Ministry of Natural Resources

Ontario

Natural. Valued. Protected.

Forest Information Manual **2009**

Forest Resources Inventory Technical Specifications 2009

Foreword

The *Forest Information Manual* (FIM) prescribes FIM technical specifications that describe information standards. Technical specifications are prepared to facilitate the provision of information prescribed by FIM. They provide the direction for exchanging information between the MNR and the forest industry. They provide detailed, technical and product specific requirements and outline roles and responsibilities. The FIM technical specifications cover subjects such as:

- detailed data attribute descriptions;
- acceptable file and media formats;
- metadata requirements;
- information exchange parameters and protocol, and
- standards/procedures for quality control, error handling, and verification.

FIM technical specifications are effective upon regulation of the FIM or as they are developed. Technical specifications may be revised periodically to consider more effective and efficient ways of managing, transferring, and receiving information. Changes or revisions to technical specifications do not impact the requirements or direction for the provision of information as prescribed by the FIM. It is a requirement of the FIM that the FIM technical specifications (as revised from time to time) be followed.

These *FIM Forest Resources Inventory Technical Specifications* are prescribed by the *Forest Information Manual*.

A list of current FIM technical specifications and the scope of information to which they apply will be maintained and available on the Forest Information Portal website (FI Portal). The MNR and forest industry are required to use the technical specifications listed on the FI Portal.

Table of Contents

1.0 Introduction

An inventory of forest resources must be created and maintained for each forest management unit in the province of Ontario. The Forest Resources Inventory (FRI) is a product that provides description of all areas within a forest management unit and provides a snapshot in time of the characteristics of water and land base geography.

FRI information is used to support various forest management planning and land-use planning decisions over a wide range of geographic areas (extents). The geographic areas can vary from individual forest stands, which represent small areas (less than a hectare to hundreds of hectares) to forest level, forest management unit, mill woodshed, and landscape extents, which involve very large areas (thousands or millions of hectares). In some cases, the quality of forest management planning decisions can be linked to the quality of information maintained and updated in the FRI.

An FRI is created when the area within a forest management unit is delineated and classified, based on its geographic features and characteristics, into homogeneous water and land types called polygons. All polygons in an FRI must have a geographic location, referred to as a spatial component, and a description of each polygon's characteristics, referred to as a descriptive or a tabular component. Information that identifies the geographically referenced locations and boundaries of the polygons are referred to as spatial attributes. Information that describes the characteristics of a polygon are referred to as tabular attributes.

Forest resources inventories are based on a standard map projection, coordinate system, and a common area classification process used to delineate water polygons and land types into polygons based on the homogeneity of forest cover and vegetation. The area classification process creates a key forest cover description layer called the 'Polygon Forest'. The polygon forest contains water polygons and a description of the forest condition. Individual layers such as the polygon forest, wetlands, ownership, transportation and forest management unit boundaries can be combined to create snapshots of the forest estate at any point in time, according to a set of process rules.

The Forest Resources Inventory program is currently evolving from a 20-25 year production rotation cycle to a 10 year cycle, and from a periodic inventory to a continuous inventory that is ecologically based. This evolution will ensure that the information base used to make forest management decisions is far more reliable than the current system.

Additional enhancements to inventory production include:

- higher quality and additional forest and tree information captured through the implementation of new technologies,
- implementation of an audit function to provide confidence estimates through increased sampling,
- and updated procedures for acquiring base and ownership information as part of the inventory process to provide an integrated set of products.

The new inventory design is being developed under a framework that allows for a more detailed stand or tree view versus a general landscape or forest view. This new design should provide information in support of forest product planning. The enhanced product will also include basic terrain and topography information to allow for enhanced planning and analysis.

The extent of the FRI program is being expanded as well. The program will now produce inventory information for all lands within the Area of the Undertaking; not just those involved in forest management planning under the *Forest Management Planning Manual* and the *Forest Information Manual*. Forest resource inventories will describe licensed and non-licensed areas within forest management units, provincial parks, federal parks, and protected areas. The program will also inventory forest dominated lands within the boreal region that is north of the Area of the Undertaking.

However, the purpose of these technical specifications is to support the *Forest Information Manual*. As such, these specifications only apply to those areas managed under the jurisdiction of the *Forest Management Planning Manual* and the *Forest Information Manual*. These technical specifications are written to support the *Forest Information Manual* requirements for the exchange of FRI information in a standardized digital format between MNR and Sustainable Forest Licensees, Plan holders or other forest resource licence holders with forest management responsibilities (referred to as Licensees in the remainder of this document). These specifications describe the format for data exchange only and do not affect how information may be stored or maintained by either the MNR or the Licensee.

These specifications do not apply to areas not under the jurisdiction of the *Forest Information Manual*, such as federal parks, but may be used to assist with delivery of standardized inventory information for these areas. These specifications could be used to provide details about the structure and content of the inventory product being delivered. And in these cases, the extent of inventory will be a boundary appropriate for the area inventoried (i.e., not be management unit based).

2.0 Roles and Responsibilities

2.1 Ministry of Natural Resources

The Ministry of Natural Resources (MNR) is responsible for creating a forest resources inventory (FRI), specifically the polygon forest layer, and providing it to Licensees in accordance with the requirements and standards described in Chapter 4, Product Descriptions. Creating and providing the FRI is the responsibility of MNR's Inventory Monitoring and Assessment Section.

The MNR will ensure that the polygon forest layer provides complete area coverage based on the area boundaries of the forest management unit and will include both Crown and patented land. This includes licensed areas and non-licensed areas within forest management units, provincial and federal parks, and protected areas.

The MNR will retain the overall stewardship role, policy responsibility, scheduling, priority setting, standard setting, quality control and information management of the FRI.

The MNR must retain a copy of the polygon forest and treat the information as the original information.

2.2 Licensee

The Licensee is responsible for checking the FRI for completeness within 3 months of delivery of the inventory by the MNR (Refer to the *Forest Information Manual*, Part B, Section 4.0, Polygon Forest). The Licensee is also responsible for maintaining and updating the FRI for their own purposes throughout its ten year life cycle.

The Licensee responsibilities also include maintenance/update of existing FRI information until such time that a new FRI product as per these technical specification is delivered to the Licensee.

Licensees have the option to contribute funding toward the production of the FRI so that the product received goes beyond the standard FRI program delivery. Additional attributes that are deemed important to a forest company may be collected and managed by the company at its own expense and sole responsibility as part of the overall inventory production process.

Licensees are responsible for retaining their original copy of the FRI that is provided by the MNR. In the case of any discrepancies regarding the information which is provided by the MNR, the MNR will be considered the holder of the source and original information.

3.0 Implementation

Implementation of the standards and requirements described in these technical specifications will not be linked as closely to the forest management planning cycle as past FRI production schedules have been. Based on the move to a ten year forest management planning cycle, adjustment of the previous twenty year FRI rotating production cycle to a ten year cycle, and the timing of redesigning the FRI program, it became impossible to create new forest inventories where the delivery of these inventories aligned with the timelines of the respective forest management unit planning processes. **Therefore, the FRI production schedule for the initial ten year cycle will be based on a variety of factors such as vintage of the existing FRI, natural change to forest conditions, production continuity, and monetary considerations. Ultimately production scheduling is dependent on approval of the Provincial Forest Inventory Advisory Committee (PFIAC) who carry out an annual review of those considerations.**

The procedures and specifications as set out in this document will take effect for forest management units as described in Section 4.1.5, Data Transfer and Schedule, but are subject to change based on technical or business circumstances. Initiation of the new FRI program will entail imagery acquisition for the entire Area of the Undertaking as defined by the *Class Environmental Assessment for Timber Management on Crown Lands in Ontario* and portions of the northern boreal area over a five year period commencing in the summer of 2006 with completion scheduled for the summer of 2010. Subsequent steps in the FRI production process are planned to commence in 2007 with completion planned for 2016.

3.1 Revision Notes

Changes and revisions from the June 2008 version include:

- General formatting, clarification, organizational, and typographical corrections.
- An attribute was added for recording the type of last disturbance (DEPTYPE) as a companion field to year of last disturbance (YRDEP).
- The tree species "largetooth aspen" (Populus grandidentata) is now being interpreted during the inventory production process. The species table in the overstorey species composition attribute has been updated accordingly (Section A1.1.5, OSPCOMP).
- For the vertical structure attribute (VERT), the code ,"MV" has been replaced by two codes "MO" and "MU", and the code "TT "has been replaced by the two codes "TO" and "TU". Refer to Section A1.30.
- The width of the ecosite fields (PRI_ECO, SEC_ECO) has been expanded from 10 to 13 characters and a detailed description of the ecosite coding structure has been added. Refer to Section A1.33, PRI_ECO.
- Information on other products created during the inventory production process has been added. Refer to Section 4.2.

4.0 Product Descriptions

There are a number of products resulting from creation of the forest resources inventory. The focus of this *FIM Forest Resources Inventory Technical Specifications* is the polygon forest, the geospatial layer that is the end product of the inventory process (as per the *Forest Information Manual*, Part B, Section 4.0), but other products are also discussed. The standards and requirements of the polygon forest product are discussed in detail in Section 4.1. Other products related to the inventory creation process, such as aerial photography products, are discussed in Section 4.2.

4.1 Polygon Forest

4.1.1 Description, Intent and Intended Use

The polygon forest is a geospatial information product that is comprised of polygon features only and provides the primary description of the forest estate of a forest management unit (MU). The MU layer provides the map extent and geographic boundaries for each polygon forest. All areas within an MU must be classified into water, non-forested land, forested land productive and forested land non-productive polygon types.

4.1.2 Packaging and Naming Convention

A single compressed (.ZIP) file will be created for delivery of the polygon forest information. The delivery file will be named in a standardized format. The standardized naming convention for the zipped delivery file is based on the information product, the area the inventory is for, and the year of extract from the MNR database. The format for the standardized file name is:

FRI_<area identifier>_<YYYY>.ZIP

- the letters FRI (for **f**orest **r**esources **i**nventory)
- the underscore (underline) character as a separator
- the area identifier is the three digit MU number, left padded with zero if necessary

(If this specification is being used to describe inventory information for an area not under the jurisdiction of FIM, the area identifier will be a label appropriate for the extent of the inventory, such as a provincial park name (e.g., WABAKIMI) or a the name of a northern boreal area (e.g., WHITEFEATHER)).

- the underscore (underline) character as a separator
- the four digits that are the year the data was extracted from the database
- the file extension for a compressed file .ZIP

These naming convention pieces are to be concatenated such that there are no blank spaces within the file name. For example, if inventory information for management unit 098 was being delivered in 2008, the zip file would be named:

FRI_098_2008.ZIP

The zip file will contain inventory information and metadata information. The inventory information (the polygon forest as detailed in these technical specifications) is delivered as a geospatial layer that contains only polygon features. The polygon forest will be packaged as an ArcInfo E00 file with no compression. Metadata information for the inventory will be provided in a Word document.

The same standardized naming convention that is used for the zip file will be applied to the contents of the zip file as well, with appropriation changes to the file extension. For example, the zip file FRI_098_2008. zip would contain two files:

FRI_098_2008.E00 (inventory information)
FRI_098_2008.DOC (metadata information)

4.1.3 Metadata

In order to track the author, history and other qualities/properties associated with a forest inventory, metadata is created and stored. Metadata associated with the polygon forest will be delivered in a separate file (a Word document) that is included in the data transfer (zip) file. Refer back to section 4.1.2, Packaging and Naming Convention.

General Data Standards

The relative positional accuracy for all polygon boundaries within a Polygon Forest will be within 10 metres. Absolute positional accuracy should also be within 10 meters, but is subject to the method of image capture which forms the basis for the Polygon Forest as well as the base feature information. Based on experience with sub meter digital imagery, relative accuracies within 2.5 meters should be realized.

Accuracies for stand boundaries and stand areas are reflected in the following table:

Absolute Accuracy	Relative Accuracy	Area
always within 10.0 meters	within 2.5 meters	within 1/10th of a hectare

4.1.4 Format

The Polygon Forest is a geospatial data layer that contains polygon features only. All polygons in the Polygon Forest must have a geographic location, referred to as a spatial component, and a description of each polygon's characteristics, referred to as a descriptive or a tabular component. Information that identifies the geographically referenced locations and boundaries of the polygons are referred to as spatial attributes. Information that describes the characteristics of a polygon is referred to as tabular attributes.

4.1.4.1 Spatial Requirements

The spatial information within the polygon forest refers to the topologic data, which is maintained as polygon attributes. Polygon attributes define the area, perimeter, and geo-reference identification of each polygon feature.

The spatial boundaries used to delineate polygons may be determined by interpretation of aerial photography, analysis of satellite imagery, operational mapping, or the physical coordinates of polygon boundaries collected with a global positioning system (GPS) device during forest operations, surveys, or inspections.

The polygon forest will be delivered to Licensees as:

- A standard ESRI Interchange format file (Arc Info .e00 layer) with no compression.

- All polygon boundaries will form contiguous lines within the area of a MU boundary. This layer will be a seamless product.

- The layer will be double precision.

- The geographic coordinates for spatial information in the polygon forest layer will be the NAD83 geodetic datum with the Ontario 76 Adjustment (NAD83 CNT) and a geographic (latitude/longitude) map projection system. The spatial information will be compatible with the Arc/Info methodology for maintaining geographic information.

- The spatial information component of a polygon forest layer will be compatible with the ARC/INFO methodology for creating and maintaining topologic data.

Polygon Area

The actual area and perimeter of each polygon within the polygon forest layer is generated and stored as part of the spatial attributes. The polygon area is the total area within a closed polygon boundary. The spatial polygon area attribute represents area in square metres and is stored as a double precision value. The spatial polygon area attribute provides the definitive source for polygon area information and should be used in all calculations or representations of area. The spatial area attribute is also currently used to calculate the area in hectares, to the nearest 1/10 (0.1) of a hectare, for reporting purposes. As a general rule, all calculations involving area should be based on the actual spatial area in metres, before it is rounded to the nearest 1/10 (0.1) of a hectare.

Minimum Polygon Size Targets

Polygon size targets provide a source of guidance and should not be treated as a rigid standard. When capturing imagery, all attempts are made by the pilot to maintain a flying height that will lead to a constant cell size as it relates to ground dimensions.

During the photo interpretation process, the following minimum polygon size targets normally apply to polygon forest layer:

- Productive forest land of eight hectares or larger will be delineated. The minimum polygon size for productive forest lands can be reduced from eight to four hectares for areas of ecological or economic importance.
- For polygons which are created from forest management activities and the supporting silvicultural records (e.g., harvest, renewal), the minimum polygon size is one hectare.
- For non-productive or non-forested areas, the minimum polygon size is a one hectare.
- For practicality and cost considerations, only islands that are eight hectares or larger will be interpreted and delineated according to the above bullet points. Islands smaller than 8 hectares down to a lower limit of 0.0025 hectares or 25 square meters in size (e.g., 5 meters X 5 meters) will be classified simply as an island in the polygon type attribute (i.e., POLYTYPE = ISL).

Polygons, which are smaller than the minimum size targets should normally be absorbed into an adjoining polygon. The joining of polygon areas should result in no net loss in area. The tabular attributes (common description or forest stand description information) of the new, larger polygon should also be adjusted, where appropriate, to reflect any changes.

Absolute Minimum Polygon Size:

Stand Delineation from Photo Interpretation	Delineation from Forest Change using Silvicultural Records	Non-Productive Forest	Forested Islands
4.0 ha	1.0 ha.	1.0 ha.	8 ha.

Spatial Quality Control

Base features that have been captured in the same manner as the polygon forest (source imagery) are saved and maintained in digital geographic information layers which provide a spatial frame of reference for portraying or associating other physical, biological, or resource feature inventory data. Base features provide fixed reference points on the surface of the earth when represented in two dimensions (a planar surface), such as on a map. Base features information provides a consistent geographic base fabric for relating other inventory information such as forest resources inventories, wildlife habitat, ecological land classification, values, and various other biological information. Base features information is also used in various analytical modelling processes, such as viewshed analysis, water movement and flow analysis, road location and transportation network analysis, watershed

analysis, landscape diversity analysis, harvest scheduling, and other spatial analyses which require relational analysis of geographic information.

Of most importance for spatial quality of the polygon forest is having a spatial reference frame on which to 'hang' the digital inventory. In order to do this, the base data (e.g., water bodies) must be captured in the same manner as the polygon forest in order that everything 'lines up' so spatial reference of all features is correct.

The geographic location and spatial extent of each forest polygon will be spatially referenced to existing base features such as lakes, double line rivers, etc. The base features, which are used as geographic reference points, must be adjacent to, or in close proximity to, the polygons that form the stand boundaries of the forest. Geographic information, that describes values in a layer, must be created using the Universal Transverse Mercator (UTM) map projection with the North American Datum for 1983 (NAD 83) including the Ontario 76 Adjustment for horizontal data (NAD83 CNT). The layer will be created in the accepted zone for that forest management unit. If the MU straddles two zones, the accepted zone will be the one where the majority of the unit resides.

Once the above data has been quality control checked and stored in the MNR's internal database (Forest Cover), the polygon forest will be extracted and delivered to the Licensee in geographic (latitude/longitude) map projection with the North American Datum for 1983 (NAD83) including the Ontario 76 Adjustment for horizontal data (NAD83 CNT). (Conversion of the spatial data from UTM to geographic will take place within the MNR's storage area.)

