ETS FMA Carbon Measurement

Standardised Inventory Systems
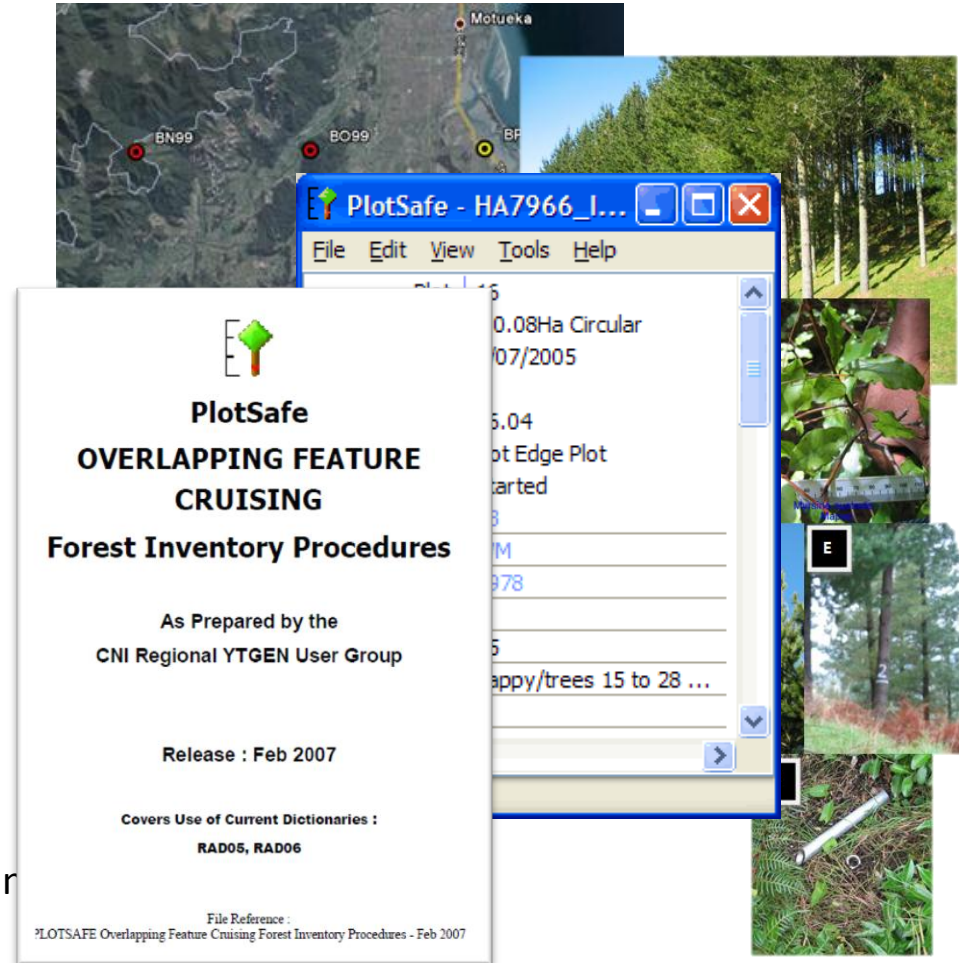## for Collection and Analysis

David Herries

Interpine Forestry Limited

Interpine Forestry Limited
Carbon Measurement Involvement

- National Carbon Assessment, Design and Implementation since 2005

- LUCAS (Land-use Carbon Analysis System) national plantation field survey since 2007

- Electronic Data Capture Software Development
  - Custom LUCAS data capture software
  - PlotSafe co-development with Silmetra Ltd

- Published a Practical Forest Inventory, Industry Procedures Manual in 2005, 2007

- Involved in a MAF Information Standard Validation with 116 FMA Plots completed in Nov 2011

PlotSafe
OVERLAPPING FEATURE CRUISING
Forest Inventory Procedures

As Prepared by the
CNI Regional YTGEN User Group

Release : Feb 2007

Covers Use of Current Dictionaries :
RAD05, RAD06

File Reference :
PLOTSAFE Overlapping Feature Cruising Forest Inventory Procedures - Feb 2007

A World of Acronyms
Apologies Up Front

- **ETS – emissions trading scheme**

- **LUCAS - land-use carbon analysis system**

- **PFSI – permanent forest sink initiative**

- **FMA – forest measurement approach**

- **CAA – carbon assessment area**

- **PLOTSAFE – handheld computer forest inventory data collection software**

INTERPINE FORESTRY LTD

Overview

FMA Standardised Inventory System for Collection and Analysis

1. **What is the FMA ?**

   – How Does it Compare to Other Forest Inventory ?

   – Data Requirements ?

   – Expectations on Cost ?

2. **Practical advice for collection of FMA carbon measurement data**

   – Pre-deployment Field Specification

   – Field Plot Placement Guidelines

   – Stand Record Observations

   – Electronic Data Collection

   – Quality Assurance

   – Other considerations, MRI, LiDAR

3. **Post processing data for MAF delivery**

   – XML Information Standards

   – Data Translation, Data Storage

A Guide to the

Field Measurement Approach

for Forestry in the Emissions Trading Scheme

September 2011
Ministry of Agriculture and Forestry

Forest Measurement Approach
What is the ETS FMA ?

