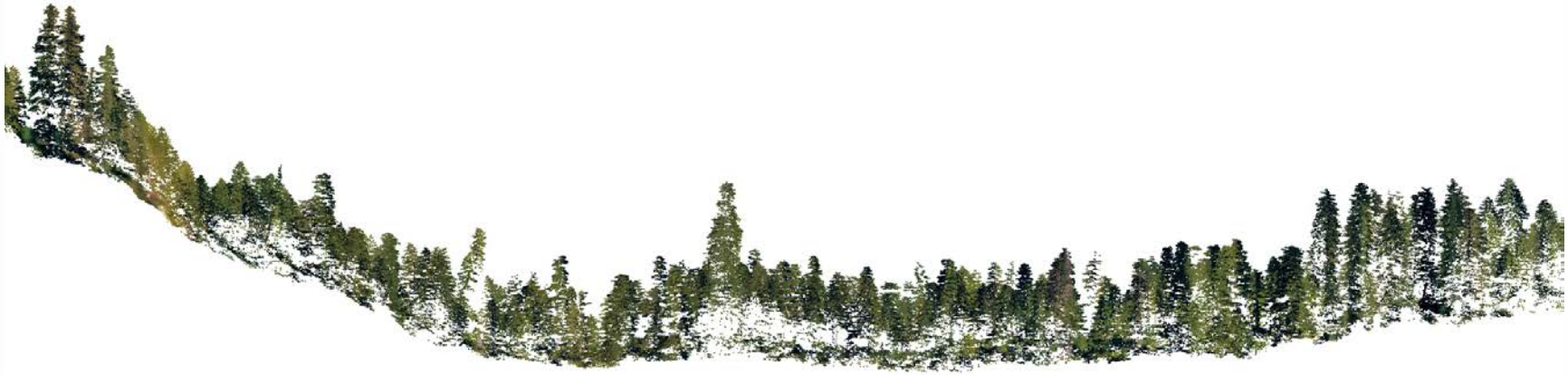
LiDAR & It's Innovative Uses

West Island Woodlands Advisory Group

February 11th, 2021

Presentation Overview

- LiDAR 101
- What is TFL44 doing with LiDAR?
  - Benefits to planning
  - Individual Tree Inventory
  - ‘Big Tree’ Identification
  - CSA Indicator Reporting



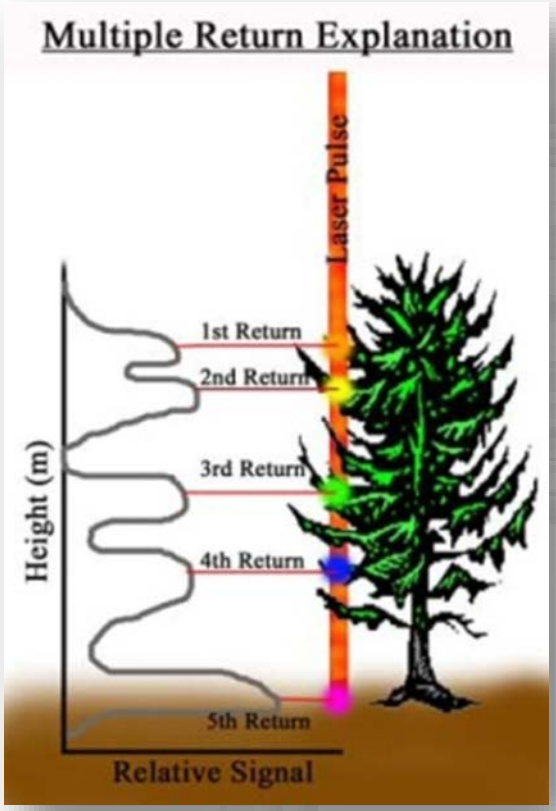
LiDAR 101

- **Li**ght **D**etection **A**nd **R**anging (LiDAR)
- Is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (distances) to the Earth.
- 3 Methods of Deployment:
  - Ground
  - Airborne (Fixed wing, UAV, Rotary Wing)
  - Space





LiDAR 101



- A beam of light is shot from the sensor.
- A portion of its energy is reflected off an object(s) and returned to the receiver.
- Precisely measures the elapsed time for the reflection to return from the surface below.
- Uses GPS and an IMU (Inertial Measuring Unit) to calculate the precise X, Y, Z position of each reflection.
- Each reflection may be referred to as a 'return'
- Multiple returns / pulse
- Today, (Laser) pulse rates are commonly at 500,000 pulses/second, and as high as 1,000,000.