4.1.4.2 Tabular Requirements

Along with the spatial data, there is tabular data for the polygon forest. The tabular information will be exported in the attribute table (.pat) as part of the layer. Each record or row in the table describes one of the polygons in the polygon forest layer. Keeping to a tabular standard and ensuring accuracy of each record are paramount to maintaining a useable FRI.

Structure of the polygon attribute table (.pat) file for the Polygon Forest layer

start col.	field name	field type	field width	number of decimal places	attribute information	description (appendix) link
1	AREA	floating	8	5	Area	A1.1
9	PERIMETER	floating	8	5	Perimeter	A1.2
17	<cover_name>#	binary	4	--	ESRI assigned feature identifier	A1.3
21	<cover_name>-ID	binary	4	-	user assigned feature identifier	A1.4
25	FMFOBJID	integer	13	--	FMF object identification	A1.5
38	POLYID	character	25	--	polygon identification	A1.6
63	POLYTYPE	character	3	--	polygon type	A1.7
66	YRSOURCE	integer	4	--	year of update	A1.8
70	SOURCE	character	8	--	source of inventory update	A1.9
78	FORMOD	character	2	--	productive forest modifier	A1.10
80	DEVSTAGE	character	8	--	stage of development	A1.11
88	YRDEP	integer	4	--	year of last ‘depletion’	A1.12
92	DEPTYPE	character	8	--	'depletion' type	A1.13
100	OYRORG	integer	4	--	overstorey year of origin	A1.14
104	OSPCOMP	character	60	--	overstorey species composition	A1.15
164	OLEADSPC	character	3	--	overstorey leading species	A1.16
167	OAGE	integer	3	--	overstorey age	A1.17
170	OHT	numeric	4	1	overstorey height	A1.18
174	OCCLO	Integer	3	--	overstorey crown closure	A1.19
177	OSI	numeric	4	2	overstorey site index	A1.20
181	OSC	integer	1	--	overstorey site class	A1.21
182	UYRORG	integer	4	--	understorey year of origin	A1.22
186	USPCOMP	character	60	--	understorey species composition	A1.23
246	ULEADSPC	character	3	--	understorey leading species	A1.24
249	UAGE	integer	3	--	understorey age	A1.25

start col.	field name	field type	field width	number of decimal places	attribute information	description (appendix) link
252	UHT	numeric	4	1	understorey height	A1.26
256	UCCLO	Integer	3	--	understorey crown closure	A1.27
259	USI	numeric	4	2	understorey site index	A1.28
263	USC	integer	1	--	understorey site class	A1.29
264	INCIDSPC	character	3	-	incidental species	A1.30
267	VERT	character	2	--	vertical structure	A1.31
269	HORIZ	character	2	--	horizontal structure	A1.32
271	PRI_ECO	character	13	--	primary ecosite	A1.33
284	SEC_ECO	character	13	--	secondary ecosite	A1.34
297	ACCESS1	character	3	--	accessibility indicator	A1.35
300	ACCESS2	character	3	--	accessibility indicator	A1.35
303	MGMTCON1	character	4	--	management consideration	A1.36
307	MGMTCON2	character	4	--	management consideration	A1.36
311	MGMTCON3	character	4	--	management consideration	A1.36
315	VERDATE	date	8	--	verification date	A1.37
323	SENSITIV	character	3	--	data sensitivity indicator	A1.38
326	BED	date	8	--	business effective date	A1.39

The pat file structure contains multiple attributes for recording some information, such as two attributes for ecosite information and three attributes for management consideration information. With respect to using these ‘multiple’ attributes, the data entry personnel complete only what is needed to accurately describe the polygon and to satisfy the rules of the information requirement. Any ‘unused’ instances of the ‘multiple’ attributes are left blank, but all the attributes appear in the .pat file structure as described in the specifications, even though they are empty/unfilled. This ensures a standardized file format that is readily used by all partners when exchanging information.

Summary listing of when attributes are completed during inventory production

start column	field name	field type	field width	number of decimal places	polygon type = productive forest (FOR)	polygon type = all other types
1	AREA	floating	8	5	X	X
9	PERIMETER	floating	8	5	X	X
17	<cover_name>#	binary	4	--	X	X
21	<cover_name>-ID	binary	4	-	X	X
25	FMFOBJID	integer	13	--	X	X
38	POLYID	character	25	--	X	X
63	POLYTYPE	character	3	--	X	X
66	YRSOURCE	integer	4	--	X	X
70	SOURCE	character	8	--	X	X
78	FORMOD	character	2	--	X	
80	DEVSTAGE	character	8	--	X	
88	YRDEP	integer	4	--	X [1]	
92	DEPTYPE	character	8	--	X [1]	
100	OYRORG	integer	4	--	X	
104	OSPCOMP	character	60	--	X	
164	OLEADSPC	character	3	--	X	
167	OAGE	integer	3	--	X	
170	OHT	numeric	4	1	X	
174	OCCLO	Integer	3	--	X	
177	OSI	numeric	4	2	X [2]	
181	OSC	integer	1	--	X	
182	UYRORG	integer	4	--	X [3]	
186	USPCOMP	character	60	--	X [3]	
246	ULEADSPC	character	3	--	X [3]	
249	UAGE	integer	3	--	X [3]	
252	UHT	numeric	4	1	X [3]	
256	UCCLO	integer	3	--	X [3]	
259	USI	numeric	4	2	X [2, 3]	
263	USC	integer	1	--	X [3]	
264	INCIDSPC	character	3	-	X	

start column	field name	field type	field width	number of decimal places	polygon type = productive forest (FOR)	polygon type = all other types
267	VERT	character	2	--	X	
269	HORIZ	character	2	--	X	
271	PRI_ECO	character	13	--	X	X [4]
284	SEC_ECO	character	13	--	X	X [4]
297	ACCESS1	character	3	--		
300	ACCESS2	character	3	--		
303	MGMTCON1	character	4	--	X	X [5]
307	MGMTCON2	character	4	--	X	
311	MGMTCON3	character	4	--		
315	VERDATE	date	8	--	X	X
323	SENSITIV	character	3	--	X	X
326	BED	date	8	--	X	X

NOTES:

1 The year of last depletion/disturbance attribute (YRDEP) and the associated depletion type attribute (DEPTYPE) are only required to be completed during the photo interpretation process when the stage of development attribute is set to one of the 'newly depleted' options (i.e., DEVSTAGE = DEPHARV or DEPNAT). The fields are also generally completed for newly regenerated stages of development (i.e., DEVSTAGE = NEWNAT, NEWPLANT, or NEWSEED). For other stages of development, the fields may be completed if the interpreter has access to additional information pertaining to past disturbances.

2 Completion of the site index attribute (OSI, USI) is being phased in as the associated lookup tables become available.

3 The set of understorey attributes is only required to be completed when a stand has been identified as containing more than one distinct canopy layer. Refer to the description of the vertical structure attribute (i.e., VERT).

4 Ecosite information (PRI_ECO, SEC_ECO) is not assessed for water or island polygons (i.e., when POLYTYPE = WAT or ISL).

5 Management consideration information is only recorded for non-productive and non-forested polygons if they are located on an island (MGMTCON1 = ISLD).

4.1.5 Data Transfer and Schedule

4.1.5.1 Scheduling of the FRI Cycle for Forest Management Units

Implementation of the standards and requirements described in this *FIM Forest Resources Inventory Technical Specifications* will not be linked as closely to the forest management planning cycle as past FRI production schedules have been. Based on the move to a ten year forest management planning cycle, adjustment of the twenty year FRI cycle to a ten year cycle, and the timing of redesigning the FRI program, it became impossible to create new forest inventories for all but a few MUs in time for their respective planning processes. Therefore the FRI production schedule for the initial ten year cycle will be based on a variety of factors such as; vintage, natural change to forest conditions, production continuity and monetary considerations.

Initiation of the new FRI program will entail imagery acquisition for the entire Area of the Undertaking as defined by the *Class Environmental Assessment for Timber Management on Crown Lands in Ontario* and portions of the boreal forest north of the Area of the Undertaking over a five year period commencing in the summer of 2006 with completion scheduled for the summer of 2010. Subsequent steps in the FRI production process are planned to commence in 2007 with completion planned for 2016.

4.1.5.2 Detailed Schedule of Events Leading to the Production of the Polygon Forest

The following gives an **abbreviated example** of the timing of the product deliveries that lead up to the ultimate production of the Polygon Forest. Knowledge of this schedule will help contractors and planners to anticipate the delivery of these products and build them into their work schedule.

YEAR 1

mid April – Inventory Monitoring and Assessment Section (IMAS) provides vendor with:

- Access to digital or hard copy aerial imagery for plot layout and operations
- Calibration Plot Attribute Data Base template
- FRI/FIM compliant attribute data base template

early May – Vendor provides IMAS with:

- One copy of the plot layout map for pre-cruising approval by MNR
- One copy of plot location imagery depicting calibration plot locations (digital or hardcopy)

mid May – IMAS provides vendor with:

- Plot layout approval

late May – IMAS provides vendor with:

- one week training program for forest ecosystem classification and calibration plot methodology

mid October – Vendor provides IMAS with:

- A digital attribute data base for calibration plots, completed according to *Ontario Forest Resources Inventory Calibration Plot Specifications*
- Coverage (line type) of GPS locations for each plot, as done

early December – IMAS provides vendor with:

- one week training program on air photo interpretation of eco-sites and FRI attributes

YEAR 2

early January – IMAS provides vendor with:

- Ortho corrected Pan sharpened True Colour imagery
- Panchromatic with minimum of 60% overlap
- Pan Sharpened True Colour with minimum 60% overlap
- Pan sharpened Colour IR with minimum 60% overlap
- Supporting data files, such as aerial triangulation files, camera report files, model files (.mod) and surface files (.sdt) are requirements of this contract and must be provided along with the stereoscopic imagery in a format compatible with PurView software.

mid January – Vendor provides IMAS with:

- Sample of the new base data layer that will be used for classification

late January – IMAS provides vendor with:

- Approval of the base data

late December – Vendor provides IMAS with:

- Coverage of interpreted imagery (Polygon Forest) completed according to *Ontario Forest Resources Inventory Photo Interpretation Specifications*
- FRI/FIM compliant attribute data base linked to Polygon Forest coverage labels

- All necessary base update coverages (lakes, double line rivers)

YEAR 3

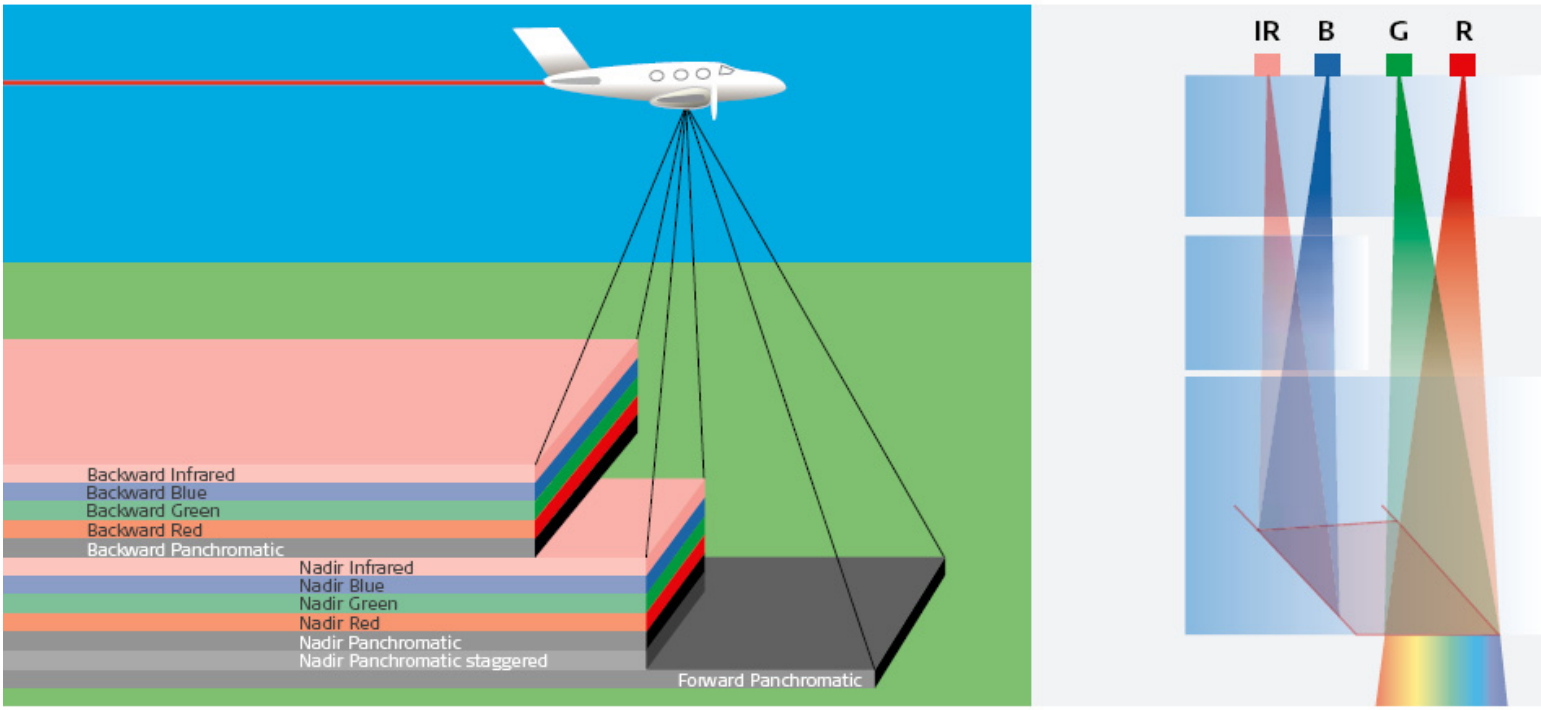
late February – IMAS provides vendor with:

- Feedback regarding quality control of all photo interpreted products

4.2 Aerial Photography Products

Aerial photography in support of digital forest resources inventory production is being captured using a new technology; Leica ADS40 SH52 platform. Designed for aerial capture, the ADS40 SH52 is a linescanner system which captures three different panchromatic views and two multi spectral views as illustrated in Figure 1 below. The new Leica ADS80 sensor has only been on the market for a short time, so the data handling and dissemination process has been a challenging learning experience. As expertise is gained with this technology, this section may be updated.

Figure 1: ADS40 SH52 imagery capture (Image courtesy of Leica Geosystems)



4.2.1 Description, Intent and Intended Use

The aerial photography products which are currently being captured during “leaf on” periods include digital stereo imagery, orthorectified mosaics, and digital surface models.

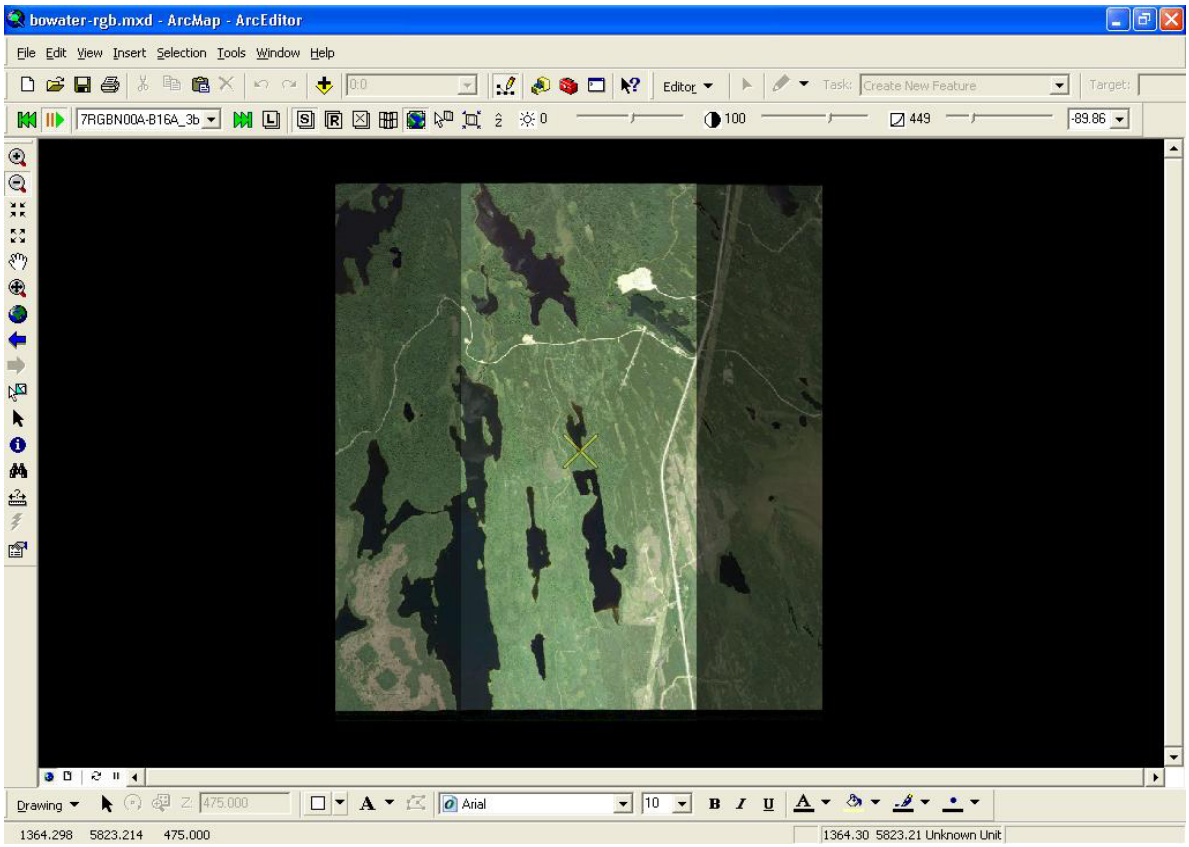
4.2.1.1 Digital Stereo Imagery

Digital stereo pairs are useful to OMNR and its partners in landscape planning for natural resources management, base data capture, and forest inventory operations based applications. Two stereo data products are available:

- A single band panchromatic image strip with a bit-depth of 16 bits and a resolution of 20 cm. Forward, nadir and backwards view angles are being made available.
- A four band multi-spectral (red, green, blue, near infrared (R, G, B, NIR)) image strip with a bit depth of 16 bits and a resolution of 40 centimeters. Nadir and backwards view angles are being made available.