Field Measurement Based Carbon Stock Assessment for Post-89 Forests

Required for ETS Post-89 and PFSI
- participants with ≥ 100ha

Regulated into force 1 Sept 2011
- Field Inventory from 1 Sept 2011 to 31 Dec 2012
- Data submission from 1 Sept 2012

~ 15,000+ plots to be measurement in 2012

A Guide to the

Field Measurement Approach

for Forestry in the Emissions Trading Scheme

September 2011
Ministry of Agriculture and Forestry

Simplicity of FMA
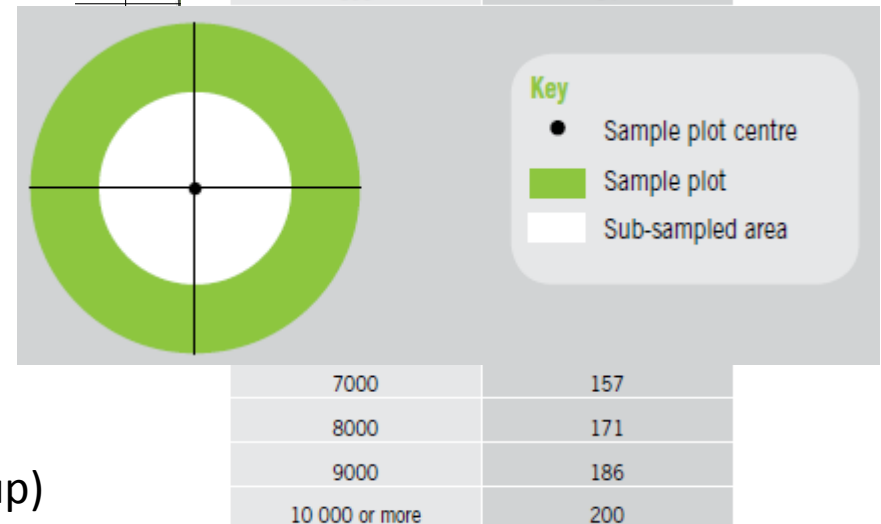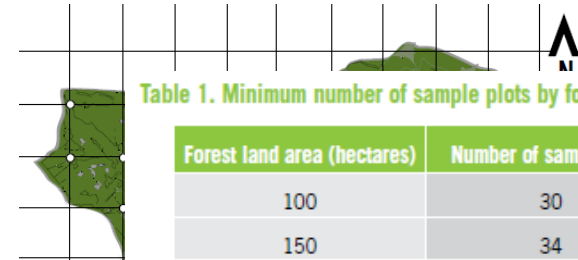## What is the ETS FMA ?

In Field Work Effort Minimum Requirements

Sample Size
- Systematic MAF allocated grid of
    - 30 plots for 100ha
        scaled through to..
    - 200 plots for 10,000ha or more

20-30 Tree Measurements Per Plot
- Targeted species >25mm DBH
- DBH all
- 5 heights per plot (50 per species group)

Table 1. Minimum number of sample plots by forest land area

Forest land area (hectares)	Number of sample plots
100	30
150	34
7000	157
8000	171
9000	186
10 000 or more	200

Key
- ● Sample plot centre
- ▇ Sample plot
- ▢ Sub-sampled area

MAF, 2011

In its simplest form, simple and effective
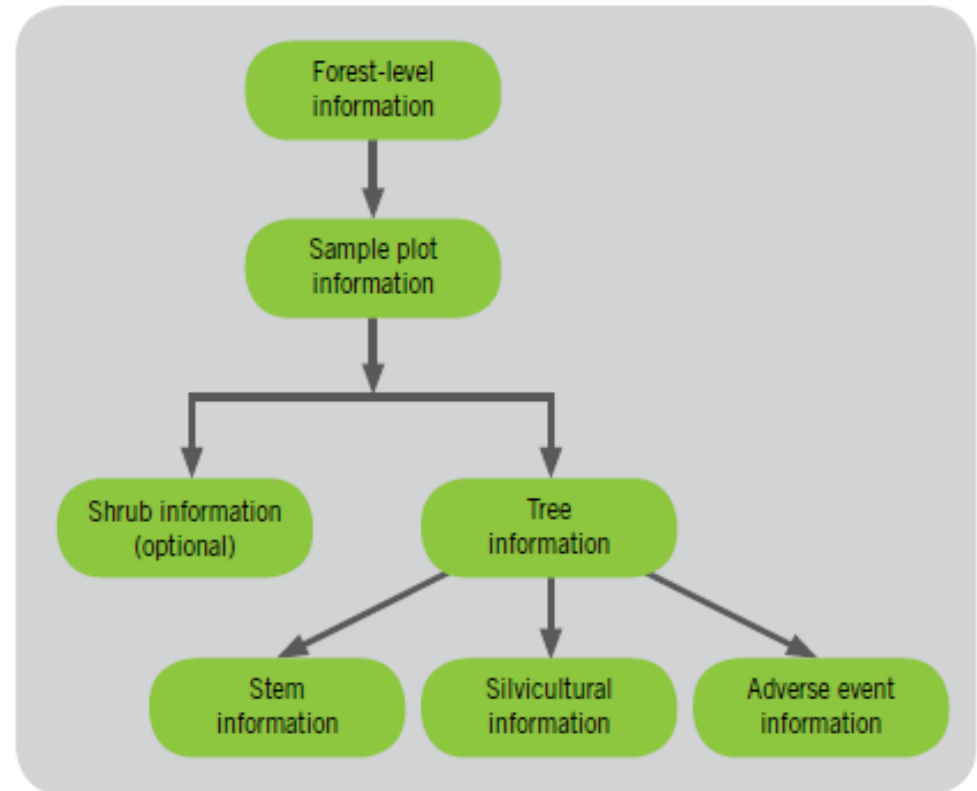
Extended Data Requirements / Options
What is the ETS FMA ?