LiDAR 101

Where sunlight can penetrate through the forest canopy down to the forest floor, so can LiDAR. In spots where the sunlight is completely blocked, so are the LiDAR pulses.

LiDAR 101

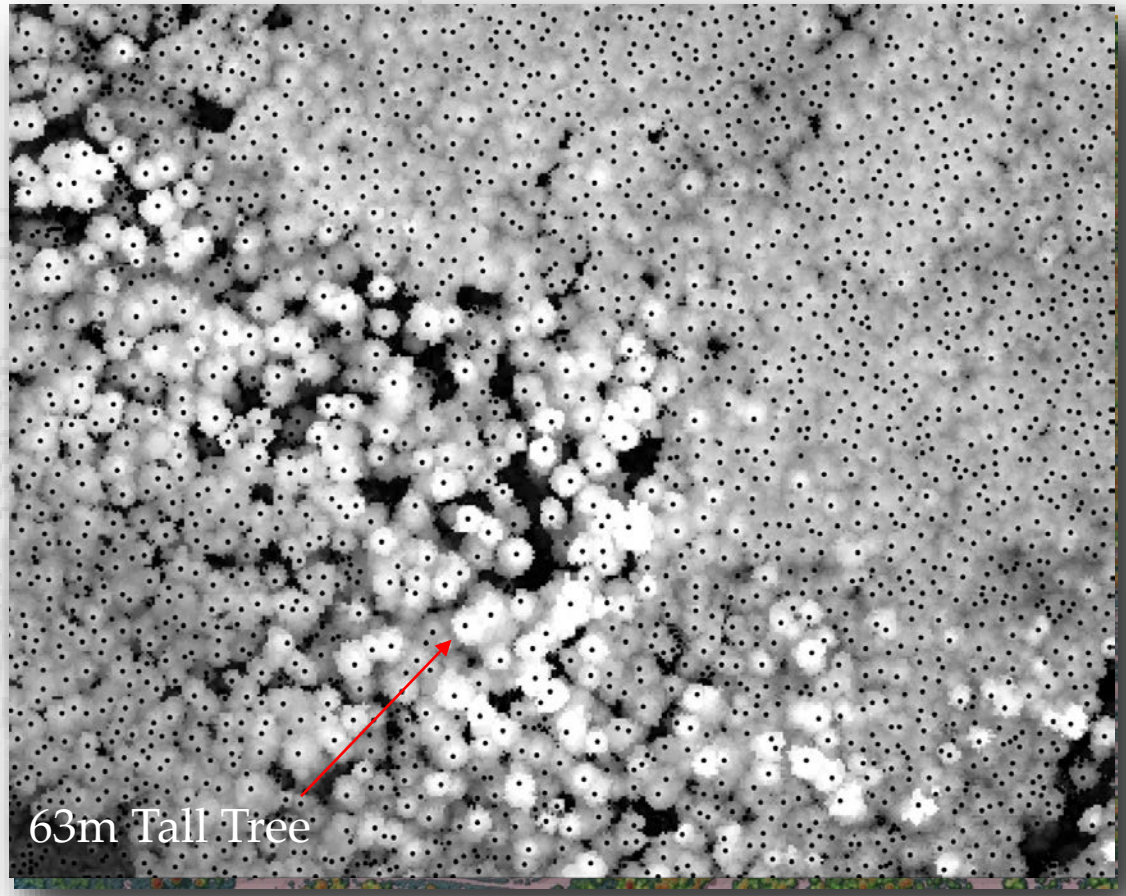
- The result is a dataset (LAS Files) of a mass number of coordinates that can be displayed in 3D as a "Point Cloud"
- LiDAR Derivatives (From LAS Files)
  - Contours
  - Digital Terrain Models (DTM)
  - Digital Elevation Models (DEM)
  - Digital Surface Models (DSM)
  - Hillshade
  - Slope Models
  - Canopy Height Models
  - Tree Top Analysis / Tree Segmentation
  - Hydrological Models

The use of LiDAR products has fundamentally changed how we do development planning and reporting of inventories.