The ability to see in stereo enhances the user's interpretability of features on the ground. By using parallax, the user has the ability to calculate vertical measurements of features such as tree heights or water levels along shorelines. The digital stereo pair segments will be delivered in entire flight line segments. Refer to the FRI User Guide document that is supplied with the imagery for further specific information regarding suggested hardware, software and data file configurations.

Figure 2: Example of RGB stereo viewing environment using ESRI's ArcGIS ArcMap platform with a PurVIEW plug-in.



4.2.1.2 Orthorectified Mosaics

Ortho mosaics are seamless image products developed through a process that uses the precise position from which the image was captured in order to remove distortion originating from the aerial capture process along with removing geometric distortion. The resulting image layer is a “true map".

Two ortho imagery products will be made available:

- seamless (mosaiced) ortho imagery tiles, and
- raw (non-mosaiced) ortho imagery strip segments.

The seamless clipped imagery tiles will be based on the size of a quarter of an Ontario Base Map (OBM) tile in size (5 km X 5 km). The raw strip segments will be delivered in so that each flightline is broken up into individual segments of the nadir few containing minimal radiometric enhancements.

- Single band, 16 bit panchromatic image tiles with a resolution of 20 cm
- 4 band, 16 bit multi-spectral (R, G, B, NIR) image tiles with a resolution of 40 cm.

Apart from being used in forest inventory production, seamless ortho mosaics may serve as map backdrop imagery or as reference data for thematic feature capture including extracting hydrologic details such as streams and updating infrastructure layers such as transportation.

The non-mosaiced strips are intended for very specific automated processes where no image enhancement or mosaic lines are desired. This type of imagery is intended for automated feature extraction algorithms (such as segmentation) and for automated classifications (such as individual tree classification). It is not well suited for use as image backdrops.

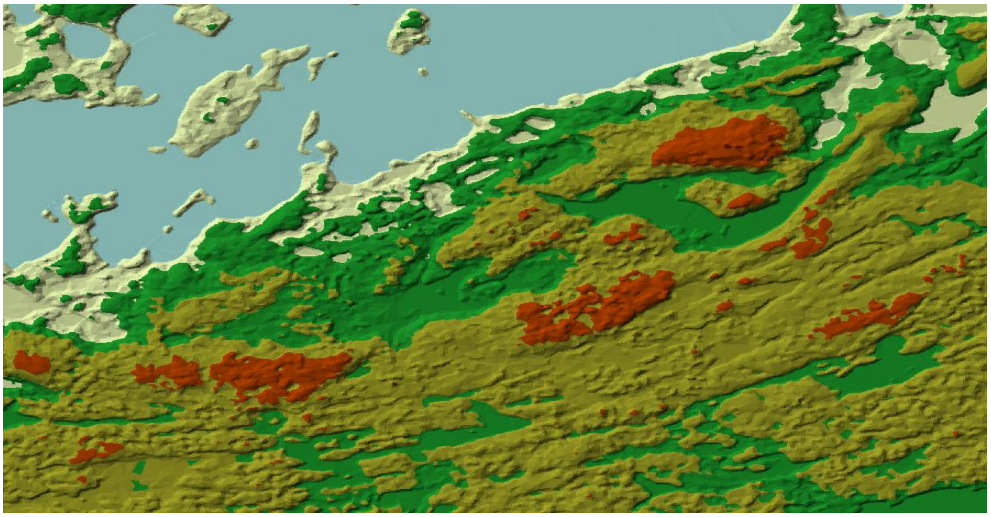
4.2.1.3 Digital Surface Models

Digital surface models (DSM) aid in photo interpretation, forest management planning, and forest management operations planning. Two types of digital surface models are developed during the inventory production process; unclassified and classified.

Unclassified Digital Surface Models (DSM)

The DSM products are based on 5 meter postings and are derived through a pixel auto correlation procedure using the patented ATE algorithm. This procedure uses the 20 centimeter forward and backward panchromatic view angles.

The unclassified DSM will be made available in an ERDAS Imagine (img) raster format, divided by line segments.



Classified Digital Surface Model (CDSM)

CDSM is created using a multi resolution spectral based classification of the L2 cut tiles mosaics combined with the raw DSM strip data. Both data sets are classified to produce a three class elevation product. The three classes include water, forest cover, and ground features. It is important to note that the ground features are not mapped as true ground features found in a last return LiDAR product as this class can includes elevation points that are captured on the bare ground, on low lying shrubs and vegetation. The product is being delivered using the same indexing system as the L2 cut tile mosaics in an ASCII digital elevation model format.

4.2.2 Packaging and Naming Convention

This section to be completed at a later date.

4.2.3 Metadata

This section to be completed at a later date.

4.2.4 Format

All imagery data is delivered in 16 bit format to offer the user the greatest amount of viewing detail. For example, 16 bit imagery allows for the extraction of increased information in areas that are found within shadow or located on a north facing slope.

A series of instructions and tools have been assembled by MNR Forest Resources Inventory staff in conjunction with contractors to enhance the performance of working with ADS40 imagery for inventorying applications. A brief description of each tool, along with the problems that it is designed to fix is included in Appendix 3.

4.2.5 Data Transfer and Schedule

Aerial photography products can be provided to forest industry clients who will receive the final digital polygon forest product and to the MNR. Aerial photography information is provided on request as it becomes available.

Imagery information is transferred on portable hard drives provided by the requester. Each hard drive must have a two terabyte capacity and multiple drives will be required. To determine your data storage needs, first plan for one terabyte of information per every 1000 square kilometres and then add 33% to this for pyramids. Refer to Appendix 3, Section A3.4 for more information on pyramids.

5.0 Future Directions

The *Forest Resources Inventory Strategy* describes the concepts and framework that support Ontario's forest inventory program, as well as, the direction that the forest inventory program intends to take over time from a technical aspect. The strategy is intended to provide clients an understanding of the forest inventory program and potential future direction. It also provides a framework for research and development that may be required to support future forest inventory production processes and technology.

These *FIM Forest Resources Inventory Technical Specifications* are subject to change over time. Influences or drivers that may necessitate changes might be political, new policies, technology advances, etc.

At the time of writing of this document, known influences included:

Projects	Changes
Land Information Ontario - Forest Cover Development	Improved data storage, editing and management in line with corporate data management strategies
MNR - Enhanced Forest Resource Inventory - Forest Cover Development	Ongoing improvement to attribution related to Ontario's forest inventory. Continued development of NRVIS as a tool for updating and editing FRI information
Imagery Acquisition	Investigation of potential updating to base features and or values information.

Appendix 1 Tabular Attribute Descriptions

NOTE: The material in this appendix is organized based on order of presentation in Section 4.1, Polygon Forest.

A1.1 AREA

Descriptive Name: Area

Definition: The *area* attribute is an ESRI standard attribute for a coverage containing polygon features which contains the size of a geographic feature (polygon) measured in meters squared.

Format: floating 8.5

If an area in hectares value is desired for a polygon, then it needs to be computed from this area in meters squared value. An area in hectares value is not stored in this attribute file.

A1.2 PERIMETER

Descriptive Name: Perimeter

Definition: The *perimeter* attribute is an ESRI standard attribute for a coverage containing polygon features which contains the distance along the outside of a polygon measured in meters.

Format: floating 8.5

A1.3 <cover_name>#

Descriptive Name: ESRI assigned feature identifier

Definition: The *<cover_name>#* attribute is an ESRI standard attribute for a coverage containing polygon features which contains a unique sequence number automatically generated

by ArcInfo for each coverage feature. This internal number is used to directly access features and to describe topological relationships between coverage features. It is often referred to as the 'record number'.

Format: binary 4

A1.4 <cover_name>-ID

Descriptive Name: User assigned feature identifier

Definition: The *<cover_name>-ID* attribute is an ESRI standard attribute for a coverage containing polygon features which contains an integer identifier, assigned by the user, to relate geographic features and corresponding attribute data. Cover-ID is an item found in feature attribute tables, with 'Cover' replaced by the coverage name (e.g., for a soils coverage, the Cover-ID would be SOILS-ID). Feature-ID and User-ID are synonymous terms to Cover-ID.

Format: binary 4

A1.5 FMFOBJID

Descriptive Name: FMF Object Identification

Definition: The *FMF object identification* attribute contains a system generated identifier that is unique at the MNR application level.

The intent is to use this field to identify / track change data in the future.

Format: integer 13

A1.6 POLYID

Descriptive Name: Polygon Identification

Definition: The *polygon identification* attribute contains a unique identifier / label for the polygon.

Format: character 25

- the inventory production process assigns a sequential number that is auto-generated

A1.7 POLYTYPE

Descriptive Name: Polygon Type

Definition: The *polygon type* attribute indicates the classification of the area within the polygon boundaries into one of several generalized water and land types.

Format: character 3

CODE	OPTION	DEFINITION
water types		
WAT	Water	All water areas delineated to the high water mark. No designation (or polygon delineation) between lakes and wide rivers. Therefore, includes lakes, ponds and reservoirs (i.e., inland basin areas containing water) and wide ('two sided') rivers. These rivers are natural or man-made bodies of flowing water, emptying into a stream, river or lake. These are permanent rivers or streams that can be defined by area (versus a line). During the inventory production process rivers 10 meters or wider are identified from the imagery as polygons. Smaller/narrower rivers and streams are maintained as linear features in a centre-line layer(s).
non-forested types		
DAL	developed agricultural land	Lands which are cultivated for growing crops, orchards, floral gardens, etc. These areas may include abandoned agricultural lands.
GRS	grass and meadow	Farm areas devoted to pasture for domesticated animals. These areas may also include abandoned grass and meadows, but are not part of the productive forest land base and do not include 'barren and scattered' areas. These areas are similar to barren and scattered, but are located near developed agriculture land or unclassified areas and are usually fenced.
ISL	small island	Islands less than 8 hectares in size, down to a lower limit of 0.0025 hectares or 25 square meters in size (e.g., 5 meters X 5 meters) are recorded during the inventory production process, but are not interpreted/typed for practicality and cost considerations. Only islands 8 hectares and larger are interpreted and assigned an appropriate POLYTYPE code, such as FOR or BSH.
UCL	Unclassified	Non-forested areas which were created for specific uses other than timber production, such as roads, railroads, logging camps, mines, utility corridors, logging camps, gravel pits, airports, etc. Most of these areas have been cleared of trees.
non-productive forest types		

CODE	OPTION	DEFINITION
BSH	brush and alder	Areas covered with 'non-commercial' tree species or shrubs. These areas are normally associated with wetlands or water features, and must not be confused with productive forest areas of similar brush or bush cover which have developed as a result of forest management operations (e.g., areas that have been recently depleted or areas that are below silvicultural standards).
OMS	open wetland	Wet areas of mosses, grasses, sedges, and small herbaceous plants, often interspersed with small areas of open water.
RCK	Rock	Areas of barren or exposed rock (e.g., bedrock, cliff face, talus slope) which may support a few scattered trees, but is less than or equal to 25% stocked.
TMS	treed wetland	Areas of dry or wet muskeg on which stunted trees occur as widely spaced individuals or in small groups.
productive forest types		
FOR	productive forest	Areas that are capable of producing trees and can support tree growth. The areas may or may not have timber currently growing on them depending upon the stage of development (e.g., recently depleted). These areas may or may not be capable of supporting the harvesting of timber on a sustained yield basis. Some areas may have physical and/or biological characteristics which effect land use. Thus, this polygon type includes both production and protection forest areas.

If a delineated polygon is an island or is located on an island, the management consideration attribute is set to island (MGMTCON1 = ISLD). This applies to all polygon types. This apparent redundancy in classification for polygons having a type of island (i.e., POLYTYPE = ISL *and* MGMTCON1 = ISLD) allow resource managers to easily identify:

1. all polygons located on islands regardless of polygon type (by querying on MGMTCON1 = ISLD)
2. just the small uninterpreted islands (by querying on POLYTYPE = ISL) depending upon the desired analysis.

A1.8 YRSOURCE

Descriptive Name: Year of Source

Definition: The *year of source* attribute is a four-digit number representing the year that the source information (which was used to update the stand description) was acquired. For example, the date of imagery, date photos were flown/taken, date of field survey. This attribute is used to determine the age of forest stands.

Format: integer 4

- YYYY

A1.9 SOURCE

Descriptive Name: Source of Update Data

Definition: The *source of update data* attribute identifies the methodology by which the information stored in the other tabular attributes that are associated with the same polygon was determined (i.e., how the polygon description was determined).

Format: character 8

CODE	OPTION	DEFINITION
BASECOVR	base layer	Base feature information that is provided by the MNR (e.g., water).
DIGITALA	multispectral scanning (digital image) -- automated process	Digital analysis, automated processing. (e.g., Ecognition). Use of recognition software to analyze the imagery and produce polygon boundaries. Most commonly used for water feature extraction or roads.
DIGITALP	multispectral scanning (digital image) -- manual process	Photo-interpretation of multi-spectral imagery using "Softcopy" software.
ESTIMATE	expected / estimated outcome / result	This source option is only for use in areas that have been recently renewed and have not been revisited since the renewal work was performed. That is, where a follow-up survey has not yet been performed (e.g., regeneration survey, FTG survey). Therefore, the description of the newly regenerated stand is a 'best estimate' of the expected outcome / result of the renewal treatment that was applied to the area based on past silvicultural successes.
FOC	forest operations compliance inspection	Inspection of a site after silvicultural treatment to determine whether an operator / operation conforms to the approved plan or permit. The evaluation of any harvest, renewal, maintenance, or access forest management activity (e.g., post-harvest site inspection) can be included here.
FRICNVRT	Forest Resource Inventory conversion	The current polygon description is based on data conversion from a previous FRI product.
INFRARED	infrared satellite imagery	Note: This type of imagery is used to asses succession and distinguish hardwood versus conifer regeneration in young plantations.

CODE	OPTION	DEFINITION
MARKING	pre-harvest site inspection / marking	Assessment of the trees in a stand for purpose of establishing a silvicultural or operational prescription. Selecting and marking the trees to be harvested and/or the trees to be left to grow; to sustain and enhance the stand for timber management, wildlife habitat management, aesthetics, recreation, biodiversity and other environmental and heritage concerns.
OCULARA	aerial survey / reconnaissance	Visual assessment of a stand from a helicopter or fixed wing aircraft.
OCULARG	ocular estimate (ground)	Visual assessment of a stand using extensive ground survey methodologies (i.e., no detailed measurements).
OPC	operational cruise	Measuring standing trees to determine the volume of wood on a given tract of land.
PHOTO	air photo interpretation	Photography at a conventional scale of 1:10,000 to 1:20,000.
PHOTOLS	large scale aerial photography	Photography at a scale larger than 1:10,000 (e.g., 1:500, 1:1000).
PHOTOSS	small scale aerial photography	Photography at a scale smaller than 1:20,000 (e.g., 1:100,000).
PLOTFIXD	fixed area plot	(e.g., FRI – permanent inventory plot)
PLOTVAR	variable area (radius) plot	BAF prism cruise (e.g., FRI calibration plot)
RADAR	radar satellite imagery	Note: Radar imagery may provide for image separation among forest types when pre-existing forest and non-forest land cover classifications are incorporated.
REGENASS	regeneration assessment	Survey of a regenerated area to determine how well the new stand is growing. This includes seeding, survival, and stocking assessments.
SEMEXTEN	extensive silvicultural effectiveness monitoring survey	An appraisal of a forest stand's structure and composition using generalized survey sampling methodologies to determine if regeneration or management objectives have been met (i.e., determine if the expected results were achieved). Extensive survey methods are generally used where there are obvious successes or failure, or to identify problem areas requiring more intensive assessment.
SEMINTEN	intensive silvicultural effectiveness monitoring survey	An appraisal of a forest stand's structure and composition using rigorous survey sampling methodologies to determine if regeneration or management objectives have been met (i.e., determine if the expected results were achieved). Intensive survey methods are intended for stands where the status of regeneration is uncertain or specific quantitative data is required to determine the silvicultural effectiveness for operational treatments.
SPECTRAL	spectral satellite imagery	Note: This type of imagery can be used to distinguish and identify different forest and plantation types.

CODE	OPTION	DEFINITION
SUPINFO	supplied information	Stand update information from a source other than those listed/defined in the other coding options that is provided by either MNR or Licensee. For example, disturbance records. The date of information capture/acquisition and the age of the stand as of the date of information was acquired must be supplied for the information to be incorporated into the inventory.

A1.10 FORMOD

Descriptive Name: Productive Forest Modifier

Definition: The *productive forest modifier* attribute represents a further classification (sub-division) of productive forest areas based on the presence or absence of physical or biological factors which may influence the ability to practice forest management.