Additional Provision of
- **Silvicultural Records**
  - History and planned events
- **Adverse Events**
  - Fire, wind-throw…

Optional Field Assessment
- Forest class assignment
- Shrub cover by species group (6 classes)
- Small trees <25mm (root collar)
- All trees species

Forest-level information → Sample plot information → Shrub information (optional) / Tree information → Stem information / Silvicultural information / Adverse event information

MAF, 2011

Scope definition is critical for cost effectiveness !

Expected FMA Field Productivity

What is the ETS FMA ?

Widely spaced plots

- Productivity 2-5 plots per day
- Target species
- Vehicle navigation between sites

Closely spaced plots

- Productivity 5-8 plots per day
- Target species
- Walking distance between sites

Closely spaced, all tree species

- Productivity 1-2 plots per day
- Walking distance between sites

MAF Discussion Document $125 to $500 per plot ?

Shaping Today's Forests with Technology of Tomorrow
He rangahau tenei ra he hangarau apopo

INTERPINE FORESTRY LTD

Overview

FMA Standardised Inventory System for Collection and Analysis

1. **What is the FMA ?**
   – How Does it Compare to Other Forest Inventory ?
   – Data Requirements ?
   – Expectations on Cost ?

2. **Practical advice for collection of FMA carbon measurement data**
   – Pre-deployment Field Specification
   – Field Plot Placement Guidelines
   – Stand Record Observations
   – Electronic Data Collection
   – Quality Assurance
   – Other considerations, MRI, LiDAR …

3. **Post processing data for MAF delivery**
   – XML Information Standards
   – Data Translation, Data Storage

A Guide to the

Field Measurement Approach

for Forestry in the Emissions Trading Scheme

September 2011
Ministry of Agriculture and Forestry

Pre-Deployment Specification
Practical Advice for Collection of FMA ?

What Forest Class has been assigned ?

What trees are to be measured ? Nominated species or all ?

Should shrubs be measured ?

What regimes of management do the plots fall in ?
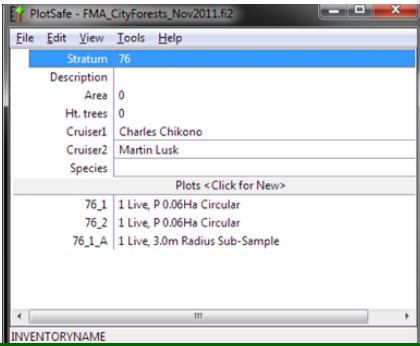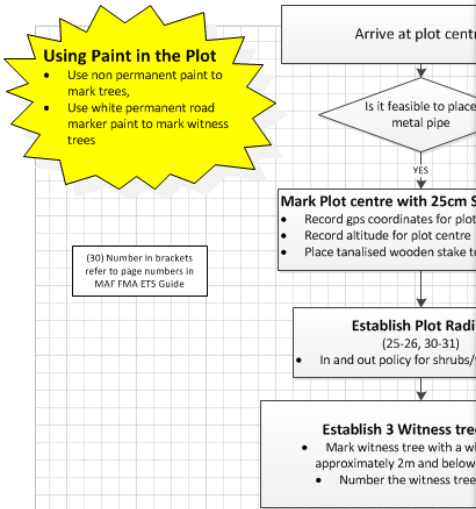
What's your final crop stocking for each regime ?

Do any field trials intersect with your plot network ?

Are good maps available showing CAA boundaries and recent photography ?

What are the expected audit criteria and processes ?

Pre-Deployment Specification
Practical Advice for Collection of FMA ?