LiDAR 101

Basic derived datasets:

- Contours 10m intervals
- Digital Terrain Models (DTM/TIN)
- Digital Elevation Model (DEM)
- Digital Surface Model (DSM)
- Hillshade
- Slope Model
- Canopy Height Models (CHM)
- Tree Top Analysis / Tree Segmentation



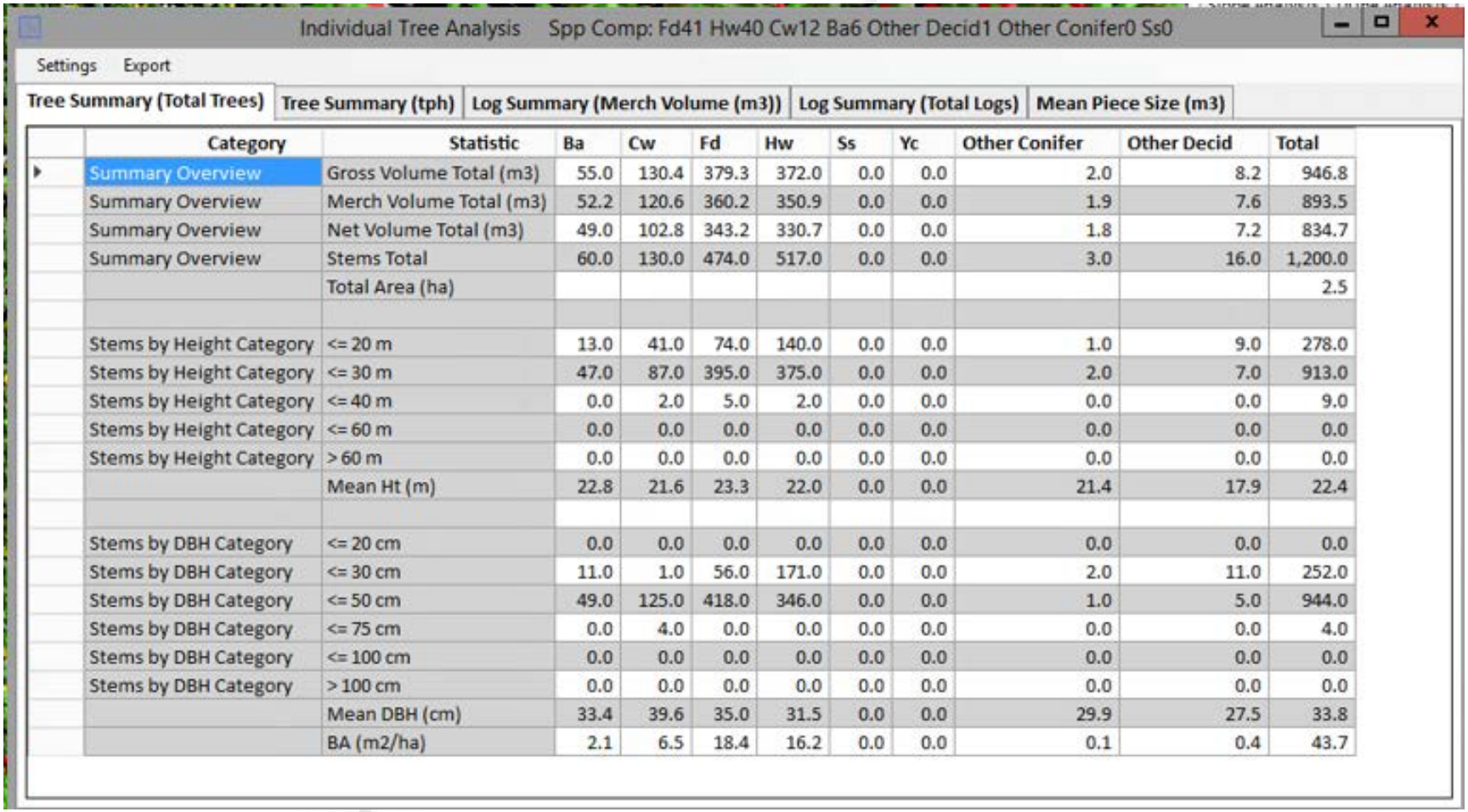
Benefits to Planning

- **Safety:**
  - Reduction in overall exposure hours
  - Cable Yarding optimization
  - Detailed slope mapping for ground based operations.
- **Terrain:**
  - Concentrate field assessment efforts in the 'right' place.
  - 'Downstream' or downhill impact assessment (where are the benches?)
- **Wildlife:**
  - Accurate Tree Location
  - Measurement of canopy structure and stand density.
- **Engineering:**
  - Pre-layout Visual Design
  - Detailed harvest system delineation.
  - More efficient DL's from office, Streams pre-mapped, More efficient surveying.
- **Information Sharing:**
  - Solid Predevelopment Datasets for Information Sharing.
- **Inventory:**