Format: character 2

CODE	OPTION	DEFINITION
PF	Protection Forest	Areas that may have adequate timber growth, but which contain features that pose a significant operational challenge or risk in terms of forest management and site protection. These areas have been designated as a reserve for the purpose of protecting a specific site or ecosystem and are excluded from forest operations.
RP	Production Forest ('regular')	Productive forest areas at various stages of growth and development, including areas that have been recently depleted (by harvest or natural causes) or renewed (by artificial or natural means), that are capable of producing adequate growth of timber to support harvesting on a sustained yield basis. These areas have no significant physical or biological limitations on the ability to practice forest management, but may include areas which pose an operational challenge in terms of harvest, access, protection, silviculture, or renewal (areas formerly called production forest reserves). *).*

If the productive forest modifier is set to protection forest (FORMOD = PF), then the reason for the designation must be entered in the management consideration attribute (MGMTCON1 <> NONE).

There is a relationship between the site class (OSC, USC) and the productive forest modifier (FORMOD) values assigned to a forested area. Generally, areas assigned a site class value of 4 (protection forest) are also assigned a productive forest modifier value of PF (protection forest), but it

is not a requirement. Areas assigned a site class value other than 4 (e.g., 3) can also be assigned the productive forest modifier value of PF. Conversely areas assigned a site class value of 4 may be assigned a productive forest modifier value of production forest (RP) instead of protection forest. The apparent discrepancy in the protection forest assignment between the site class attribute and the productive forest modifier attribute reflects the difference between a calculated assessment of site conditions (OSC, USC) versus a timber management decision (FORMOD) that is based on more than just site class.

A1.11 DEVSTAGE

Descriptive Name: Stage of Development

Definition: The *stage of development* attribute indicates the current state of growth and development for a productive forest stand. Note that some states are best described based on the last major silvicultural treatment that was applied to the stand, if the stand is being managed for timber production.

Format: character 8

CODE	OPTION	DEFINITION
Low Stocking Codes		
LOWMGMT	not satisfactorily regenerated harvest disturbance	Productive forest stands which were previously harvested and have not reached the regeneration standards as described in an approved forest management plan within the estimated timeframe. Further, these areas require additional silvicultural treatment to bring them up to regeneration standards. This does not include areas that have been recently depleted or recently renewed. However, it may include areas which have received renewal treatments in the past that have failed to produce a regenerated forest to the applicable regeneration standards. This option may also include those areas which have traditionally been designated as barren and scattered (i.e., stocking less than 25%) and areas that have been classified as not satisfactorily regenerated (NSR). The former NSR classes of 2 to 5 are included here.
LOWNAT	not satisfactorily regenerated natural disturbance	Productive forest stands which were previously depleted by natural causes and have not reached the regeneration standards as described in an approved forest management plan within the estimated timeframe. Further, these areas require additional silvicultural treatment to bring them up to regeneration standards. This does not include areas that have been recently depleted or recently renewed. However, it may include areas which have received renewal treatments in the past that have failed to produce a regenerated forest to the applicable regeneration standards. This option may also include those areas which have traditionally been designated as barren and scattered (i.e., stocking less than 25%) and areas that have been classified as not satisfactorily regenerated (NSR). The former NSR classes of 2 to 5 are included here.
Depleted Area Codes		
DEPHARV	recent harvest disturbance with no regeneration	Productive forest area that was recently depleted by clearcut harvesting and have not received a silvicultural treatment such as natural regeneration, seeding or planting. These areas do not have advanced regeneration, or a distinct or established regeneration layer that would be released and/or protected as part of the depletion operation.
DEPNAT	recent natural disturbance with no regeneration	Productive forest area that was recently depleted by natural causes (i.e., fire, blowdown, ice damage, insect and disease) and have not received a silvicultural treatment such as natural regeneration, seeding or planting. These areas do not have advanced regeneration, or a distinct or established regeneration layer.
Newly Regenerated Codes		
NEWPLANT	recently renewed : mainly planted	Productive forest areas which have been regenerated predominantly by planting, but have not received a silvicultural effectiveness monitoring survey and have not been assessed as free-to-grow / free growing.

CODE	OPTION	DEFINITION
NEWSEED	recently renewed : mainly seeded	Productive forest areas which have been regenerated predominantly by seeding, but have not received a silvicultural effectiveness monitoring survey and have not been assessed as free-to-grow / free growing.
NEWNAT	recently renewed : mainly natural regeneration	Productive forest areas which have been regenerated predominantly by natural means, but have not received a silvicultural effectiveness monitoring survey and have not been assessed as free-to-grow / free growing.
Free-to Grow Codes		
FTGPLANT	free growing: mainly planted regeneration	Productive forest areas which were regenerated predominantly from planted stock and which have been assessed as free-to-grow / free growing based on a silvicultural effectiveness monitoring survey. This includes areas representing a wide range of stand ages, from recently assessed as free-to-grow / free growing to mature and overmature stands, if the stand has not received any further silvicultural treatment.
FTGSEED	free growing: mainly seeded regeneration	Productive forest areas which were regenerated predominantly by seeding and which have been assessed as free-to-grow / free growing based on a silvicultural effectiveness monitoring survey. This includes areas representing a wide range of stand ages, from recently assessed as free-to-grow / free growing to mature and overmature stands, if the stand has not received any further silvicultural treatment.
FTGNAT	free growing: mainly natural regeneration	Productive forest areas which were regenerated predominantly by natural means and which have been assessed as free-to-grow / free growing based on a silvicultural effectiveness monitoring survey. This includes areas representing a wide range of stand ages, from recently assessed as free-to-grow / free growing to mature and overmature stands, if the stand has not received any further silvicultural treatment.
Harvest Codes (generic use or Clearcut Silvicultural System related)		
THINPRE	received a pre-commercial thinning/spacing treatment	Free-growing productive forest areas which have received a mid-rotation partial harvest (reduction in the growing stock) that is designed to meet various objectives such as improving tree spacing, removing trees not suited to the site, and promoting the growth of the best quality trees. The trees selected for removal do not result in a harvest of merchantable volume.
THINCOM	received a commercial thinning/spacing treatment	Free-growing productive forest areas which have received a mid-rotation partial harvest (reduction in the growing stock) that is designed to meet various objectives such as improving tree spacing, removing trees not suited to the site, and promoting the growth of the best quality trees. The harvested trees are removed from the site and used for commercial purposes.

CODE	OPTION	DEFINITION
STRIPCUT	Modified cut: strip	The removal of a portion of the existing trees in a stand in progressive strips in more than one operation so that the non-depleted portion of the stand is left primarily to provide a natural seed source for regeneration of the depleted area. Several cutting patterns are available to achieve same goal. The removal of trees in one or more passes in a system of strips of various widths; where each strip is less than or equal to 100 meters (5 chains) wide. It is designed to encourage regeneration on difficult and/or fragile sites. **Note:** Harvesting where the cut strips are greater than 100 meters wide (> 5 chains) should be recorded as clearcut.
FRSTPASS	modified cut: first pass	A partial harvest where the first harvest operation removes target/specific merchantable tree species from a forest stand. The remaining species are merchantable and are intended to be harvested by another logger/contractor/forest resource licence holder in the next pass. A first pass should be recorded if merchantable tree species remain in the forest stand which have been allocated for harvest - but not yet harvested.
SEEDTREE	modified cut: seed tree	An even-aged, silvicultural system that retains mature standing trees scattered throughout the cutblock to provide seed sources for natural regeneration. A method of harvesting and regenerating a forest stand in which all trees are removed from the area except for a small number of seed-bearing trees that are left singly or in small groups. The objective is to create an even-aged stand.
Shelterwood Silvicultural System Codes		
PREPCUT	received a preparatory cut	A shelterwood silvicultural system stage of management designed to remove undesirable species of any species from the stand and to select trees to remain that will provide the best seed source. The removal of undesirable trees opens the canopy and enables the crowns of remaining seed bearing trees to enlarge; to improve conditions for seed production and natural regeneration.
SEEDCUT	Received a seed cut	A shelterwood silvicultural system stage of management where trees are removed from a mature stand in order to create openings in the canopy / create spaces and to prepare sites for natural regeneration while maintaining the seed bearing trees and protecting any existing advance regeneration.
FIRSTCUT	received a first removal harvest	A shelterwood silvicultural system stage of management where overstorey trees are removed in one or more harvests in order to release the established seedlings from competition.
LASTCUT	received a final removal harvest	A shelterwood silvicultural system stage of management where all of the remaining trees in the overstorey are removed. This is the removal of the seed or shelter trees after the regeneration has been effective.

CODE	OPTION	DEFINITION
Selection Silvicultural System Codes		
IMPROVE	received an improvement cut	A selection silvicultural system stage of management where a cut is made in an uneven-aged stand primarily to improve stand composition. distribution and quality by removing less desirable trees of any species.
SELECT	received a selection harvest	A selection silvicultural system stage of management where individual trees or groups of trees are selected for cutting in order to recover the yield and develop a balanced uneven-aged structure, while providing the cultural measures required for tree growth and seeding establishment.

A1.12 YRDEP

Descriptive Name: Year of Last 'Depletion'/Disturbance

Definition: The *YRDEP* attribute identifies the most recent (latest) FISCAL year that a productive forest area was disturbed, completely or partially, by harvest or by natural causes. This includes mid-rotation or stand improvement operations where merchantable timber is removed.

Format: integer 4

- YYYY
- based on fiscal year so, for example, any disturbances occurring during the period of April 1, 2006 through March 31, 2007 would be recorded as 2006

Note: The year of depletion attribute (YRDEP) and the associated depletion type attribute (DEPTYPE) are only completed during the photo interpretation process when the stage of development attribute is set to one of the 'newly depleted' options (i.e., DEVSTAGE = DEPHARV or DEPNAT). The fields are also generally completed for newly regenerated stages of development (i.e., DEVSTAGE = NEWNAT, NEWPLANT, or NEWSEED). For other stages of development, the fields may be completed if the interpreter has access to additional information pertaining to past disturbances.

A1.13 DEPTYPE

Descriptive Name: Type of 'Depletion'/Disturbance

Definition: The *DEPTYPE* attribute identifies the disturbance that occurred in the year recorded in the companion attribute YRDEP (year of disturbance). The disturbance may have effected the entire stand or only a portion of it.

Format: character 8

Code	Option	Definition
BLOWDOWN	wind / blowdown	
DISEASE	disease	
DROUGHT	drought	
FIRE	fire	
FLOOD	flood	
HARVEST	harvest	Partial or full stand removal of timber. This includes mid-rotation or stand improvement operations where merchantable timber is removed.
ICE	ice damage	
INSECTS	insects	
SNOW	snow	

A1.14 OYRORG

Descriptive Name: Overstorey Year of Origin

Definition: The *OYRORG* attribute is the year of origin for the stand (or for just the uppermost canopy layer if the stand canopy contains two or more distinct layers).

Format: integer 4

- YYYY
- This is a calculated value. Overstorey year of origin is calculated as the year of the data source from which age is determined *minus* the overstorey age as determined using the source (i.e., OYRORG = year of age source - OAGE). For example, using imagery taken in 2007, the age of the stand is interpreted to be 50 years at that time (in 2007). Thus the year of origin for the stand is 2007 - 50 = 1957. Note that the source used to determine age may not be the data source listed in the SOURCE attribute if multiple data sources were used to generate the stand description.

A1.15 OSPCOMP

Descriptive Name: Overstorey Species Composition

Definition: The *overstorey species composition* attribute identifies the tree species in the stand (or in just the uppermost canopy layer if the stand canopy contains two or more distinct layers), along with the percentage of cover that each tree species occupies within the canopy.

Format: character 60

- repeating pattern of species code and corresponding proportion value
- each species code is 3 characters (including blanks) and is left justified
- each proportion is 3 characters which represents an integer value from 1 to 100 and is right justified. Note that initial inventory values determined by photo interpretation will not go below 10% and are rounded to the nearest 10% (e.g., 10, 20, 30). During inventory update, proportions based on subsequent field survey sampling that are of a finer resolution can be entered (e.g., go below 10% or be a value in between the initial rounded proportions such as 15).
- pattern is SSSPPPSSSPPP For example: PJ 80PO 20 (there are two blanks between the species and the proportion)
- maximum of 10 species and proportions pairs in the string
- no duplicate species codes allowed in the string
- proportion values in the string must sum to 100
- when two or more species have the same proportion then the species which appears to be more prevalent is listed first

Valid species codes follow. The first table is in order by common name. A second table sorted by code value. Both tables contain a full listing of species codes available for use. Note, however, that **only a subset of these codes are interpreted from imagery during inventory creation.** The species in this subset are indicated in the tables by an X in the 'Interp' column.

Species codes listed in order by COMMON NAME

Interp	Code	Common Name	Scientific Name
	AL	alder, any / mixed	Alnus spp.
X	AX	ash, any / mixed	Fraxinus spp.
X	Ab	ash, black	Fraxinus nigra
	Aq	ash, blue	Fraxinus quadrangulata
	Ap	ash, pumpkin	Fraxinus profunda
	Ag	ash, red (or green)	Fraxinus pennsylvanica
X	Aw	ash, white	Fraxinus Americana
X	Pl	aspen, largetooth	Populus grandidentata
X	Pt	aspen, trembling	Populus tremuloides
X	Bd	basswood	Tilia Americana
X	Be	beech, American	Fagus grandifolia
	Bc	birch, cherry	Betula lenta
	Bp	birch, European white (or weeping)	Betula pendula
X	Bg	birch, grey	Betula populifolia
X	Bw	birch, white (or paper)	Betula papyrifera
X	By	birch, yellow	Betula alleghaniensis
	Gb	black gum	Nyssa sylvatica
	Bb	blue-beech (also called American hornbeam)	Carpinus caroliniana
X	Bn	butternut	Juglans cinerea
	Cat	catalpa, northern (also called bean-tree)	Catalpa speciosa
X	CE	cedar, all	Thuja spp.
X	Cr	cedar, eastern red (redcedar)	Juniperus virginiana
X	Cw	cedar, eastern white- (also called northern white-cedar)	Thuja occidentalis
X	CH	cherry, any / mix	Prunus, spp.
X	Cb	cherry, black	Prunus serotina
	Cc	cherry, choke	Prunus virginiana
	Cm	cherry, mazzard	Prunus avium
	Cp	cherry, pin (or wild red or fire)	Prunus pensylvanica
	Cs	cherry, sour (or pie or sour red)	Prunus cerasus
X	Cd	chestnut, American	Castanea dentate
X	OC	conifers, other	----------
X	Pd	cottonwood, Eastern	Populus deltoids
	Ct	cucumber tree	Magnolia acuminate

Interp	Code	Common Name	Scientific Name
X	EX	elm, any / mix.	Ulmus spp
	Er	elm, red (or slippery)	Ulmus rubra
	Eu	elm, rock	Ulmus thomasii
X	Ew	elm, white (or American)	Ulmus americana
X	Bf	fir, balsam	Abies balsamea
	Hk	hackberry	Celtix occidentalis
X	OH	hardwoods, other	----------
	Ht	hawthorn	Crataegus spp.
X	He	hemlock, eastern	Tsuga Canadensis
X	Hi	hickory, all	Carya spp.
	Hl	hickory, big shellbark	Carya laciniosa
	Hb	hickory, bitternut (or swamp)	Carya cordiformis
	Hm	hickory, mockernut	Carya tomentosa
	Hp	hickory, pignut (or red or sweet pignut)	Carya glabra
	Hs	hickory, shagbark	Carya ovata
	Hc	horsechestnut	Aesculus hippocastanum
X	Iw	ironwood (also called Eastern hop-hornbeam)	Ostrya virginiana
	Kk	Kentucky coffee tree	Gymnocladus dioicus
X	La	larch, eastern (also called Tamarack or American Larch)	Larix, laricina
	Le	larch, European	Larix deciduas
	Lj	larch, Japanese	Larix leptolepis
	Bl	linden, big leaf	Tilia platyphyllos
	Ll	linden, little leaf	Tilia cordata
X	LO	locust (black and/or honey)	Robinia spp.
	Lb	locust, black	Robinia pseudoacacia
	Gt	locust, honey-	Gleditsia triacanthos
X	MX	maple, any / mix	Acer spp.
	Mb	maple, black	Acer nigrum (Acer saccharam ssp.nigrum)
	Mf	maple, freeman	Acer X freemanii
X	Mh	maple, hard (= sugar maple)	Acer saccharum
	Mm	maple, Manitoba (or box elder)	Acer negundo
	Mt	maple, mountain	Acer spicatum
	Mn	maple, Norway	Acer platanoides
X	Mr	maple, red (also called soft maple)	Acer rubrum
X	Ms	maple, silver	Acer saccharinum