Using Paint in the Plot
- Use non permanent paint to mark trees,
- Use white permanent road marker paint to mark witness trees

Arrive at plot centr

Is it feasible to place metal pipe

YES

(30) Number in brackets refer to page numbers in MAF FMA ETS Guide

Mark Plot centre with 25cm S
- Record gps coordinates for plot
- Record altitude for plot centre
- Place tanalised wooden stake t

Establish Plot Radi
(25-26, 30-31)
- In and out policy for shrubs/t

Establish 3 Witness tre
- Mark witness tree with a wh approximately 2m and below
- Number the witness tree

PlotSafe - FMA_CityForests_Nov2011.fi2

File Edit View Tools Help

Stratum	76
Description	
Area	0
Ht. trees	0
Cruiser1	Charles Chikono
Cruiser2	Martin Lusk
Species	

Plots <Click for New>	
76_1	1 Live, P 0.06Ha Circular
76_2	1 Live, P 0.06Ha Circular
76_1_A	1 Live, 3.0m Radius Sub-Sample

INVENTORYNAME

INTERPINE
Forestry Innovation

A Practical Guide for Collecting ETS FMA Data with PlotSafe

Herries D, Chikono C, Lusk M

FREE PUBLICATION
Print Date: Tuesday, 6 December 2011

Ref. No: FMA30112011
6 pages (including cover)

Interpine Forestry Ltd
P.O. Box 1209, Rotorua
Telephone. (07) 345 7573, Facsimile. (07) 345 7571
Email. info@interpine.co.nz

Example: FMA PLOT 76

CROP TYPE 1   CROP TYPE 2

Sub-Sample A
76_1_A

Sub-Plot 1   Sub-Plot 2
76_1   76_2
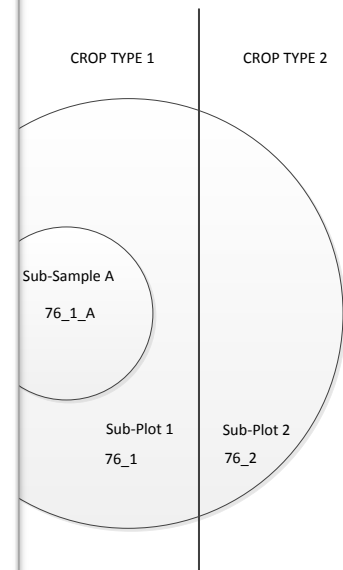
Fig 1. Diagram Shows the FMA Plot Naming Convention

acted Inventory Specifications

ual companies to outline the variations to the PlotSafe Overlapping Feature both the contractor and forest manager. It should be attached to the service f any of these specifications are not applicable just enter NA.

_____ **DATE** _____

FREE PUBLICATION: Collecting FMA Data With PlotSafe

Shaping Today's Forests with Technology of Tomorrow
He rangahau tenei ra he hangarau apopo

INTERPINE FORESTRY LTD

Field Plot Placement

Practical Advice for Collection of FMA ?

Guidelines for movement of plots is different than current inventory practice.

Where possible remove the subjective nature before the crews get into the field

Train field staff on the FMA mapping standards

Important for field survey teams to have clear concise guidance

Field Plot Placement
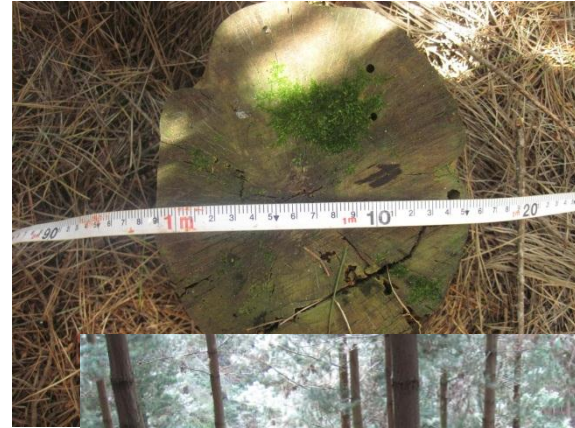
Practical Advice for Collection of FMA ?

Guidelines for movement of plots is different than current inventory practice.

Where possible remove the subjective nature before the crews get into the field

Train field staff on the FMA mapping standards

Important for Field Survey Teams to Have Clear Concise Guidance

Field Plot Placement

Practical Advice for Collection of FMA ?

Guidelines for movement of plots is different than current inventory practice.

Where possible remove the subjective nature before the crews get into the field

Train field staff on the FMA mapping standards

Important for Field Survey Teams to Have Clear Concise Guidance

Field Plot Placement
Practical Advice for Collection of FMA ?

Guidelines for movement of plots is different than current inventory practice.

Where possible remove the subjective nature before the crews get into the field

Train field staff on the FMA mapping standards

Important for Field Survey Teams to Have Clear Concise Guidance

Shaping Today's Forests with Technology of Tomorrow
He rangahau tenei ra he hangarau apopo

INTERPINE FORESTRY LTD

Silvicultural History
Practical Advice for Collection of FMA ?

FMA wants specific information on events and dates which you simply might not have ?

e.g. asking field crews to validate it was thinned in Nov 2003 is simply not practical

Questions will arise when current plot information does not match stand records provided ?

e.g. Current stocked at 700 SPH, when it was thinned to 400 SPH in 2006

Silvicultural Observations
Practical Advice for Collection of FMA ?

