attributes and line work was validated using in-house software. All files were also processed using Ministry VEGCAPS and VEGCHECK software as a final check to ensure all attributes and polygon lines met Ministry standards.

Final VRI mapping was delivered in IDGS format UTM Projection to the Ministry and in ESRI format BC Albers projection to Canfor.

7. Deliverables

Following is a list of deliverables that were sent to MoFR Kamloops on February 2, 2009 and a duplicate set to Canfor on February 9, 2009:

- Hardcopy Orthophotos with 2008 fieldwork
- Digital (MoF calibration tile .xls format) and hard copies of all air call and ground calls
- Vegetation and history attributes validated through VEGCAPS
- Final VEGCAPS reports From the Validate and Compare functions
- Final design files to RAIB in IDGS format UTM projection Digital files in .dgn, .FC1 and .mdb for all 10 maps within the project area.
- Final design files to Canfor in ESRI format BC Albers projection
- All project materials returned to client MoFR and Canfor, as required
- Project Completion Report

8. Quality Assurance

All third-party quality assurance was provided by Jim Grace, RPF - VRI Inventory Forester, Southern Interior Forest Region. Following is a summary of the QA reports:

- Polygon delineation – the delineation on 33 models was checked with an average score of 96.4%.
- Fieldwork – two 3-point ground calls and two 1-point ground calls were checked with an average rating of 97.3%. Ten air calls were checked with an average score of 97.4%.
- Final attributing – 3% of the polygons in the TFL were checked with an average rating of 92%.

The primary issues concerning VRI, occurred with the quality of results (silviculture) data (a ½ day conference call between contractor, licensee and MOF, resolved much of this). The small

business Results data was not initially provided to the contractor. There was also an issue with complex SB stands being called 2 layers. This was requested by the licensee to facilitate operational issues.

Quality of the 2007 imagery at the out set, appeared to be good. At times there was an issue with getting similar softcopy height measurements as the contractors. For the QA, some areas of the imagery appeared to be flattened out, making softcopy height measurements difficult. This was also identified by Roman Bilik (FAIB) with softcopy height measurements being made for the TFL 18 Lidar project that was running concurrently. In areas where no satisfactory height measurements could be made, by the QA person, photo estimation was used as a back up. It points to a need to take care with softcopy heights for any projects.

9. Costs

FDI Forest Dimensions', Canfor and Forsite costs for the Phase 1 VRI were:

- Data source transfer and polygon delineation - \$ 18,640.00
- Fieldwork (helicopter costs not included) - \$ 16,375.00
- Final classification - \$ 55,920.00
- Digital Mapping - \$ 4,268.00
- Helicopter - \$ 12,518.00
- Canfor - \$ 5,138.66
- Forsite - \$ 5,704.10
- \$ 118,563.76

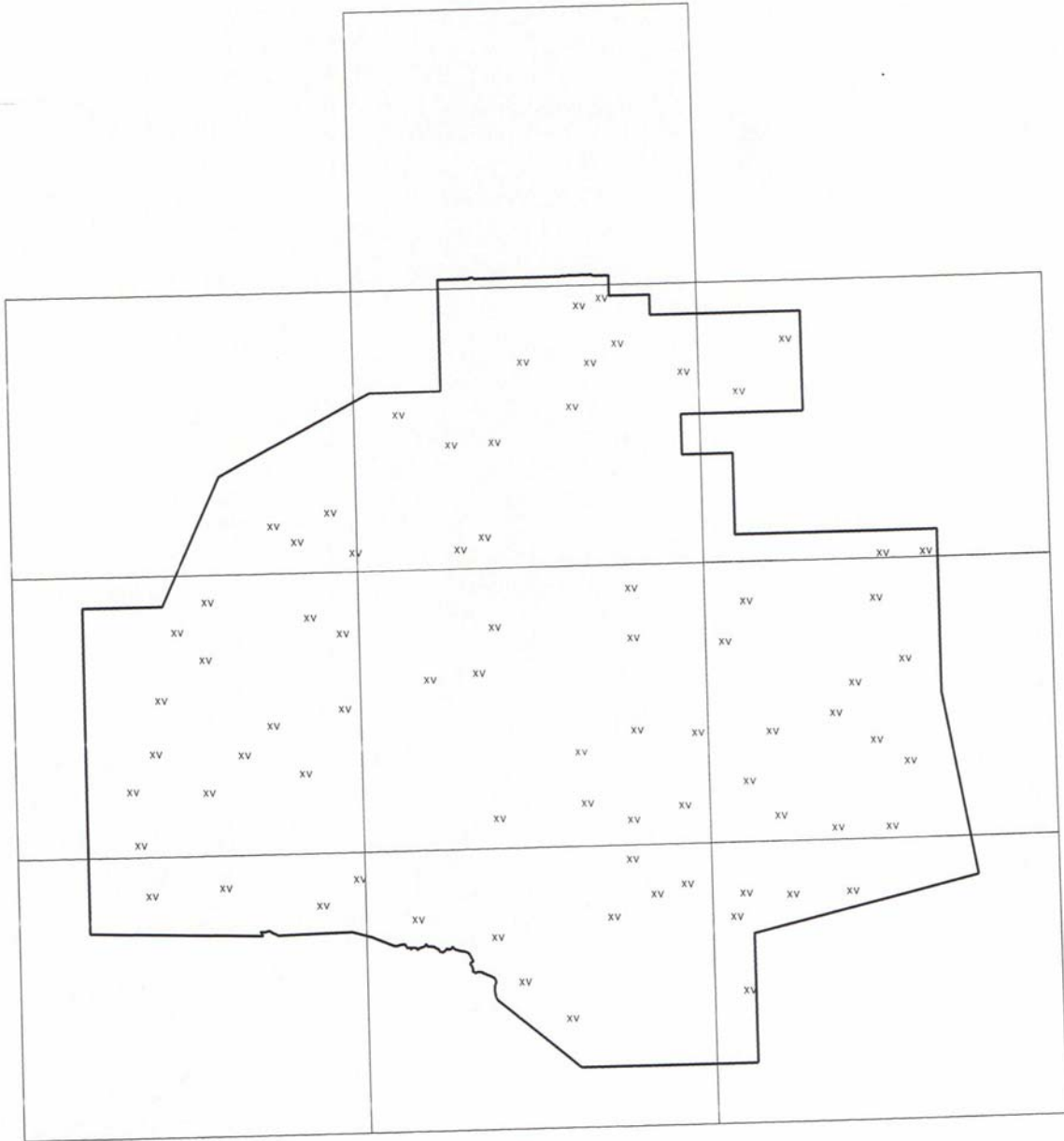
Quality Assurance by MoF VFRI Southern Interior Region staff at no cost.