Interp	Code	Common Name	Scientific Name
X	Mr	maple, soft (= red maple)	Acer rubrum
	Mp	maple, striped	Acer pensylvanicum
X	Mh	maple, sugar (also called hard maple)	Acer saccharum
	AM	mountain-ash, any/mix	Sorbus spp.
	Ema	mountain-ash, European	Sorbus aucuparia
	Mo	mulberry, red	Morus rubra
X	OX	oak, any / mix	Quercus spp.
	Obl	oak, black	Quercus nigra
	Ob	oak, bur	Quercus macrocarpa
	Och	oak, Chinquapin (or yellow)	Quercus muehlenbergii
	Op	oak, pin (or swamp)	Quercus palustris
X	Or	oak, red (or northern red)	Quercus rubra
	Os	oak, shumard's (or swamp red)	Quercus shumardii
	Osw	oak, swamp white	Quercus bicolour
X	Ow	oak, white	Quercus alba
	Pa	pawpaw	Asimina triloba
X	PX	pine, any / mix	Pinus spp.
	Pn	pine, Austrian or black	Pinus nigra
X	Pj	pine, jack	Pinus banksiana.
	Pp	pine, pitch	Pinus rigida
X	Pr	pine, red	Pinus resinosa
X	Ps	pine, scots	Pinus sylvestris
X	Pw	pine, white *[eastern white]*	Pinus strobes
X	PO	poplar, any / mix	Populus spp.
X	Pb	poplar, balsam	Populus balsamifera
	Pc	poplar, Carolina	Populus X Canadensis
	Ph	poplar, hybrid	Populus
	Pe	poplar, silver (or European white or white)	Populus alba
	Red	redbud	Cercis Canadensis
	Ss	sassafras	Sassafras albidum
X	SX	spruce, any / mix	Picea spp.
X	Sb	spruce, black	Picea mariana
	Sc	spruce, Colorado (or blue)	Picea pungens
	Sk	spruce, koyama	Picea koyamai
	Sn	spruce, Norway	Picea abies
	Sr	spruce, red	Picea rubens
X	Sw	spruce, white	Picea glauca

Interp	Code	Common Name	Scientific Name
	Sy	sycamore	Platanus occidentalis
X	La	tamarack *[= eastern larch]*	Larix laricina
	Tp	tulip tree	Liriodendron tulipifera
X	Wb	walnut, black	Juglans nigra
X	Wi	willow, any / mix	Salix spp.
	Haz	witch-hazel, American	Hamamelis virginiana

Species listed in order by CODE

Interp	Code	Common Name	Scientific Name
X	Ab	ash, black	Fraxinus nigra
	Ag	ash, red (or green)	Fraxinus pennsylvanica
	AL	alder, any / mixed	Alnus spp.
	AM	mountain-ash, any/mix	Sorbus spp.
	Ap	ash, pumpkin	Fraxinus profunda
	Aq	ash, blue	Fraxinus quadrangulata
X	Aw	ash, white	Fraxinus Americana
X	AX	ash, any / mixed	Fraxinus spp.
	Bb	blue-beech (also called American hornbeam)	Carpinus caroliniana
	Bc	birch, cherry	Betula lenta
X	Bd	basswood	Tilia Americana
X	Be	beech, American	Fagus grandifolia
X	Bf	fir, balsam	Abies balsamea
X	Bg	birch, grey	Betula populifolia
	Bl	linden, big leaf	Tilia platyphyllos
X	Bn	butternut	Juglans cinerea
	Bp	birch, European white (or weeping)	Betula pendula
X	Bw	birch, white (or paper)	Betula papyrifera
X	By	birch, yellow	Betula alleghaniensis
	Cat	catalpa, northern (also called bean-tree)	Catalpa speciosa
X	Cb	cherry, black	Prunus serotina
	Cc	cherry, choke	Prunus virginiana
X	Cd	chestnut, American	Castanea dentate
X	CE	cedar, all	Thuja spp.
X	CH	cherry, any / mix	Prunus, spp.
	Cm	cherry, mazzard	Prunus avium
	Cp	cherry, pin (or wild red or fire)	Prunus pensylvanica
X	Cr	cedar, eastern red (redcedar)	Juniperus virginiana
	Cs	cherry, sour (or pie or sour red)	Prunus cerasus
	Ct	cucumber tree	Magnolia acuminate
X	Cw	cedar, eastern white- (also called northern white-cedar)	Thuja occidentalis
	Ema	mountain-ash, European	Sorbus aucuparia
	Er	elm, red (or slippery)	Ulmus rubra
	Eu	elm, rock	Ulmus thomasii

Interp	Code	Common Name	Scientific Name
X	Ew	elm, white (or American)	Ulmus Americana
X	EX	elm, any / mix.	Ulmus spp
	Gb	black gum	Nyssa sylvatica
	Gt	locust, honey-	Gleditsia triacanthos
	Haz	witch-hazel, American	Hamamelis virginiana
	Hb	hickory, bitternut (or swamp)	Carya cordiformis
	Hc	horsechestnut	Aesculus hippocastanum
X	He	hemlock, eastern	Tsuga Canadensis
X	Hi	hickory, all	Carya spp.
	Hk	hackberry	Celtix occidentalis
	Hl	hickory, big shellbark	Carya laciniosa
	Hm	hickory, mockernut	Carya tomentosa
	Hp	hickory, pignut (or red or sweet pignut)	Carya glabra
	Hs	hickory, shagbark	Carya ovata
	Ht	hawthorn	Crataegus spp.
X	Iw	ironwood (also called Eastern hop-hornbeam)	Ostrya virginiana
	Kk	Kentucky coffee tree	Gymnocladus dioicus
X	La	larch, eastern (also called Tamarack or American Larch)	Larix, laricina
X	La	tamarack *[= eastern larch]*	Larix laricina
	Lb	locust, black	Robinia pseudoacacia
	Le	larch, European	Larix deciduas
	Lj	larch, Japanese	Larix leptolepis
	Ll	linden, little leaf	Tilia cordata
X	LO	locust (black and/or honey)	Robinia spp.
	Mb	maple, black	Acer nigrum (Acer saccharam ssp.nigrum)
	Mf	maple, freeman	Acer X freemanii
X	Mh	maple, hard (= sugar maple)	Acer saccharum
X	Mh	maple, sugar (also called hard maple)	Acer saccharum
	Mm	maple, Manitoba (or box elder)	Acer negundo
	Mn	maple, Norway	Acer platanoides
	Mo	mulberry, red	Morus rubra
	Mp	maple, striped	Acer pensylvanicum
X	Mr	maple, red (also called soft maple)	Acer rubrum
X	Mr	maple, soft (= red maple)	Acer rubrum
X	Ms	maple, silver	Acer saccharinum

Interp	Code	Common Name	Scientific Name
	Mt	maple, mountain	Acer spicatum
X	MX	maple, any / mix	Acer spp.
	Ob	oak, bur	Quercus macrocarpa
	Obl	oak, black	Quercus nigra
X	OC	conifers, other	----------
	Och	oak, Chinquapin (or yellow)	Quercus muehlenbergii
X	OH	hardwoods, other	----------
	Op	oak, pin (or swamp)	Quercus palustris
X	Or	oak, red (or northern red)	Quercus rubra
	Os	oak, shumard's (or swamp red)	Quercus shumardii
	Osw	oak, swamp white	Quercus bicolour
X	Ow	oak, white	Quercus alba
X	OX	oak, any / mix	Quercus spp.
	Pa	pawpaw	Asimina triloba
X	Pb	poplar, balsam	Populus balsamifera
	Pc	poplar, Carolina	Populus X Canadensis
X	Pd	cottonwood, Eastern	Populus deltoids
	Pe	poplar, silver (or European white or white)	Populus alba
	Ph	poplar, hybrid	Populus
X	Pj	pine, jack	Pinus banksiana.
X	Pl	aspen, largetooth	Populus grandidentata
	Pn	pine, Austrian or black	Pinus nigra
X	PO	poplar, any / mix	Populus spp.
	Pp	pine, pitch	Pinus rigida
X	Pr	pine, red	Pinus resinosa
X	Ps	pine, scots	Pinus sylvestris
X	Pt	aspen, trembling	Populus tremuloides
X	Pw	pine, white *[eastern white]*	Pinus strobes
X	PX	pine, any / mix	Pinus spp.
	Red	redbud	Cercis Canadensis
X	Sb	spruce, black	Picea mariana
	Sc	spruce, Colorado (or blue)	Picea pungens
	Sk	spruce, koyama	Picea koyamai
	Sn	spruce, Norway	Picea abies
	Sr	spruce, red	Picea rubens
	Ss	sassafras	Sassafras albidum
X	Sw	spruce, white	Picea glauca

Interp	Code	Common Name	Scientific Name
X	SX	spruce, any / mix	Picea spp.
	Sy	sycamore	Platanus occidentalis
	Tp	tulip tree	Liriodendron tulipifera
X	Wb	walnut, black	Juglans nigra
X	Wi	willow, any / mix	Salix spp.

A1.16 OLEADSPC

Descriptive Name: Overstorey Leading Species

Definition: The *overstorey leading species* attribute indicates the most prevalent species in the forest stand (or in just the uppermost canopy layer if the stand canopy contains two or more distinct layers) based on its percentage of crown closure.

Format: character 3

- use the same coding as is listed in the OSPCOMP (overstorey species composition) attribute description
- must be species listed in the overstorey species composition (OSPCOMP)

Note: This leading species attribute replaces the working group attribute (WG) that was present in previous inventory products for determining the major species to manage for in a forest stand.

A1.17 OAGE

Descriptive Name: Overstorey Age

Definition: The *overstorey age* attribute contains the average age of the leading species of the dominant and co-dominant trees in the forest stand (or in just the uppermost canopy layer if the stand canopy contains two or more distinct layers).

Format: integer 3

A1.18 OHT

Descriptive Name: Overstorey Height

Definition: The *overstorey height* attribute contains the average height in meters of the dominant and co-dominant trees of the leading species in the stand (or in just the uppermost canopy layer if the stand canopy contains two or more distinct layers).

Format: numeric 4.1

A1.19 OCCLO

Descriptive Name: Overstorey Crown Closure

Definition: The *OCCLO* attribute contains the percent of crown closure of the forest stand (or of just the uppermost canopy layer if the stand canopy contains two or more distinct layers). Crown closure is defined as the percentage of ground area covered by the vertical projection of the tree crowns onto the ground.

Format: integer 3

- The maximum crown closure value is 100%.
- If an understorey crown closure value is entered, then the total crown closure for the two layers must never exceed 200% (i.e., OCCLO + UCCLO <= 200).

A1.20 OSI

Descriptive Name: Overstorey Site Index

Definition: *Overstorey site index* is a numerical expression of forest quality (forest site productivity) based on the height in meters, at a specified age (traditionally 50 years), of dominant and co-dominant trees in a stand (or in just the overstorey canopy layer if the stand canopy contains two or more distinct layers).

Format: numeric 4 2

Note: Completion of this attribute is to be phased in as site index lookup tables are developed.

A1.21 OSC

Descriptive Name: Overstorey Site Class

Definition: Site Class is the expression of the age height relationship of the leading species based upon Plonski's Normal Yield Tables and is expressed as 0, 1, 2, 3 or 4. The *overstorey site class* attribute is the site class value determined for the stand (or for just the uppermost canopy layer if the stand canopy contains two or more distinct layers) The OMNR will be responsible for the derivation of this attribute from the interpreted age and height values. For young stands (e.g., less than 20 years old) where the age and height can not be interpreted, a default value of 2 will be entered.

Format: integer 1

- a number from 0 through 4

CODE	OPTION	DEFINITION
0	Best	
1	Better	
2	Good	
3	Poor	
4	Protection Forest	Productive forest land on which forest management activities cannot normally be practiced without incurring deleterious environmental effects because of obvious physical limitation such as steep slopes or shallow soils over bedrock.

Note that zero is the default value for an integer field, so when performing a query to identify the best stands (site class = 0), be sure to include the polygon type attribute in the query (AND POLYTYPE = FOR) so that non-productive forest stands are not included in the query results.

There is a relationship between the site class (OSC, USC) and the productive forest modifier (FORMOD) values assigned to a forested area. Generally, areas assigned a site class value of 4 (protection forest) are also assigned a productive forest modifier value of protection forest (FORMOD = PF), but it is not a requirement. Areas assigned a site class value other than 4 (e.g., 3) can also be assigned the productive forest modifier value of protection forest. Conversely areas assigned a site class value of 4 may be assigned a productive forest modifier value of production forest (FORMOD = RP) instead of protection forest. The apparent discrepancy in the protection forest assignment

between the site class attribute and the productive forest modifier attribute reflects the difference between a calculated assessment of site conditions (OSC, USC) versus a timber management decision (FORMOD) that is based on more than just site class.

A1.22 UYRORG

Descriptive Name: Understorey Year of Origin

Definition: The *UYRORG* attribute is the year of origin for the understorey layer of the stand canopy.

Format: integer 4

- YYYY
- This is a calculated value. Understorey year of origin is calculated as the year of source minus the understorey age (i.e., UYRORG = YRSOURCE - UAGE).
- If the stand canopy has been determined to be two-tiered or multi-layered (refer to the VERT attribute), then an understorey year of origin value must be entered (i.e., UYRORG <> null).

A1.23 USPCOMP

Descriptive Name: Understorey Species Composition

Definition: The *understorey species composition* attribute identifies the tree species in the understorey canopy layer of the forest stand, along with the percentage of cover that each tree species occupies within the canopy.

Format: character 60

- repeating pattern of species code and corresponding proportion value
- each species code is 3 characters (including blanks) and is left justified
- each proportion is 3 characters which represents an integer value from 1 to 100 and is right justified. Note that initial inventory values determined by photo interpretation will not go below 10% and are rounded to the nearest 10% (e.g., 10, 20, 30). During inventory update, proportions based on subsequent field survey sampling that are of a finer resolution can be entered (e.g., go below 10% or be a value in between the initial rounded proportions such as 15).

- pattern is SSSPPPSSSPPP for example: PJ 80PO 20 (there are two blanks between the species and the proportion)
- maximum of 10 species and proportions pairs in the string
- no duplicate species codes allowed in the string
- proportion values in the string must sum to 100
- when two or more species have the same proportion then the species that appears to be more prevalent is listed first
- the species in the understorey composition are to be coded using the scheme listed in the OSPCOMP (overstorey species composition) attribute description.
- if the stand canopy has been determined to be two-tiered (VERT = TO, TU, MO, or MU), then an understorey species composition must be entered (i.e., USPCOMP <> null).

A1.24 ULEADSPC

Descriptive Name: Understorey Leading Species

Definition: The *overstorey leading species* attribute indicates the most prevalent species in the overstorey canopy layer of the forest stand based on its percentage of crown closure.

Format: character 3

- use the same species coding scheme as is listed in the OSPCOMP (overstorey species composition) attribute description.
- must be species listed in the understorey species composition (USPCOMP)
- if the stand canopy has been determined to be two-tiered (VERT = TO, TU, MO, or MU), then an understorey leading species value must be entered (i.e., ULEADSPC <> null).

A1.25 UAGE

Descriptive Name: Understorey Age

Definition: The *understorey age* attribute contains the average age of the leading species in the understorey canopy layer of the forest stand.

Format: integer 3

- if the stand canopy has been determined to be two-tiered (VERT = TO, TU, MO, or MU), then an understorey age value must be entered (i.e., UAGE <> null).

A1.26 UHT

Descriptive Name: Understorey Height

Definition: The *understorey height* attribute contains the average height in meters of the dominant and co-dominant trees of the leading species in the understorey canopy layer of the stand.

Format: numeric 4.1

- if the stand canopy has been determined to be two-tiered (VERT = TO, TU, MO, or MU), then an understorey height value must be entered (i.e., UHT <> null).

A1.27 UCCLO

Descriptive Name: Understorey Crown Closure

Definition: Crown closure is defined as the percentage of ground area covered by the vertical projection of tree crowns onto the ground. The *understorey crown closure* attribute contains the percent of crown closure of the understorey canopy layer of the forest stand. Each defined layer within a stand requires a crown closure. In the case of multi-layered or two-tiered stands, the total of crown closure for the two tiers must never exceed 200% (i.e., OCCLO + UCCLO <= 200).

Format: integer 3

- if the stand canopy has been determined to be two-tiered (VERT = TO, TU, MO, or MU), then an understorey crown closure value must be entered (i.e., UCCLO <> null).
- The maximum understorey crown closure value is 100%.
- The total crown closure for the two layers must never exceed 200% (i.e., OCCLO + UCCLO <= 200).

A1.28 USI

Descriptive Name: Understorey Site Index

Definition: Site index is a numerical expression of forest quality (forest site productivity) based on the height in meters, at a specified age (traditionally 50 years), of dominant and co-dominant trees in a stand. The *USI* attribute is the site index value determined for the understorey layer of the stand canopy. The OMNR will be responsible for the derivation of this attribute from the interpreted age and height. For young stands (e.g., less than 20 years old) where the age and height can not be interpreted, a default value of 2 will be entered.

Format: numeric 4 2

- if the stand canopy has been determined to be two-tiered (VERT = TO, TU, MO, or MU), then an understorey site index value must be entered (i.e., USI <> null). *

* **Note**: Completion of this attribute is to be phased in as site index lookup tables are developed.

A1.29 USC

Descriptive Name: Understorey Site Class

Definition: Site Class is the expression of the age height relationship of the leading species based upon Plonski's Normal Yield Tables and is expressed as a value from 0 to 4. The *understorey site class* attribute is the site class value determined for the understorey canopy layer of the stand. The OMNR will be responsible for the derivation of this attribute from the interpreted age and height values.

Format: integer 1

- a number from 0 through 4
- if the stand canopy has been determined to be two-tiered (VERT = TO, TU, MO, or MU), then an understorey site class value must be entered (i.e., USC <> null).

CODE	OPTION	DEFINITION
0	Best	
1	Better	
2	Good	
3	Poor	
4	Protection Forest	Productive forest land on which forest management activities cannot normally be practiced without incurring deleterious environmental effects because of obvious physical limitation such as steep slopes or shallow soils over bedrock.

Note that zero is the default value for an integer field, so when performing a query to identify the best stands (site class = 0), be sure to include the polygon type attribute in the query (AND POLYTYPE = FOR) so that non-productive forest stands are not included in the query results.