  - Know every hectare is accounted for ("what is on your shelves and how is it accessed").
- **Riparian:**
  - Accurate gully assessment metrics.
  - Estimating Q100 flows using catchment areas.

Individual Tree Inventory

- Individual Tree Inventory (ITI) uses the LiDAR point cloud to determine the location, species, height, diameter and volume of individual trees. This has the potential to fundamentally change our planning process. Migration from traditional, stand based, polygonal inventory, to one that is based on individual stems.
- Uses ground truth trees to identify differentiating point cloud characteristics between tree species
  - Intensity
  - Point density
- Predicts the species of all trees across our landbase
  - Assigns a probability by species
  - Only applied to trees >20m tall
- At the ***individual tree*** level, ITI species is correct most of the time

Individual Tree Inventory



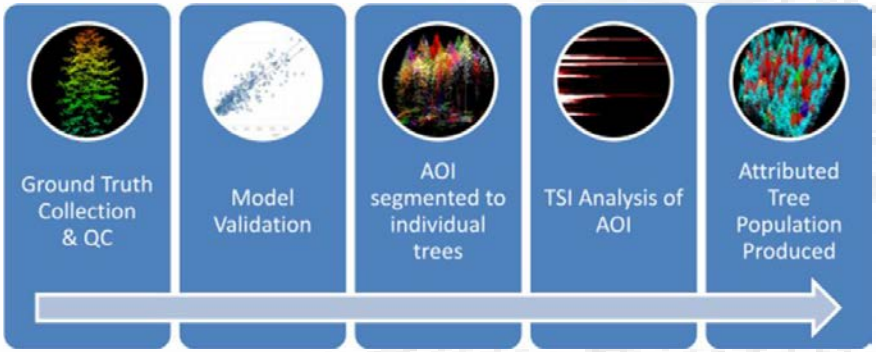
Individual Tree Analysis Spp Comp: Fd41 Hw40 Cw12 Ba6 Other Decid1 Other Conifer0 Ss0