We can only ask crews to observe

1. Is pruning evident ?
2. Has the plot been thinned ?
3. Have thinnings been removed or are decayed stems present ?
4. Can you see more than 1 thinning base on size and decay of stumps ?
5. Provide the average diameter of the predominate thinning stumps on site
6. Estimate the initial stocking from row and tree spacing where evident
7. Take 8 cardinal compass photos of the plot

Avoid second visits to plots, by taking a couple of minutes to observe

Electronic Data Collection
Practical Advice for Collection of FMA ?
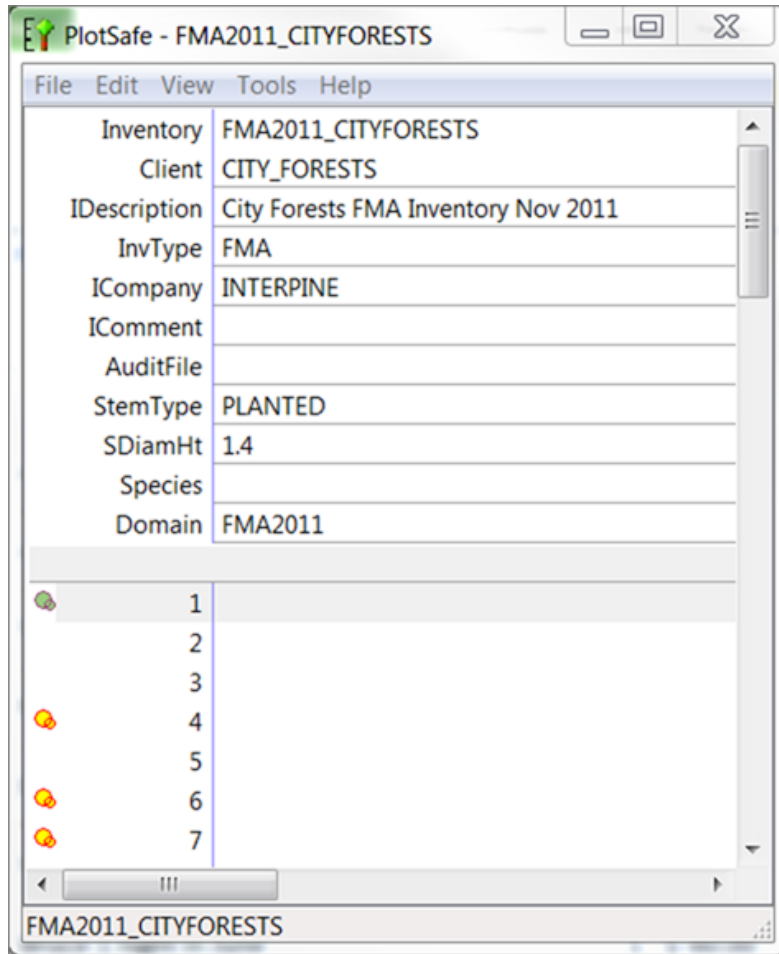
- **MAF have not developed a field data capture software option**

- **Template file for PLOTSAFE available**

- **Joint work by Interpine, PF Olsen, Silmetra and City Forests to provide to wider industry**

FREE DATA TEMPLATE FOR PLOTSAFE
FMA11

Electronic Data Collection
Practical Advice for Collection of FMA ?

POPULATION
Inventory Name

STRATUMS
Name,Description, Area

PLOTS
Name,Type,Date, Slope,Radius,Edge Plot, Status

TREES
No.,Live/ Dead,Outside Plot,DBH,Height

STEM FEATURES
Diameter,Height

Forest-level information → Sample plot information → Sub-plot information → Shrub information (optional) / Tree information → Stem information / Silvicultural information / Adverse event information
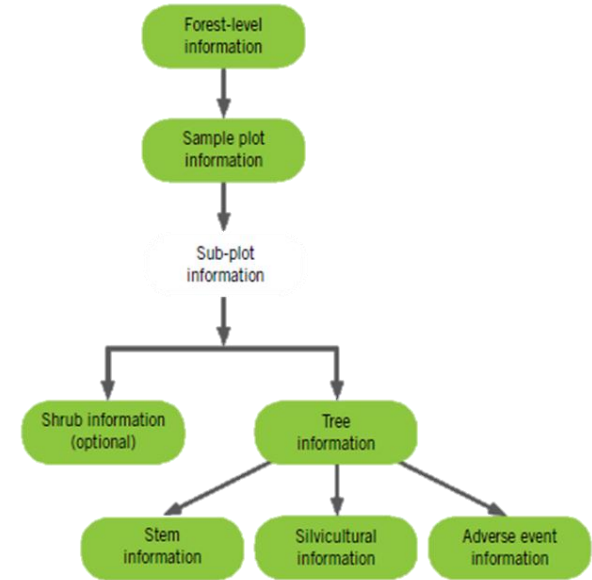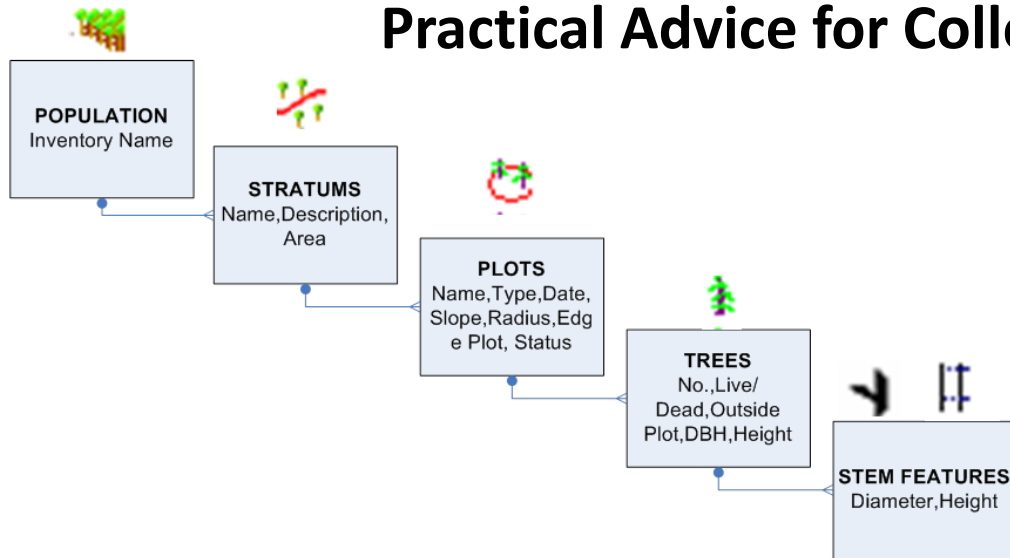
POPULATION LEVEL