There is a relationship between the site class (OSC, USC) and the productive forest modifier (FORMOD) values assigned to a forested area. Generally, areas assigned a site class value of 4 (protection forest) are also assigned a productive forest modifier value of PF (protection forest), but it is not a requirement. Areas assigned a site class value other than 4 (e.g., 3) can also be assigned the productive forest modifier value of PF. Conversely areas assigned a site class value of 4 may be assigned a productive forest modifier value of production forest (RP) instead of protection forest. The apparent discrepancy in the protection forest assignment between the site class attribute and the productive forest modifier attribute reflects the difference between a calculated assessment of site conditions (OSC, USC) versus a timber management decision (FORMOD) that is based on more than just site class.

A1.30 INCIDSPC

Descriptive Name: Incidental Species

Definition: The *incidental species* attribute indicates a species that is viewable from photo-interpretation but is not normally found in the species string, but may be important for wildlife assessment or because of market or ecological value. For example, a scattering of small pockets of hemlock or cedar within a dominant sugar maple stand, or the presence of butternut in a white ash stand. Only one species can be recorded in this attribute. Incidental species is a management unit specific attribute. A list of

species (and priority ranking) that will be captured will be determined by the stakeholders at the pre-inventory meeting.

Format: character 3

- use the coding scheme associated with the overstorey species composition attribute (OSPCOMP) for a list of species codes
- can't be a code listed in the species composition attributes (e.g., Pw can't be listed in INCIDSPC and in either OSPCOMP or USPCOMP)
- during inventory production, if an incidental species is not identified by the stakeholders, then a value of NON will be entered

A1.31 VERT

Descriptive Name: Vertical Stand Structure

Definition: The *vertical stand structure* attribute indicates the number of distinct layers (stories) that can be identified in the stand canopy. A stand canopy is considered to have more than one story when at least two distinct layers are present of at least 3 meters in height difference or 20 years of age difference, and each distinct layer should occupy at least 10% of the total canopy crown closure for the stand. When more than one distinct layer/storey is identified, a full description is required for each storey (e.g., species composition, height, site class, etc.).

A veteran component (super canopy) that occupies less than 10% of the total canopy crown closure is not considered to be a distinct layer/storey, but the presence of these trees is acknowledged by selecting a vertical structure code containing the letter 'V', such as SV. In this case, a separate full description of the veteran component is not recorded, but the species and associate proportion of the veterans must be included in the species composition string for the storey nearest in height.

Format: character 2

CODE	OPTION	DEFINITION
SI	single storey	Mainly a single story stand.

CODE	OPTION	DEFINITION
SV	single storey with veterans	Mainly a single story stand with a veteran (super canopy) component representing less than 10% of the total crown closure for the stand.
TO	two-tiered - overstorey used to set DEVSTAGE	The stand canopy is composed of mainly two distinct layers that have at least 3 meters in height difference or 20 years of age difference, and each layer represents at least 10% of the total canopy crown closure for the stand. The overstorey is the layer used to assign the DEVSTAGE value during photo interpretation / inventory creation.
TU	two-tiered - understorey used to set DEVSTAGE	The stand canopy is composed of mainly two distinct layers that have at least 3 meters in height difference or 20 years of age difference, and each layer represents at least 10% of the total canopy crown closure for the stand. The understorey is the layer used to assign the DEVSTAGE value during photo interpretation / inventory creation.
MO	two-tiered with veterans - overstorey used to set DEVSTAGE	Mainly a two-tiered canopy with an additional veteran (super canopy) component of less than 10% of the total stand canopy crown closure. The overstorey is the layer used to assign the DEVSTAGE value during photo interpretation / inventory creation.
MU	two-tiered with veterans- understorey used to set DEVSTAGE	Mainly a two-tiered canopy with an additional veteran (super canopy) component of less than 10% of the total stand canopy crown closure. The understorey is the layer used to assign the DEVSTAGE value during photo interpretation / inventory creation.
CX	complex or continuous	A stand with a wide range of heights and ages to the point of no distinct layers being identifiable.

If the vertical stand structure is set to single story or complex (VERT = SI, SV, or CX), then a description of the stand is entered using only the overstorey attributes (e.g., OSPCOMP, OHT, OSC).

If the vertical stand structure is set to TO, TU, MO, or MU, then a separate description must be entered for each of the main canopy layers using the overstorey and understorey sets of attributes accordingly. Species composition information for the veteran layer, if present, is incorporated into the description of the storey closest in height.

A1.32 HORIZ

Descriptive Name: Horizontal Stand Structure

Definition: The *horizontal stand structure* attribute indicates the canopy structure of the forest polygon as a whole when viewed from above. The distribution of trees species and the presence of openings are assessed. If more than one condition is present, only the

most prevalent one is recorded. Note that for the purpose of photo-interpretation for inventory creation, an opening is defined as being at least 16 square meters.

Format: character 2

CODE	OPTION	DEFINITION
SS	single stem	mainly single stem canopy structure
SP	single patch	single patch distinct from the rest of the canopy
FP	few patches	two or three distinct patches
MP	multiple patches	several distinct patches
OC	openings common	openings common – 3 or more
OU	openings uncommon	openings uncommon - 1or 2

An example of the top view of each horizontal structure indicator code is presented in the following diagram. In this diagram openings in the canopy are represented by blank spots, and the dots (.) and the X's represent two different species.

SS	*SP*	*FP*	*MP*	*OC*	*OU*
…….. …….. …….. …….. …….. ……..	…….. ……XXX…….. ……..XXX…….. ……XXX…….. …….. …….....	…….. ……XXX…. …… …….. …….. XXXX…….. ……XXX…..	……..…….. …XXX….XXX….XX ……XXX…….. ……..…….....XXX XXX…….. ……	…. …… ….. … …. …. …….. … …… .. …… ……	…….. ……. ……. …… …….. …….. …. …….. …. …….

A1.33 PRI_ECO

Descriptive Name: Primary Ecosite

Definition: Ecosite is defined as an ecological unit comprised of relatively uniform geology, parent material, soils, topography, and hydrology and consists of related vegetation conditions. An ecosite description is a vegetation description related to major vegetative attributes influencing site productivity and biological legacy, and should be relatively stable over moderate periods (20-40 years). Ecosite is the primary unit for delineation for both the forested and non-forested land. A complex of two forested ecosites is allowed to be recorded when more than one ecosite is present as long as

the secondary ecosite represents at least 20% of the area of the polygon and the area associated with the secondary ecosite does not exist in a manner suitable for meeting the minimum polygon size for creating a new polygon. The *PRI_CODE* attribute indicates the primary or dominant ecosite present with in the stand.

- **Simple ecosite:** (i.e., only PRI_ECO completed) A polygon assigned a single ecosite label and assumed to have as much as 20% of the polygon consisting of acceptable inclusions (as defined by the fact sheet) or eco-elements other than those considered "diagnostic" of the ecosite.

- **Complex ecosite:** (i.e., PRI_ECO and SEC_ECO are completed) A polygon is assigned two ecosite attributes when one ecosite condition exceeds 50% of the polygon (primary ecosite) and another ecosite condition exceeds 20% of the polygon (secondary ecosite), and the secondary ecosite does *not* exist in a manner suitable for representation meeting minimum polygon size. A common example of complex ecosites for a polygon would be a very shallow pine/spruce mix not large enough to differentiate from the surrounding dominant stand of moderately deep aspen/birch mix.

For more information about ecosites, including a fact sheet for each ecosite description, refer to: "*Ecosystems of Ontario: Provincial Ecosites", May 21st, 2008, Ecological Land Classifications Working Group*.

Format: character 13

Ecosites are a maximum of 13 characters long. There are up to seven parts to each ecosite description; a series of case-sensitive codes and a number that are concatenated in a specific order. Each part has it's own coding rules. The parts are concatenated together in the following order:

Information	# of Characters
Geographic range	1
Ecosite number	3
Vegetative modifier	2 *
substrate **D**epth modifier	2 *

substrate **M**oisture modifier	1
substrate **C**hemistry modifier	1
vegetative cover clas**S** modifier	3 *

So the pattern is: GEEEVVDDMCSSS

* The vegetative modifier and depth modifier codes may be either 1 or 2 characters long. If only one character is entered, the second position is left blank. (The 13 character pattern must be maintained.) Likewise, the vegetative cover class modifier may be 1, 2 or 3 characters long.

If a particular section of information is not relevant to the ecosite, that position in the string is left blank. For example, substrate depth modifier information is not applicable for permanently flooded sites. In this situation, blanks will be inserted in the ecosite code string in the depth position so that the code maintains its overall 13 character length.

The minimum ecosite description is a combination of the first three parts: a geographic range, an ecosite number, and a vegetative modifier. Imagery interpretation can usually only determine the minimum ecosite description. Field sampling is required to determine some parts of an ecosite description. Note that this minimum description rule does not apply to ecosites having a geographic range of "U"; unclassified. These are generally just a range and number.

Information is recorded in each of the parts of an ecosite description as follows.

Geographic range: The province is divided into four areas primarily along ecoregion and ecodistrict boundaries. This division permits the use of a single ecosite key throughout Ontario. A single letter, uppercase code is used to represent each geographic range. A map of these geographic ranges is included after the description of the chemistry modifier. Areas having evidence of human presence (e.g., residential areas, commercial/industrial areas) are also identified. These areas are marked as "unclassified" regardless of their geographic location within the province.

Code	Option
A	Sub-arctic
B	Boreal
G	Great Lakes St. Lawrence (GLSL)
S	Southern
U	Unclassified (a special case scenario used by photo interpreters only)

Ecosite number: A three digit number representing the ecosite. Values range from 001 to 224, plus 997 to 999 for unclassified areas. Refer to the list of codes following the geographic range map. Numbers less that 100 are right justified and zero filled to maintain proper positioning within the overall ecosite description pattern (e.g., 075)

Vegetative modifier: A one or two character code used to describe, in general terms, the conditions existing at the site. Single character code values are uppercase; two character code values are mixed case.

Code	Option	Definition
Tt	Tall Treed	Tree species ≥ 10m tall
Tl	Low Treed	Tree species <10m tall
S	Shrub	tall or low shrub species
N	Not Woody	Any herbaceous or non vascular vegetation
X	Not Vegetated	<2% vascular cover, <10% bryophyte or foliose lichen cover, and unlimited crustose lichen cover

substrate **Depth modifier:** A one or two character code representing the depth of the material above bedrock. All code values are uppercase.

Code	Option	Definition
R	Rock	

VS	Very Shallow	
S	Shallow	Depth of unconsolidated mineral material > 15 cm to ≤ 30 cm over rock or bedrock
M	Moderate	Depth of unconsolidated mineral material > 30 cm to ≤ 60 cm over rock or bedrock
MD	Moderately Deep	Depth of unconsolidated mineral material > 60 cm to ≤ 120 cm over rock or bedrock
D	Deep	Depth of unconsolidated mineral material > 120 cm over rock or bedrock

* Imagery interpretation cannot precisely determine this value. .During photo interpretation, substrate depth modifier information is only recorded for ecosites in Keys 4 – 9 (i.e., codes 029 -125). Further, only a determination of the depth being over or under 120 cm can be made during interpretation, so only two depth classes are recorded, M (moderate) and D (deep), where moderate represents all of the field measured depth classes of shallow, moderate and moderately deep. That is:

- During photo interpretation, depths greater than 15 cm but less than 120 cm will all be classified as “M” for moderate.
- Depths greater than 120 cm will be classified as a “D” for deep. If field data is present to suggest shallower depths, then the modifier is set to moderate (e.g., patches of exposed bedrock, extreme changes in topography indicating bedrock control). In the absence of these characteristics, the modifier is set to deep (e.g., outwash/lacustrine plains, often morainal deposits etc).

Field data can be used to augment photo interpreted depth modifier information.

If the "source of data" attribute is set to digital image (i.e., SOURCE = DIGITALP), then the depth modifier was interpreted and will be either M or D only. If the "source of data" attribute is variable area plot (i.e., SOURCE = PLOTVAR), then the ground data may have been used to determine depth modifier, so the modifier may be any of the values; S, M, MD or D.

A depth modifier can not be determined for ecosites in Key 10, Permanently Flooded or Hydric ecosites (i.e., codes 126 - 156), based on photo interpretation only. When field data is used to augment photo interpretation, a depth modifier may be assigned based on the ground observations.

The depth modifier is not applicable for ecosites in Keys 2, 3, and 11-13 (i.e., codes 001 - 028, 157-221, and 997-999); the very shallow, rocky, anthropogenic, and coastal / tidal sites.

substrate Moisture modifier: A single character code indicating the amount of water that the material above bedrock is capable of holding. Imagery interpretation cannot determine this value. Information collected from field sampling has this value as part of the ecosite description. All code values are lowercase.

Code	Option
d	dry
f	fresh
h	humid
m	moist
s	saturated
v	very moist
w	wet
x	xeric

substrate Chemistry modifier: A single character code representing the general chemical characteristic of the material above bedrock.. Field sampling or other mapped data-sources are the only methods of collecting this information. Imagery interpretation cannot determine this value. All code values are lowercase.

Code	Option
a	acidic
b	basic

Code	Option
k	calcareous
n	non calcareous
z	saline

Chemistry modifier information is not applicable to Keys 12a and 12b, Anthropogenic ecosites (i.e., codes 189 -200 and 997-999).

All ecosites in Key 10, Permanently Flooded or Hydric ecosites (i.e., codes 126 - 156 and 222 -224), are assigned the chemistry modifier “n” (for non-calcareous) unless ground data supports a calcareous call for mineral soils within the hydric ecosites.

vegetative cover clasS modifier: A one, two or three character code providing a general indication of site productivity, percent cover and vegetation type. Imagery interpretation cannot determine this value. Single character code values are upper case; two and three character code values are mixed case.

Code	Option
cTt	closed tall treed
oTt	open tall treed
sTt	sparse tall treed
Tt	greater than 25% tall treed
Tl	greater than 25% low treed
sTl	sparse low treed
St	tall shrub
sSt	sparse tall shrub
Sl	low shrub
sSl	sparse low shrub
H	herbaceous
sH	sparse herbaceous
Nv	non vascular
X	not vegetated

An example of a full ecosite description would be:

which is: Boreal (*geographic range*), 055 (*ecosite number*), tall treed (*vegetative modifier*), moderate (*substrate depth modifier*), fresh (*substrate moisture modifier*), calcareous (*substrate chemistry modifier*), closed tall tree (*vegetative cover class modifier*); where 055 represents an aspen-birch hardwood.

Map of Geographic Ranges for Ecosite Coding

Ecosite Code Table

Key Number & Description	Ecosite Code	Ecosite Description
2 *Vertical or Active Mineral Ecosites*	001	Excavated Bluff
	002	Active Bluff
	003	Open Bluff
	004	Bluff
	005	Active Mineral Shoreline
	006	Active Sand Dune
	007	Active Mineral Barren
3 *Very Shallow Ecosites*	008	Very Shallow, Dry to Fresh: Meadow
	009	Very Shallow, Dry to Fresh: Sparse Shrub
	010	Very Shallow, Dry to Fresh: Shrub
	011	Very Shallow, Dry to Fresh: Red Pine - White Pine Conifer
	012	Very Shallow, Dry to Fresh: Pine - Black Spruce Conifer
	013	Very Shallow, Dry to Fresh: Hemlock - White Cedar Conifer
	014	Very Shallow, Dry to Fresh: Conifer
	015	Very Shallow, Dry to Fresh: Red Pine - White Pine Mixedwood
	016	Very Shallow, Dry to Fresh: Aspen - Birch Hardwood
	017	Very Shallow, Dry to Fresh: Oak Hardwood
	018	Very Shallow, Dry to Fresh: Maple Hardwood
	019	Very Shallow, Dry to Fresh: Mixedwood
	020	Very Shallow, Moist: Meadow
	021	Very Shallow, Moist: Sparse Shrub
	022	Very Shallow, Moist: Shrub
	023	Very Shallow, Moist: Red Pine - White Pine Conifer
	024	Very Shallow, Moist: Pine - Black Spruce Conifer
	025	Very Shallow, Moist: Hemlock - Cedar Conifer
	026	Very Shallow, Moist: Conifer
	027	Very Shallow, Moist: Red Pine - White Pine Mixedwood
	028	Very Shallow, Moist Mixedwood
4 *Dry, Sandy Ecosites*	029	Dry, Sandy: Field
	030	Dry, Sandy: Meadow
	031	Dry, Sandy: Sparse Shrub
	032	Dry, Sandy: Shrub
	033	Dry, Sandy: Red Pine - White Pine Conifer
	034	Dry, Sandy: Jack Pine - Black Spruce Dominated
	035	Dry, Sandy: Pine - Black Spruce Conifer
	036	Dry, Sandy: Hemlock - Cedar Conifer
	037	Dry, Sandy: Spruce - Fir Conifer
	038	Dry, Sandy: Conifer
	039	Dry, Sandy: Red Pine - White Pine Mixedwood
	040	Dry, Sandy: Aspen - Birch Hardwood
	041	Dry, Sandy: Oak Hardwood
	042	Dry, Sandy: Maple Hardwood
	043	Dry, Sandy: Mixedwood