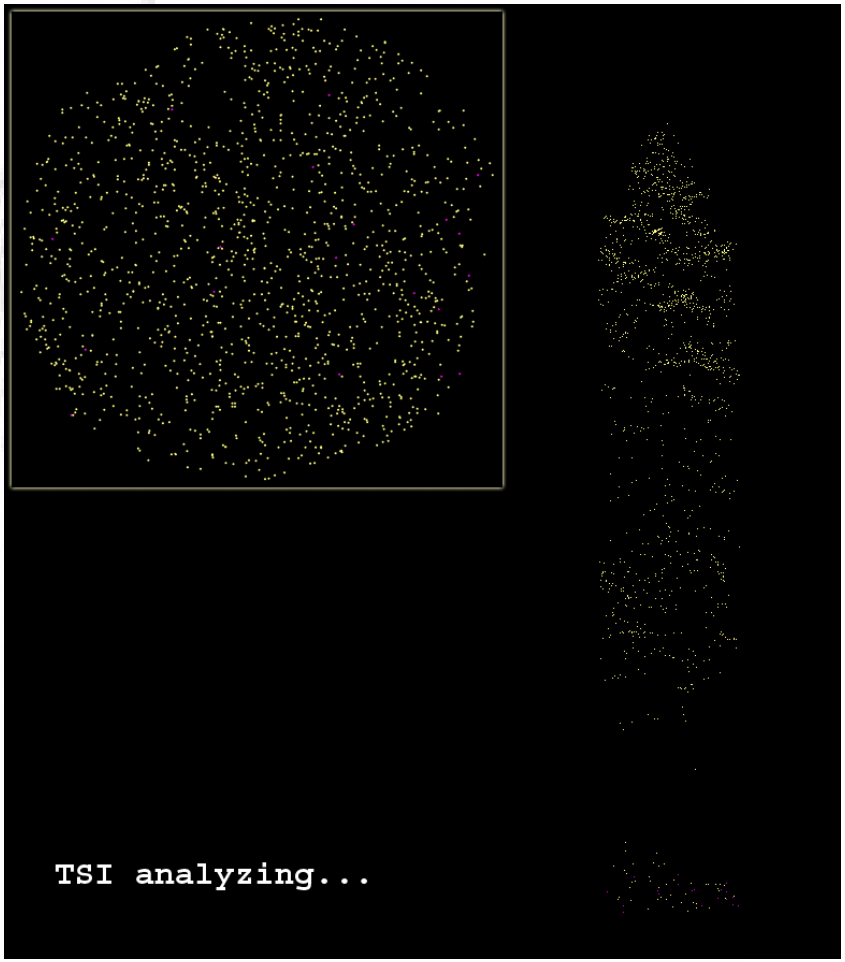
Settings Export

Tree Summary (Total Trees) | Tree Summary (tph) | Log Summary (Merch Volume (m3)) | Log Summary (Total Logs) | Mean Piece Size (m3)

Category	Statistic	Ba	Cw	Fd	Hw	Ss	Yc	Other Conifer	Other Decid	Total
Summary Overview	Gross Volume Total (m3)	55.0	130.4	379.3	372.0	0.0	0.0	2.0	8.2	946.8
Summary Overview	Merch Volume Total (m3)	52.2	120.6	360.2	350.9	0.0	0.0	1.9	7.6	893.5
Summary Overview	Net Volume Total (m3)	49.0	102.8	343.2	330.7	0.0	0.0	1.8	7.2	834.7
Summary Overview	Stems Total	60.0	130.0	474.0	517.0	0.0	0.0	3.0	16.0	1,200.0
	Total Area (ha)									2.5
Stems by Height Category	<= 20 m	13.0	41.0	74.0	140.0	0.0	0.0	1.0	9.0	278.0
Stems by Height Category	<= 30 m	47.0	87.0	395.0	375.0	0.0	0.0	2.0	7.0	913.0
Stems by Height Category	<= 40 m	0.0	2.0	5.0	2.0	0.0	0.0	0.0	0.0	9.0
Stems by Height Category	<= 60 m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stems by Height Category	> 60 m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean Ht (m)	22.8	21.6	23.3	22.0	0.0	0.0	21.4	17.9	22.4
Stems by DBH Category	<= 20 cm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stems by DBH Category	<= 30 cm	11.0	1.0	56.0	171.0	0.0	0.0	2.0	11.0	252.0
Stems by DBH Category	<= 50 cm	49.0	125.0	418.0	346.0	0.0	0.0	1.0	5.0	944.0
Stems by DBH Category	<= 75 cm	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
Stems by DBH Category	<= 100 cm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stems by DBH Category	> 100 cm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean DBH (cm)	33.4	39.6	35.0	31.5	0.0	0.0	29.9	27.5	33.8
	BA (m2/ha)	2.1	6.5	18.4	16.2	0.0	0.0	0.1	0.4	43.7