Inventory Contractor Info
Client/Participant Details
MAF Administration Details
Dataset Info
Participants Chosen Inventory Specs

STRATUM LEVEL
(PLOT/SITE INFO)

Plot Number ID (###)
NZ Region
Cruiser 1 and 2 Details
Plot Relocated?
Access Waypoints and Comments
Witness Tree BEA and DIST
Adverse Event Info
Plot Photo IDs

PLOT LEVEL
(PLOT/SUB PLOT/ SUB-SAMPLING)
Plot ID (###)
Sub Plot ID (###_1,2,3...X)
Sub Sample ID (###_X_A,B,C,D)
Plot Radius
Measurement Date
Slope
Explanation of Abnormal Stocking
Shrub Cover Estimation (if applicable)
Stand Record/Silviculture Info
Tree/Row Spacing Estimate
Crop Seedling Size Est (if Applicable)
Plot Comments
Intermingled Trees

TREE LEVEL

Live/Dead
DBH/Root Collar
Tree Height
Planted or Regen?
Species
Tree Comment

STEMS LEVEL

Broken Top

Electronic Data Collection
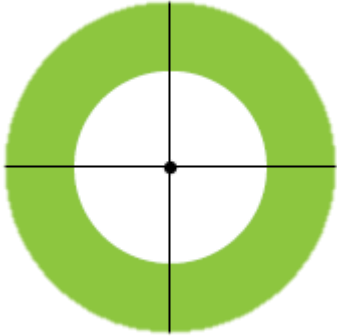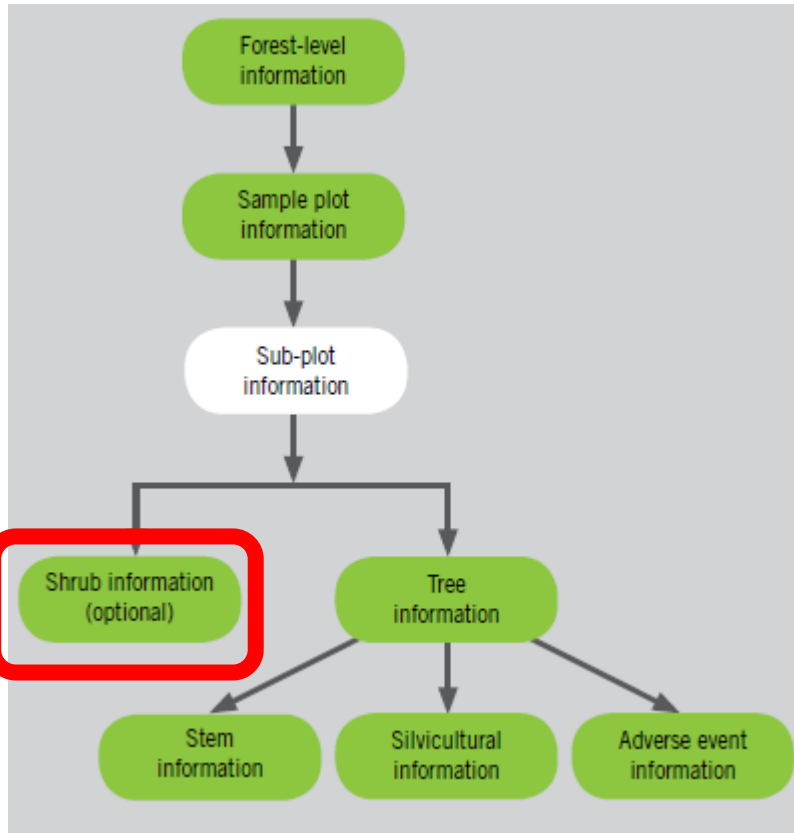
Practical Advice for Collection of FMA ?