Key Number & Description	Ecosite Code	Ecosite Description
5 Fresh, Sandy or Dry to Fresh Coarse Loamy Ecosites	044	Dry to Fresh, Coarse: Field
	045	Dry to Fresh, Coarse: Meadow
	046	Dry to Fresh, Coarse: Sparse Shrub
	047	Dry to Fresh, Coarse: Shrub
	048	Dry to Fresh, Coarse: Red Pine - White Pine Conifer
	049	Dry to Fresh, Coarse: Jack Pine - Black Spruce Dominated
	050	Dry to Fresh, Coarse: Pine - Black Spruce Conifer
	051	Dry to Fresh, Coarse: Hemlock - Cedar Conifer
	052	Dry to Fresh, Coarse: Spruce - Fir Conifer
	053	Dry to Fresh, Coarse: Conifer
	054	Dry to Fresh, Coarse: Red Pine - White Pine Mixedwood
	055	Dry to Fresh, Coarse: Aspen - Birch Hardwood
	056	Dry to Fresh, Coarse: Elm - Ash Hardwood
	057	Dry to Fresh, Coarse: Oak Hardwood
	058	Dry to Fresh, Coarse: Maple Hardwood
	059	Dry to Fresh, Coarse: Mixedwood
6 Moist, Sandy to Coarse Loamy Ecosites	060	Moist, Coarse: Field
	061	Moist, Coarse: Meadow
	062	Moist, Coarse: Sparse Shrub
	063	Moist, Coarse: Shrub
	064	Moist, Coarse: Red Pine - White Pine Conifer
	065	Moist, Coarse: Pine - Black Spruce Conifer
	066	Moist, Coarse: Hemlock - Cedar Conifer
	067	Moist, Coarse: Spruce - Fir Conifer
	068	Moist, Coarse: Conifer
	069	Moist, Coarse: Red Pine - White Pine Mixedwood
	070	Moist, Coarse: Aspen - Birch Hardwood
	071	Moist, Coarse: Elm - Ash Hardwood
	072	Moist, Coarse: Oak Hardwood
	073	Moist, Coarse: Sugar Maple Hardwood
	074	Moist, Coarse: Red Maple Hardwood
	075	Moist, Coarse: Maple Hardwood
	076	Moist, Coarse: Mixedwood
7 Dry to Fresh Clayey Ecosites	077	Fresh, Clayey: Field
	078	Fresh, Clayey: Meadow
	079	Fresh, Clayey: Sparse Shrub
	080	Fresh, Clayey: Shrub
	081	Fresh, Clayey: Red Pine - White Pine Conifer
	082	Fresh, Clayey: Jack Pine - Black Spruce Dominated
	083	Fresh, Clayey: Pine - Black Spruce Conifer
	084	Fresh, Clayey: Hemlock - Cedar Conifer
	085	Fresh, Clayey: Spruce - Fir Conifer
	086	Fresh, Clayey: Conifer
	087	Fresh, Clayey: Red Pine - White Pine Mixedwood
	088	Fresh, Clayey: Aspen - Birch Hardwood
	089	Fresh, Clayey: Elm - Ash Hardwood
	090	Fresh, Clayey: Oak Hardwood
	091	Fresh, Clayey: Maple Hardwood
	092	Fresh, Clayey: Mixedwood

Key Number & Description	Ecosite Code	Ecosite Description
8 Dry to Fresh Silty to Fine Loamy Ecosites	093	Fresh, Silty to Fine Loamy: Field
	094	Fresh, Silty to Fine Loamy: Meadow
	095	Fresh, Silty to Fine Loamy: Sparse Shrub
	096	Fresh, Silty to Fine Loamy: Shrub
	097	Fresh, Silty to Fine Loamy: Red Pine - White Pine Conifer
	098	Fresh, Silty to Fine Loamy: Jack Pine - Black Spruce Dominated
	099	Fresh, Silty to Fine Loamy: Pine - Black Spruce Conifer
	100	Fresh, Silty to Fine Loamy: Hemlock - Cedar Conifer
	101	Fresh, Silty to Fine Loamy: Spruce - Fir Conifer
	102	Fresh, Silty to Fine Loamy: Conifer
	103	Fresh, Silty to Fine Loamy: Red Pine - White Pine Mixedwood
	104	Fresh, Silty to Fine Loamy: Aspen - Birch Hardwood
	105	Fresh, Silty to Fine Loamy: Elm - Ash Hardwood
	106	Fresh, Silty to Fine Loamy: Oak Hardwood
	107	Fresh, Silty to Fine Loamy: Maple Hardwood
	108	Fresh, Silty to Fine Loamy: Mixedwood
9 Moist, Silty to Fine Loamy to Clayey Ecosites	109	Moist, Fine: Field
	110	Moist, Fine: Meadow
	111	Moist, Fine: Sparse Shrub
	112	Moist, Fine: Shrub
	113	Moist, Fine: White Pine Conifer
	114	Moist, Fine: Pine - Black Spruce Conifer
	115	Moist, Fine: Hemlock - Cedar Conifer
	116	Moist, Fine: Spruce - Fir Conifer
	117	Moist, Fine: Conifer
	118	Moist, Fine: White Pine Mixedwood
	119	Moist, Fine: Aspen - Birch Hardwood
	120	Moist, Fine: Elm - Ash Hardwood
	121	Moist, Fine: Oak Hardwood
	122	Moist, Fine: Sugar Maple Hardwood
	123	Moist, Fine: Red Maple Hardwood
	124	Moist, Fine: Maple Hardwood
	125	Moist, Fine: Mixedwood
10 Permanently Flooded or Hydric Ecosites	126	Treed Bog
	127	Poor Conifer Swamp
	128	Intermediate Conifer Swamp
	129	Rich Conifer Swamp
	130	Intolerant Hardwood Swamp
	131	Maple Hardwood Swamp
	132	Oak Hardwood Swamp
	133	Hardwood Swamp
	134	Mineral Thicket Swamp
	135	Organic Thicket Swamp
	136	Sparse Treed Fen
	137	Sparse Treed Bog
	138	Open Bog
	139	Poor Fen
	140	Open Moderately Rich Fen
	141	Open Extremely Rich Fen
	142	Mineral Meadow Marsh
	143	Rock Meadow Marsh

Key Number & Description	Ecosite Code	Ecosite Description
	144	Organic Meadow Marsh
	145	Floating Marsh
	146	Open Shore Fen
	147	Shrub Shore Fen
	148	Mineral Shallow Marsh
	149	Organic Shallow Marsh
	150	Open Water Marsh: Floating-leaved
	151	Open Water Marsh: Mineral
	152	Open Water Marsh: Organic
	153	Constructed Water Collections
	154	Active Limnetic Bedrock
	155	Active Limnetic Mineral
	156	Active Limnetic Organic
11 Rock Ecosites	157	Active Cliff
	158	Cliff
	159	Open Cliff
	160	Active Bedrock Shoreline
	161	Bedrock Shoreline
	162	Open Bedrock Shoreline
	163	Active Rock Barren
	164	Rock Barren
	165	Open Rock Barren
	166	Active Talus or Historic/Raised Beach
	167	Talus or Historic/Raised Beach
	168	Open Talus or Historic/Raised Beach
	169	Anthropogenic Coarse Shoreline
	170	Active Coarse Shoreline
	171	Coarse Shoreline
	172	Open Coarse Shoreline
	173	Calcareous Active Cliff
	174	Calcareous Cliff
	175	Calcareous Open Cliff
	176	Calcareous Active Bedrock Shoreline
	177	Calcareous Bedrock Shoreline
	178	Calcareous Open Bedrock Shoreline
	179	Calcareous Active Rock Barren
	180	Calcareous Rock Barren
	181	Calcareous Open Rock Barren
	182	Calcareous Active Talus or Historic/Raised Beach
	183	Calcareous Talus or Historic/Raised Beach
	184	Calcareous Open Talus or Historic/Raised Beach
	185	Calcareous Anthropogenic Coarse Shoreline
	186	Calcareous Active Coarse Shoreline
	187	Calcareous Coarse Shoreline
	188	Calcareous Open Coarse Shoreline

Key Number & Description	Ecosite Code	Ecosite Description
12a Anthropogenic Ecosites	189	Constructed Vertical Surface
	190	Industrial Waste
	191	Active Waste Disposal/Landfill
	192	Waste Disposal/Landfill
	193	Active Coarse Clean Fill
	194	Coarse Clean Fill
	195	Active Fine Clean Fill
	196	Fine Clean Fill
	197	Pavement/Concrete
	198	Compact Graveled Surface
	199	Compact Mineral Surface
	200	Other Materials
13 Coastal or Tidal Ecosites	201	Active Coastal Cliff
	202	Open Coastal Cliff
	203	Coastal Cliff
	204	Active Coastal Bedrock Shoreline
	205	Open Coastal Bedrock Shoreline
	206	Coastal Bedrock Shoreline
	207	Active Coastal Coarse Shoreline
	208	Open Coastal Coarse Shoreline
	209	Coastal Coarse Shoreline
	210	Active Coastal Bluff
	211	Open Coastal Bluff
	212	Coastal Bluff
	213	Active Coastal Mineral Shoreline
	214	Active Coastal Sand Dune
	215	Coastal Mineral Barren
	216	Salt Thicket Swamp
	217	Salt Poor Fen
	218	Open Salt Fen
	219	Salt Meadow Marsh
	220	Salt Marsh
	221	Open Salt Marsh
10 *(cont.)* *Flooded or Hydric*	222	Mineral Poor Conifer Swamp
	223	Mineral Intermediate Conifer Swamp
	224	Mineral Rich Conifer Swamp
12b Anthropogenic Ecosites	997	Commercial / Industrial Unclassified
	998	Utilities Unclassified
	999	Residential Unclassified

A1.34 SEC_ECO

Descriptive Name: Secondary Ecosite

Definition: Ecosite is defined as an ecological unit comprised of relatively uniform geology, parent material, soils, topography, and hydrology and consists of related vegetation

conditions. An ecosite description is a vegetation description related to major vegetative attributes influencing site productivity and biological legacy, and should be relatively stable over moderate periods (20-40 years). Ecosite is the primary unit for delineation for both the forested and non-forested land. A complex of two forested ecosites is allowed to be recorded when more than one ecosite is present as long as the secondary ecosite represents at least 20% of the area of the polygon and the area associated with the secondary ecosite does not exist in a manner suitable for meeting the minimum polygon size for creating a new polygon. The *SEC_ECO* attribute indicates the secondary or lesser (in terms of area) ecosite present with in the stand.

- **Simple ecosite:** (i.e., only PRI_ECO completed) A polygon assigned a single ecosite label and assumed to have as much as 20% of the polygon consisting of acceptable inclusions (as defined by the fact sheet) or eco-elements other than those considered "diagnostic" of the ecosite.

- **Complex ecosite:** (i.e., PRI_ECO and SEC_ECO are completed) A polygon is assigned two ecosite attributes when one ecosite condition exceeds 50% of the polygon (primary ecosite) and another ecosite condition exceeds 20% of the polygon (secondary ecosite), and the secondary ecosite does *not* exist in a manner suitable for representation meeting minimum polygon size. A common example of complex ecosites for a polygon would be a very shallow pine/spruce mix not large enough to differentiate from the surrounding dominant stand of moderately deep aspen/birch mix.

For more information about ecosites, including a fact sheet for each ecosite description, refer to: "*Ecosystems of Ontario: Provincial Ecosites", May 21st, 2008, Ecological Land Classifications Working Group*.

Format: character 13

- refer to PRI_ECO attribute for a list of valid codes
- can't be same code as recorded in PRI_ECO (i.e., PRI_ECO <> SEC_ECO)

A1.35 ACCESS1 and ACCESS2

Descriptive Name: Accessibility Indicator

Definition: The *accessibility indicator* attributes specifies whether or not there are any restrictions to accessing a productive forest stand. These restrictions may be legal (i.e., ownership), political / land use policy (i.e., land use designation, road closures), and/or a natural barrier. The focus of this field is identification of Crown productive forest stands that are inaccessible and therefore are not considered as part of the managed landbase for forest management planning purposes, but the principle may be applied to any area.

NOTE: These attributes are not completed by the photo interpreters during inventory production. Access restriction information is to be determined by the forest management planning team.

Format: character 3

- ACCESS1 and ACCESS2 can't contain the same value

CODE	OPTION	DEFINITION
GEO	geography	Area is not accessible due to geographic reasons. *
LUD	land use designation	An area is not accessible for forest management purposes due to land use designation (e.g., a provincial or federal park, agreement forest, mining claim, native lands, federal lands).
NON	no accessibility considerations	The area is accessible/reachable.
OWN	ownership	An area of Crown land that is unreachable because it is surrounded by lands owned by an other party/parties (e.g., an area of Crown productive forest land that is not accessible for forest management because it is surrounded by private land).
PRC	road closure	An area that is no longer accessible due to the permanent closure of the only road leading into the area.
STO	subject to ownership	An area of land that is owned by a party/parties other than the Crown (e.g., a parcel of private land) and where the access conditions are applied by the land owner. Note that ownership and access conditions can change over time.

* If the code of GEO is entered, then a management consideration attribute (MGMTCON) must be completed with the appropriate associated explanation/details, such as island or natural barrier. Refer to the MGMTCON attribute description.

A1.36 MGMTCON1, MGMTCON2 and MGMTCON3

Descriptive Name: Management Consideration

Definition: The *management consideration* attributes indicates whether or not ecological/landscape features or site conditions are present within the polygon. These features and conditions may require special consideration during resource management planning.

NOTE: The photo interpreters will only use the MGMTCON1 and MGMTCON2 attributes during inventory production. Use of the MGMTCON3 attribute is reserved for the forest management planning team.

Format: character 4

- If only one management consideration is entered, it is to be recorded in the MGMTCON1 attribute.
- The same value can't be entered in more than one of these attributes (i.e., MGMTCON1 <> MGMTCON2 <> MGMTCON3) except for the code "NONE". If MGMTCON1 = NONE, then MGMTCON2 and MGMTCON3 must also be "NONE"; and if MGMTCON2 = NONE, then MGMTCON3 = NONE.
- If the polygon is protection forest (FORMOD = PF), then at least one of the management consideration attributes must be set to something other than 'NONE'.
- If an accessibility indicator attribute is set to 'geographic reasons' (ACCESS1 or ACCESS2 = GEO), then the management consideration attributes can not all be blank/null or set to 'NONE'. At least one of the management consideration attributes must indicate the site condition that warranted the accessibility indicator be set to GEO.

CODE	OPTION	DEFINITION
COLD	permafrost	A site with poor or unstable growing conditions due to the soil being frozen year-round.
DAMG	physical/natural damage	A stand which contains trees that are damaged, dead and/or dying due to natural causes (e.g., ice damage, blowdown, insect/disease damage).
ISLD	island	The area is or is located on an island (i.e., an area of land that is totally surrounded by water).
NATB	natural barrier	A productive stand that is unreachable due to the physical features of the surrounding area (e.g., the area is a mesa or is productive forest surrounded by non-forested wetland).

CODE	OPTION	DEFINITION
NONE	no management consideration	There are no physical or ecological 'restrictions' in the site that need to be considered when determining management of the stand.
PENA	peninsula	An area of land that is nearly surrounded by water and is connected to the mainland.
POOR	stagnated, poor tree growth – no indicator	A stand exhibiting stagnated growth with no discernible cause for the poor growing condition.
ROCK	exposed bedrock / rocky outcrops	A site where the rocky conditions limit accessibility by forest management equipment and/or present a potential for soil erosion due to operations.
SAND	blow sand / exposed fine sand, shallow or no humus	A site where forest regeneration will be difficult due to the potential for erosion.
SHRB	heavy shrub / brush	A site where forest regeneration will be difficult without major silvicultural intervention due to shrub or brush competition.
SOIL	shallow soils	An area with minimal soil depth where forest regeneration will be limited as the site could be damaged or experience degradation due to operations (e.g., potential for root damage or erosion).
STEP	steep slopes	A site where the degree of incline is dangerous for equipment operation and presents a potential for erosion.
WATR	telluric / highly fluctuating, moving ground water	A site where forest regeneration will be difficult due to the potential of rising surface water.
WETT	poorly drained – high water table	A site where forest regeneration will be difficult due to the potential of rising water tables.

This attribute is used predominantly for productive forest stands (i.e., POLYTYPE = FOR), but is applicable for other polygon types of areas as well. For example, during inventory production all polygons which are located on an island are assigned a management consideration of island (i.e., MGMTCON1 = ISLD). Features or conditions other than island are also recorded for productive forest stands, but are not required for other types of areas (e.g., POLYTYPE = TMS) and thus are not recorded during the inventory production process.

A1.37 VERDATE

Descriptive Name: Verification Status Date

Definition: The *verification status date* attribute contains the date that the geographic unit was verified/validated.

Format: date 8

A1.38 SENSITIV

Descriptive Name: Data Sensitivity Indicator

Definition: The *data sensitivity indicator* attribute contains an indication of whether the geographic unit is classified as sensitive or not.

Format: character 3

- contains 'yes' or 'no'

A1.39 BED

Descriptive Name: Business Effective Date

Definition: The *business effective date* attribute contains the date that the record becomes effective in relation to the business (i.e., the date MNR became aware of its existence).

Format: date 8

Appendix 2 Softcopy : PurVIEW Requirements

The following is a list of the recommended hardware and software configurations currently required to run the PurVIEW extension for ESRI's ARCGIS ArcMap with the ADS40 SH52 imagery:

Hardware Option 1

- Performance 1 GIS workstation, HP xw4400 or equivalent
- 1TB additional internal hard drive with 90 degree drive end SATA cable
- NVIDIA Quadro FX1400 video card. (This technically is not currently available from NVIDIA as it is discontinued. Equivalents must be an Open GL quad buffered, PCIe card.). **Note: HDTV cards such as the FX 1500 will not work**.
- Eyewear and emitter, NuVision 60GX, available through http://www.nuvision3d.com/the60gx.html
- ViewSonic G90FB 19" CRT
- High resolution CRT monitors are becoming harder and harder to find as LCDs and HD monitors come onto the market. The CRT monitor must have a minimal refresh rate of 100 MHz with the optimal being at 120MHz. Any refresh rate under 100 MHz will not provide a acceptable viewing media.
- This configuration is one of the most economical stereo units available. The quality of the actual stereo viewing is good; however, being an active stereo display the constant light flicker can be tiring on the user's eyes over long periods of extended use.