Individual Tree Inventory





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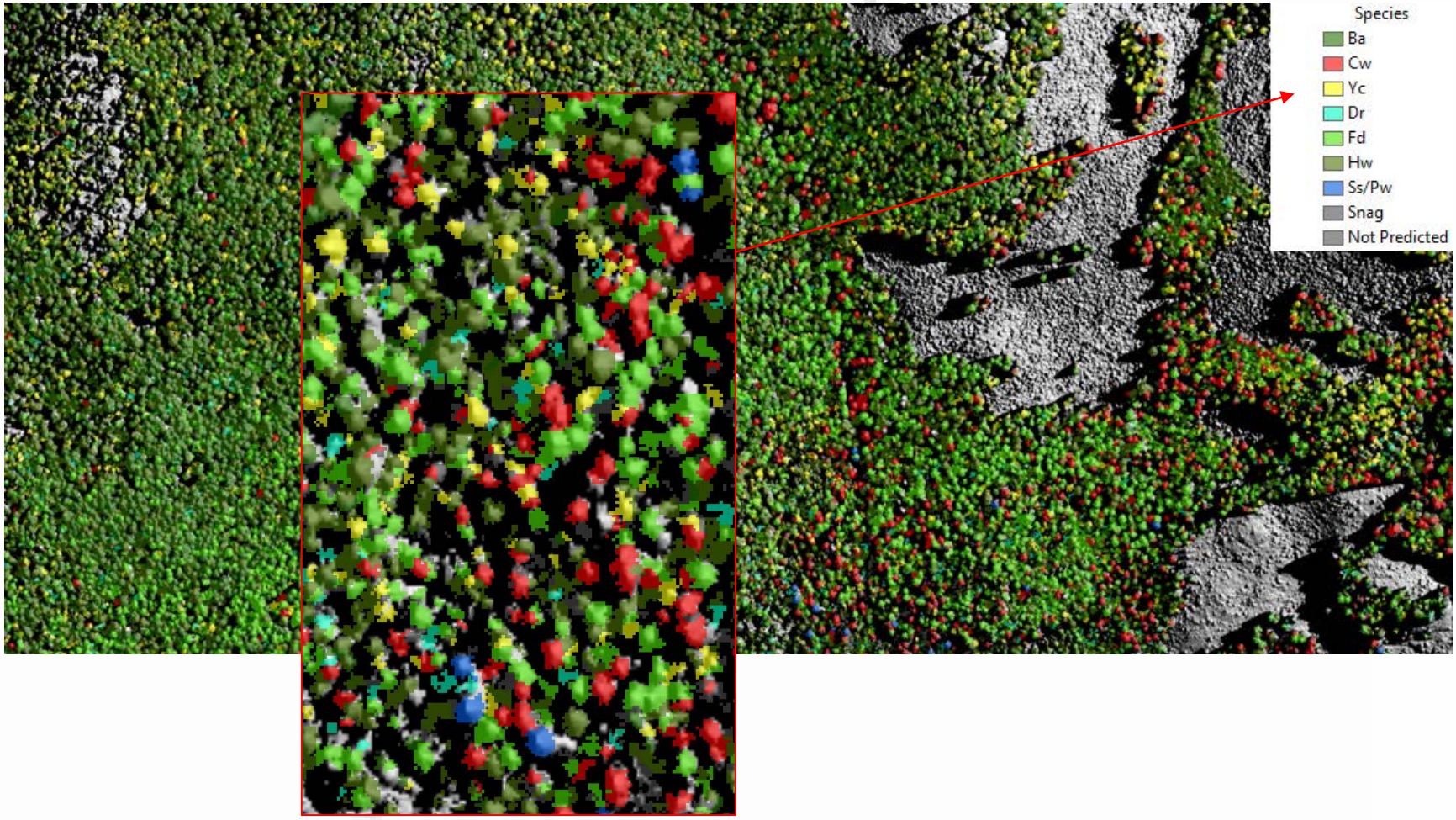
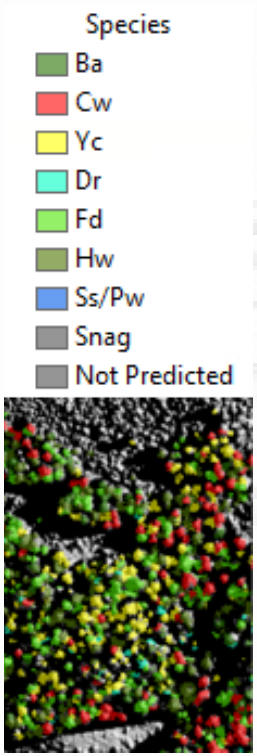
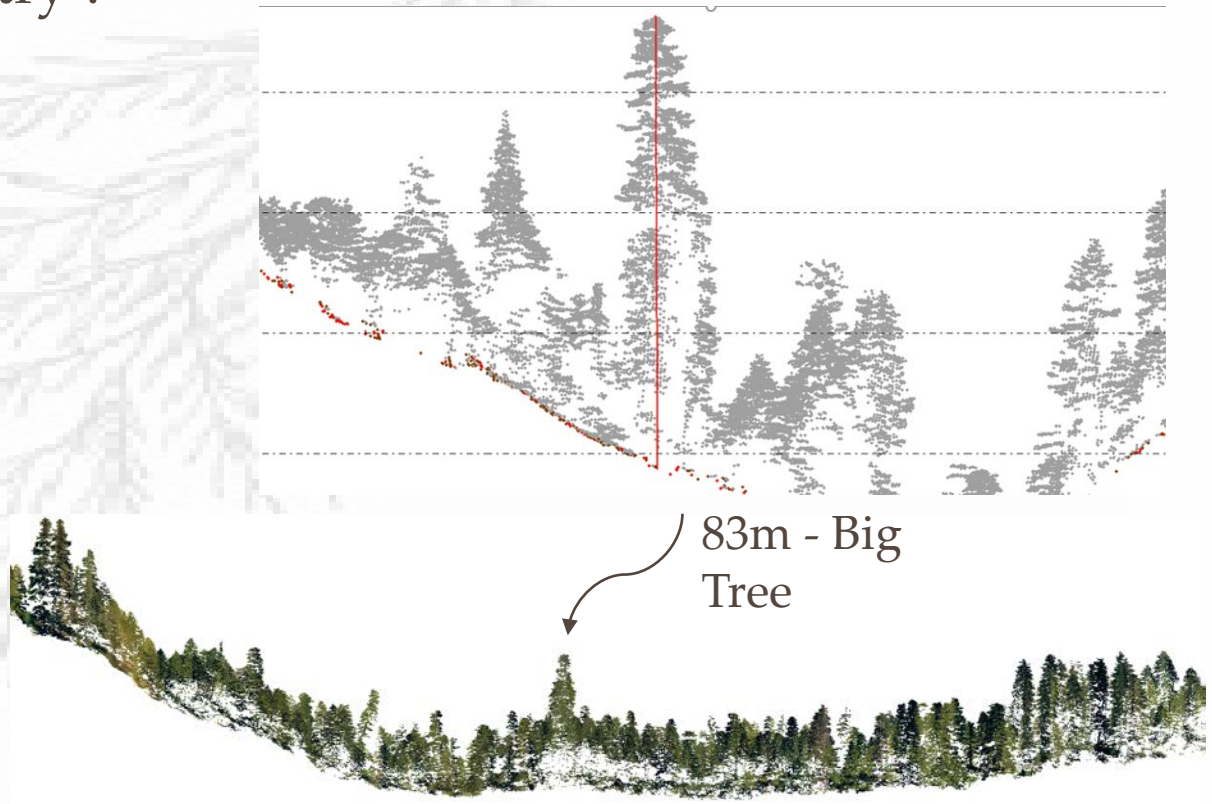