PegOffsetDIST	
PhotoID	N1285, E1286, S1287, W1288, Witness tree 1
WT1BEA	340
WT1Dist	16.5
WT2BEA	77
WT2Dist	16.5
WT3BEA	
WT3Dist	
WTComm	WT 1 16 DEG_SLOPE ,WT2 17 DEG. LSOPE,WT 3 SLOPE 19
AdEvent1Typ	
AdEventComm	
AdEvent1Stems	
AdEvent1Res	
AdEvent1Photo	
SiteComm	Clean, no understory, too many trees in the main plot so t
1_1	Not measureable
1_1A	22 Live, 10.0m Radius Sub-Sample

FMA2011_CITYFORESTS

Key
- ● Sample plot centre
- ▇ Sample plot
- ☐ Sub-sampled area

Electronic Data Collection
Practical Advice for Collection of FMA ?

Quality Assurance
Practical Advice for Collection of FMA ?

Example Audit Form

Inventory Plotting Quality Assessment Form
PLOTSAFE RAD05 Inventory Procedures Audit Template

Attribute	Tolerance
Altitude	±20 m
Sample plot centre points	Standard deviation of plot centre points from plot locations specified by MAF not exceeding 10 m, after excluding plots subject to relocation or waivers
Sample plot dimensions	1% of radius or side-length
Slope measurement	±2°, for slopes >5°
Stem diameter	<100 mm: ±2.5 mm
	100 – 500 mm: ±5 mm
	>500 mm: ±10 mm
Stem height	5% of height or ±0.1 m – whichever is greater

Equipment	Tolerance
Field compass	± 2° over a minimum distance of 15 m
Hip chain	± 4% of actual length
Lineal tape	± 0.5% of actual length
Diameter tape	± 0.5% of actual length
Height pole	± 0.5% of actual length
Vertical angle measurement equipment	± 1° over a minimum distance of 8.0 m
Direct height measurement equipment	± 2.0% of actual height over a minimum distance of 18 m

FREE PUBLICATION: Collecting FMA Data With PlotSafe

Shaping Today's Forests with Technology of Tomorrow
He rangahau tenei ra he hangarau apopo

INTERPINE FORESTRY LTD

Other Considerations
Practical Advice for Collection of FMA ?

- Conducting full or partial stem cruising during FMA assessment

- LiDAR ground controls using FMA plots.   Use of subsamples ??

Overview

FMA Standardised Inventory System for Collection and Analysis

1. **What is the FMA ?**

   – How Does it Compare to Other Forest Inventory ?

   – Data Requirements ?

   – Expectations on Cost ?

2. **Practical advice for collection of FMA carbon measurement data**

   – Pre-deployment Field Specification

   – Field Plot Placement Guidelines

   – Stand Record Observations

   – Electronic Data Collection

   – Quality Assurance

   – Other considerations, MRI, LiDAR

3. **Post processing data for MAF delivery**

   – XML Information Standards

   – Data Translation, Data Storage

A Guide to the

Field Measurement Approach

for Forestry in the Emissions Trading Scheme

September 2011
Ministry of Agriculture and Forestry

MAF

FMA Information Standards

Post Processing Data for MAF Delivery ?

```xml
    </xs:sequence>
    </xs:complexType>
<xs:complexType name="MeasuredStemsList">
<xs:sequence>
 <xs:element name="StemInfo" type="tns:StemInfo" maxOccurs="unbounded"/>
    </xs:sequence>
    </xs:complexType>
<xs:complexType name="StemInfo">
<xs:sequence>
 <xs:element name="StemID" type="xs:positiveInteger"/>
 <xs:element name="StemEstablishmentType" type="tns:StemEstablishmentType"/>
 <xs:element name="StemState" type="tns:StemState"/>
 <xs:element name="StemSpecies" type="tns:Codeset"/>
 <xs:element name="StemDiameter" type="xs:positiveInteger"/>
 <xs:element name="StemDiameterType" type="tns:StemDiameterType"/>
 <xs:element name="StemDiameterAtStdHeight" type="tns:YesNo"/>
 <xs:element name="StemDiameterEstReason" type="tns:StemDiameterEstReason" minOccurs="0" nillable="true"/>
<xs:element name="StemHeight" minOccurs="0" nillable="true">
<xs:simpleType>
<xs:restriction base="xs:decimal">
 <xs:fractionDigits value="1"/>
 <xs:totalDigits value="4"/>
 <xs:minInclusive value="0"/>
    </xs:restriction>
    </xs:simpleType>
    </xs:element>
 <xs:element name="StemBrokenTop" type="tns:YesNo"/>
    </xs:sequence>
    </xs:complexType>
<xs:complexType name="EstimatedStemsList">
<xs:sequence>
 <xs:element name="SGInfo" type="tns:SGInfo" maxOccurs="unbounded"/>
    </xs:sequence>
    </xs:complexType>
```

DRAFT

MAF, 2011

DRAFT Information Standard and XML Element XSD Definition Not Yet Finalised by MAF

FMA Information Standards

Post Processing Data for MAF Delivery ?