10. Conclusion and Recommendations

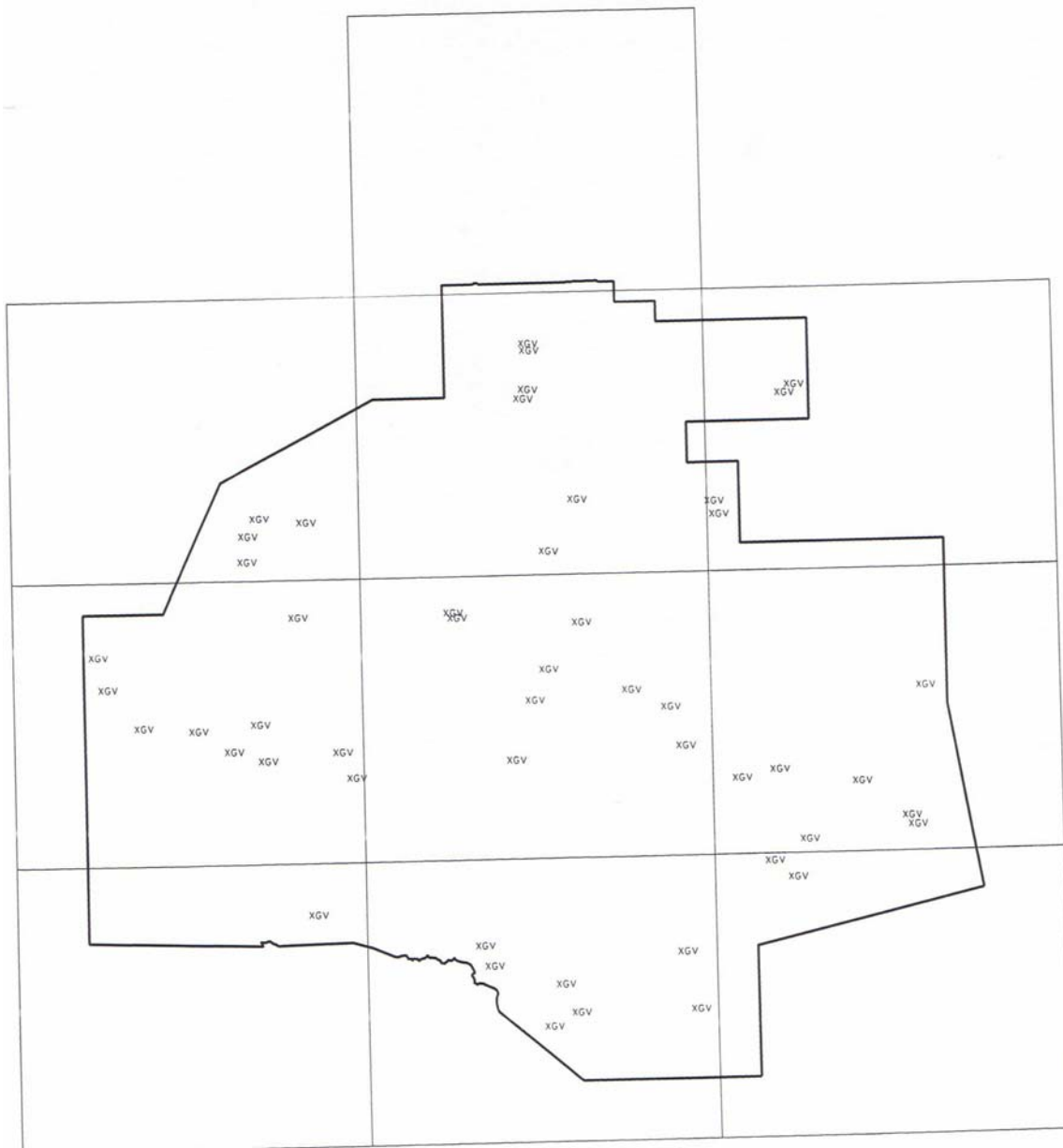
The only substantial issue with this project was the quality of the silviculture data and mapping of the roads and cutblocks that we received. This resulted in requiring more digital mapping and classification time to sort out and process than budgeted.

11. Attachments

Distribution maps of 2008 air calls and ground calls.



Distribution of 2008 air calls in TFL 18



Distribution of 2008 ground calls in TFL 18