Big Tree Identification

- The ITI has given us the ability to pre-identify ‘big trees’, record their size and location, and populate them as part of a ‘Big Tree Registry’.



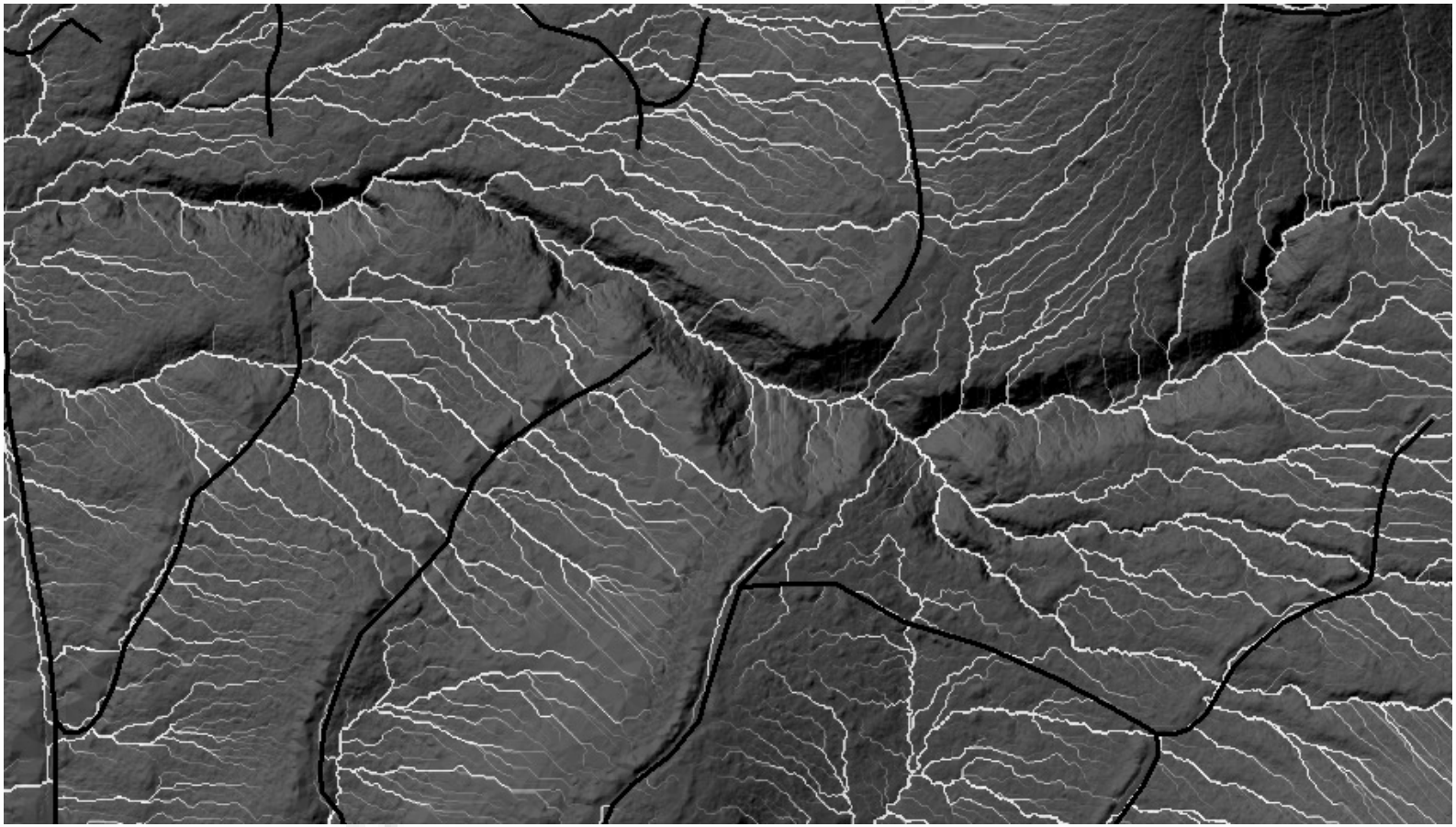


CSA Indicator Reporting

- LiDAR contributes to CSA indicator reporting by giving us the ability to capture more accurate information of critical data;
  - Streams, Dens, Nests - Increased ability to accurately map locations
  - Wildlife Tree Retention Area and Timber Leave Area, improved locations and representations
  - Informing OGMA, WHA, UWR Amendments
  - Watershed Condition, utilizing slope model.

CSA Indicator Reporting

- Streams



LiDAR The Fun Stuff

TFL 44 LIMITED PARTNERSHIP

Questions?