FMA Field Data Collection (Using PLOTSAFE)

PlotSafe File

PlotSafe SQL Forest Inventory Database

FMA Compliant XML Data File/s

Optional paper transcripts can be provided to field crews for input during field assessment

Silvicultural Information

Data Extract from Company Stand Records System
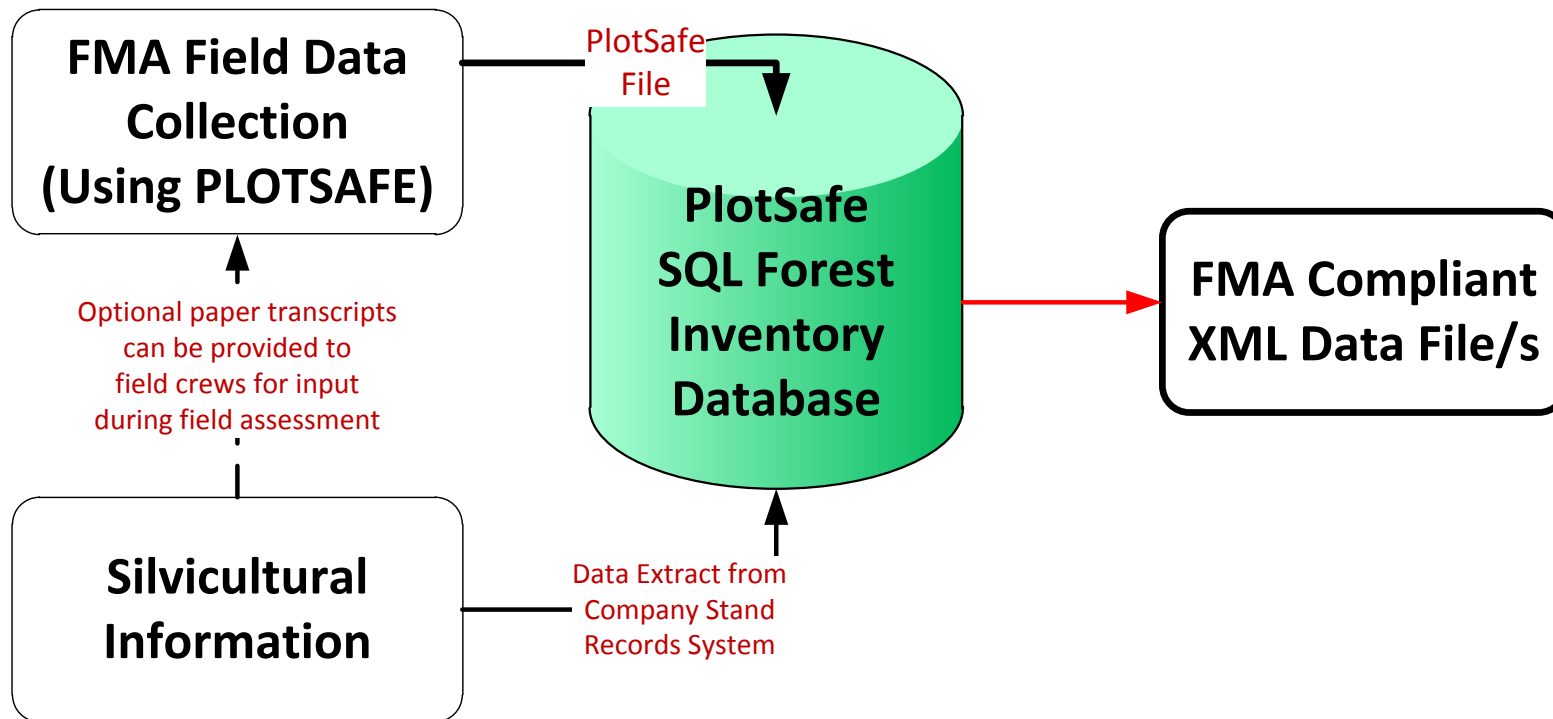
Data Storage, Secondary Validation Checks, Export to FMA Compliant Formats

Shaping Today's Forests with Technology of Tomorrow
He rangahau tenei ra he hangarau apopo

INTERPINE FORESTRY LTD

Overview

FMA Standardised Inventory System for Collection and Analysis ?

Simple Field Guide Reference

Simple pre-deployment specification and reference guide for field survey staff

Collect Data Using Handheld Computers

PLOTSAFE template available (FMA11)

Download FREE at www.interpine.co.nz
(Available from mid Dec 2011, post completion of trial 118 plots survey collection)

Overview

FMA Standardised Inventory System for Collection and Analysis ?

MAF Information Standard Data Preparation

Secondary field data validation
Bulk import of stand records
PLOTSAFE data converted to MAF XML Information Standards

Data Storage

SQL Database Storage, secondary analysis

Online Service at www.interpine.co.nz
(From Jan 2012, dependent on date of MAF finalised "FMA Information Standards")

Acknowledgements

FMA Standardised Inventory System for Collection and Analysis ?

City Forests,

MAF,

PF Olsen,

Silmetra,

Ministry for the Environment,

INTERPINE FORESTRY LTD

Questions ?

CONTACT US
david.herries@interpine.co.nz, 021 435623, www.interpine.co.nz