Hardware Option 2

- Performance 3 workstation, HP xw8400 (LRC lease option)
- 1TB additional hardware drive with 90 degree end sata cable
- NVIDA Quadro FX 4600 or FX3500 – it must be an Open GL quad buffered stereo card, PCIe graphics card. ATI also makes compatible cards.
- Planar monitor at http://www.planar3d.com/3d-products/
  or True 3Di at http://www.true3di.com/
  The polarized monitor has a series of 2 non-active high definition LCD monitors, which are split with a polarized mirror which give the user a polarized stereo viewing opportunity. These units, which are akin to having two high definition televisions with stereo mirror technology,

offers one of the best stereo views in the market. If someone is planning to sit in front of this machine for 8 hours a day it is well worth it to invest in a high quality monitor. The Polarized glasses and the second video card required to operate the system are included with the purchase of the monitor.

Software

- ArcGIS 9.1 – 9.3; the complete suite.
- PurVIEW, including ADS sensor model, available through Ian Grady at IMT (i.grady@telus.net), or other commercial stereoscopic units listed below may also be used.
- Stereo Analyst by Leica, Socet for ArcGIS by Bae Systems, Stereo Capture Systems by DAT/EM, Summit Evolution from Inpho are other softcopy workstations that our associated internal and external partners are using.

Appendix 3 FRI Data Handling Tools

This appendix contains a series of instructions and tools that have been assembled by MNR Forest Resources Inventory staff in conjunction with contractors. These instructions and tools are designed to enhance the performance of working with ADS40 imagery for inventorying applications. A brief description of each instruction/tool, along with the problems that it was designed to fix, has been included. The instructions/tools discussed are:

1. stereo data imagery configuration
2. remapper
3. ODF translator
4. pyramidization
5. sub setting stereo pairs
6. flight line building tool

For a copy of these tools or for any additional information (beyond what is contained in this appendix), please contact:

Ian Sinclair, MNR, FRI Section, at: 705.946.7442 or ian.sinclair@ontario.ca

A3.1 Stereo Data Imagery Configuration

The delivered block of imagery should include a shapefile of the flight line index. This shapefile is required within ArcGIS to define the data view's projection.

The following is a summary of how to setup a folder to view the imagery for one particular flight line:

1. Create a project folder (e.g., Quetico), and create a subfolder SHAPEFILE_INDEX. Copy the flight line shapefile index into this subfolder.

2. Within your project folder (e.g., Quetico), create a subfolder representing this flight line (e.g., 06291336).

3. Within the subfolder (e.g., 06291336) create the following subfolders for 3-3 band products.
   (a) NRG (for the colour infrared stereo imagery)

(b) PAN (for the panchromatic stereo imagery)

(c) RGB (for the red, green, blue stereo imagery)

OR **To save storage space just create two subfolders, one being NRGB and the other PAN:**

(a) NRGB (for all the multi spectral imagery)

(b) PAN (for the panchromatic stereo imagery)

4. Within each of the subfolders created in the previous step, copy in the CAM folder as supplied. This folder contains a set of subfolders that hold the CAM files. These files are camera (.CAM extension) calibration files and PurVIEW is configured to search for these files when the ADS file is selected in ArcGIS' Data Frame Properties window.

5. Configure the CIR subfolder as follows:

   (a) Copy in the .ODF and .ODF.ADJ files supplied for this specific flight line. These files are orientation data files (.ODF extension) and adjusted orientation data files (.ADJ extension). To identify which files represent this flight line, the following are examples:

   - 0629133630103CIRB16A.ODF
   - 0629133630103CIRB16A.ODF.ADJ
   - 0629133630103CIRN00A.ODF
   - 0629133630103CIRN00A.ODF.ADJ

   The B16A and N00A portion of the filenames above refer to the camera's angle of view; B16A equals backward 16 degrees and N00A equals nadir 0 degrees.

   (b) Copy in the .ADS files supplied for this specific flight line. These files are a method of indexing the image files so multiple images can be referred to through one file. To identify which files represent this flight line, the following are examples:

   - L10629133630103CIRB16A.ADS
   - L10629133630103CIRN00A.ADS

   (c) Copy in the imagery files as supplied for this specific flight line. These are the actual TIF files and can range in size from 125MB to 700MB. To identify which images to copy, open the .ADS files from the previous step, in NotePad, and refer to the list of TIFs to copy.

(d) Copy in the .SUP files supplied for this specific flight line. These files are support files that contain the metadata associated with this flight line. To identify which files represent this flight line, the following are examples:

- L10629133630103CIRB16A.SUP
- L10629133630103CIRN00A.SUP

6. Configure the PAN subfolder as follows:

(a) Copy in the .ODF and .ODF.ADJ files supplied for this specific flight line. These files are orientation data files (.ODF extension) and adjusted orientation data files (.ADJ extension). To identify which files represent this flight line, the following are examples:

- 0629133630103PANB14A.ODF
- 0629133630103PANB14A.ODF.ADJ
- 0629133630103PANF02A.ODF
- 0629133630103PANF02A.ODF.ADJ
- 0629133630103PANF27A.ODF
- 0629133630103PANF27A.ODF.ADJ

The B14A, F02A and F27A portion of the filename refers to the camera's angle of view; B14A equals backward 14 degrees, F02A equals forward 2 degrees and F27A equals forward 27 degrees.

(b) Copy in the .ADS files supplied for this specific flight line. These files are a method of indexing the image files so multiple images can be referred to through one file. To identify which files represent this flight line, the following are examples:

- L10629133630103PANB14A.ADS
- L10629133630103PANF02A.ADS
- L10629133630103PANF27A.ADS

(c) Copy in the imagery files as supplied for this specific flight line. These are the actual TIF files and can range in size from 125MB to 700MB. To identify which images to copy, open the .ADS files from the previous step, in NotePad, and refer to the list of TIFs to copy.

(d) Copy in the .SUP files supplied for this specific flight line. These files are support files that contain the metadata associated with this flight line. To identify which files represent this flight line, the following are examples:

- L10629133630103PANB14A.SUP
- L10629133630103PANF02A.SUP
- L10629133630103PANF27A.SUP

7. Configure the RGB or NRGB subfolder as follows:
   (a) Copy in the .ODF and .ODF.ADJ files supplied for this specific flight line. These files are orientation data files (.ODF extension) and adjusted orientation data files (.ADJ extension). To identify which files represent this flight line, the following are examples:
      - 0629133630103NRGBB16A.ODF
      - 0629133630103NRGBB16A.ODF.ADJ
      - 0629133630103NRGBN00A.ODF
      - 0629133630103NRGBN00A.ODF.ADJ

      The B16A and N00A portion of the filename refers to the camera's angle of view; B16A equals backward 16 degrees, and N00A equals nadir 0 degrees.

   (b) Copy in the .ADS files supplied for this specific flight line. These files are a method of indexing the image files so multiple images can be referred to through one file. To identify which files represent this flight line, the following are examples:
      - L10629133630103RGBB16A.ADS
      - L10629133630103RGBN00A.ADS

   (c) Copy in the imagery files as supplied for this specific flight line. These are the actual TIF files and can range in size from 125MB to 700MB. To identify which images to copy, open the .ADS files from the previous step, in NotePad, and refer to the list of TIFs to copy.

   (d) Copy in the .SUP files supplied for this specific flight line. These files are support files that contain the metadata associated with this flight line. To identify which files represent this flight line, the following are examples:
      - L10629133630103RGBB16A.SUP
      - L10629133630103RGBN00A.SUP

8. Start ArcGIS and add the flight line shapefile index. Identify the flight line where you would like to view the imagery and record the LineID number (i.e. 629133630103).

9. View, Data Frame Properties window, PurVIEW tab
    (a) Model Select, select button
    (b) Navigate to subfolder where ADS files are (i.e. CIR, PAN or RGB)
    (c) Select first ADS
    (d) Open
    (e) OK
    (f) Activate PurVIEW

10. View, Data Frame Properties window, Coordinate System tab
    (a) Clear
    (b) Predefined
    (c) Projected Coordinate Systems
    (d) UTM
    (e) NAD 1983
    (f) NAD 1983 UTM ZONE 15N
    (g) Apply
    (h) OK

11. Model Fit button within PurVIEW toolbar and imagery should appear.

A3.2 Remapper

Remapper was designed to convert the 16bit stereo imagery into an 8bit stereo product that fits the user's specific needs. This tool is a MS DOS prompt based program that allows the user to select specific bands of data to create a customized view. For example, the default bands for the multi spectral data CIR would be 1:2:3, and for RGB would be 2:3:4. Remapper is capable of producing a 4 band .tiff file as well, which allows the user to toggle between IR and true color stereo products (ArcMap raster options settings, so you can use Tools>Options>Default combinations to choose which 3 out of the 4 bands to display).

The program is a simple DOS application. Simply unzip it to a folder of your choice (like C:\remapper). If you type remapper at the command prompt the usage will be echoed. If you add C:\remapper to your PATH variable, you can run remapper from any command prompt.

Here is a sample dos FOR loop that can be used to create CIR imagery from the 4-band:

```
for %i in (*.ads) do remapper %i -b 1:2:3 -d -c 90 -o OutputFolder
```

As you can see, it used a compression quality of 90; probably something like 97 might be more appropriate – experimentation is required. Of course, you would want to replace OutputFolder with the real path to where you want the new imagery written. **Note:** The new imagery will have the same name as the input imagery, it is up to the user to keep track of what they have done (most likely by using descriptive folder names).

NOTE that this program DOES NOT embed pyramids with the imagery. The good news, however, is that commanding Arc to batch pyramid the 8-bit imagery is MUCH faster than having it pyramid the 16-bit. So the need/convenience of having embedded pyramids becomes much less of a concern.

A3.3 ODF Translator

The .odf translator has been designed to adjust the header files so that the most recent kappa flag standards can be applied. The .odf translator is a MS DOS prompt to run in a batch and change the header files to adjust the standards. In software suites such Stereo Analyst this will be a required process otherwise one flight line will appear in Ontario and another possible much further east than its true location.

ODF Translator Instructions – BE SURE TO BACK UP THE ORGINAL .ODF AND .ODFADJ FILES PRIOR TO FOLLOWING THESE STEPS – JUST INCASE!

1- Unzip the ofd translator tool and then Double click the installer and follow the prompts (install in the default folder: C:\Program Files\ODFTool).

2. Program is now installed, but we need to update your computer's PATH variable (see Step 4).

3. Right-click "My Computer" and select "Properties" from the pop-up menu.

4. Select the "Advanced" tab and press the "Environment Variables" button (near the bottom).

5. Select the "PATH" variable and press "Edit".

6. Click on the very end of the “variable value” text (so that the cursor appears there).

7. Enter “C:\Program Files\ODFTool;” (without the quotes). Press OK.

8. Open a new DOS window.

9. Within the DOS window browse to the location of the ODF files you want to reflag (from radians to degrees).

10. Once there, type the following command (it will loop through all of the odf and odf.adj files, writing reflagged files with an additional .new extension):

    for %i in (*.odf,*.adj) do odftool -i %i -d -o %i.new

11. When the loop is done, create a new sub-folder called “backup”.

12. Move ALL of the .odf and .odf.adj files from the current folder to the backup folder.

13. Now you should only have .new files in the current folder.

14. Type the following command (to remove the .new extensions): Ren *.new *.

15. You’re done, nice job.

A3.4 Pyramidization

The speed in which the imagery refreshes or re-draws is based on the number of levels of pyramids that currently exist. ESRI currently only calculates the 1/4, 1/8, pyramids and does not calculate the ½ layer. PurVIEW currently requires these three levels for optimal performance. Full pyramids will take up to 33% more space than the original file. Further development is currently being conducted to design a tool that will allow the user to have four band images with full pyramids for 8 and 16 bit imagery.

A3.5 Sub Setting Stereo Pairs

The digital stereo pair products (Section 4.2.1.1) are originally delivered in full lines of imagery. If desired, the user may opt to customize the stereo coverage to a specific area of interest. Using the flighline setup mentioned earlier in the document will allow the user to build full stereo flighline models. This may not be the ideal solution for viewing and working with the imagery so if the user only deletes the undesired .tiffs from the imagery folder (pan or CIR, RGB or NRGB) then the model will only display the images contained within the folder. It is important to ensure that there are enough photos selected to account for the required overlap for the model to still provide stereo coverage.

A3.6 Flight Line Building Tool

This is a DOS based tool has been designed to take the raw delivered digital stereo pair imagery and configure it into flight lines for use with softcopy programs such as PurVIEW or Stereo Analyst. The tool has been designed to sort through the directories on the drive and capture all the .tiff, .rrd, .sup, .odf, .odfadj, and .ads files and then create a new folder for each flight line and transfer the affiliated files.

Glossary

Definition Source

If the definitions provided in this glossary have been taken fully, modified or adapted from an already existing source, it is indicated. References for these entries are abbreviated as follows:

AGI On-line dictionary of GIS terms by the Association for Geographic Information and the University Of Edinburgh Department of Geography (http://www.geo.ed.ac.uk/agidict/welcome.html).

ESRI On-line GIS Dictionary at Environmental Systems Research Institute (ESRI) Support Center website (http://support.esri.com)

FIM OMNR. June 2007. *Forest Information Manual*. Toronto: Queen's Printer for Ontario. 107 pp.

FMPM OMNR. June 2004. *Forest Management Planning Manual for Ontario's Crown Forests*. Toronto: Queen's Printer for Ontario. 440 pp.

FRI Forest Inventory Procedure for Ontario (1978)

U GIS ESRI. 1992. Understanding GIS: The Arc/Info Method

Definition/Term

Absolute Positional Accuracy

Absolute positional accuracy is a measure of the average discrepancy between the true National Grid positions of features and their surveyed positions in our data (map position). The true position is determined by a more accurate method than the survey capture method.

Area of the Undertaking

Area of the Undertaking (AOU) is an area consisting of approximately 385,000 square kilometres (or 38.5 million hectares) of Crown land, on which forest management activities are conducted in Ontario. Forest Management plans are prepared for management units within this area. [FMPM]

Barren and Scattered

Productive forest land which, because of natural or artificial disturbance, contains only scattered trees (stocking below 0.25) or no trees at all with either shrub cover or bare soil, but no significant amount of regeneration. Treatment is required to restore such areas to productivity. [FRI]

Base Features

Base features represent the geographic locations and descriptions of topographic, cultural, and cadastral entities of Ontario's landbase. They can be natural, physical features, such as lakes, rivers, wetlands, or they can be features of human influence such as hydro lines, gas pipelines, provincial highways, roads, and railways. They include areas which identify subdivisions of land, water, vegetation, environmental features, and other physical and administrative boundaries. Examples of this latter type of base features include forest management units and ownership parcels, which identify areas designated for legal, political, tax base, population base, land-use zoning, or management decision purposes. [FIM]

Calibration Plot

A calibration plot is a biased sample area established to aid the photo interpreter in classifying the stand characteristics in the immediate vicinity of the plot.

Continuous Inventory

A continuous inventory refers to a forest resource inventory that has a process in place whereby portions or all of the inventory are updated on a random or periodic basis to better reflect the changes that take place over time to the landbase. Technologies that are employed to enable this update may include ground surveys, air calls, GPS data capture and supplementary air photography. Many continuous inventories in place around the world today have a basis in ecological principles which helps ensure the long term viability and productivity of the landbase. Theoretically a continuous inventory does not need to be totally replaced by a newly captured inventory, but due to the varied concepts of a continuous inventory this may be included into the process.

Crown Land

Crown Land is land vested in Her Majesty in right of Ontario. [FMPM]

Forest Information Portal

The Forest Information Portal is an extranet (an internet site with user name and password security restrictions) available to MNR and the Licensees for the sharing, distribution and exchange of forest information and data. [FIM]

Forest Management Unit

A forest management unit is an area of Crown forest designated under section 7 of the *Crown Forest Sustainability Act*, 1994. [FIM]

Forest Resources Inventory

The Forest Resources Inventory (FRI) is a spatial product that provides description of all areas within a forest management unit and provides a snapshot in time of the characteristics of water and land base geography.

Layer

A reference to a spatial data source, such as a shapefile, coverage, geodatabase feature class, or raster image. [Source: modified ESRI]

Licensee

Licensee is the term used in this document to refer to Sustainable Forest Licensees, Plan holders, or other forest resource licence holders with forest management responsibilities. [FIM]

Map Projection

A mathematical model that transforms the locations of feature on the Earth's surface to locations on a two-dimensional surface. Because the Earth is three-dimensional, some method must be used to depict a map in two dimensions. Some projections preserve shape, others preserve accuracy of area, distance, or direction. Map projections project the Earth's surface onto a flat plane. However, any such representation distorts some parameter of the Earth's surface be it distance, area, shape, or direction. [Source: U GIS]

Metadata

Information that describes the content, quality, condition, origin, and other characteristics of data or other pieces of information. Metadata for spatial data may describe and document its subject matter; how, when, where, and by whom the data was collected; availability and distribution information; its projection, scale, resolution, and accuracy; and its reliability with regard to some standard. Metadata

consists of properties and documentation. Properties are derived from the data source (for example, the coordinate system and projection of the data), while documentation is entered by a person (for example, keywords used to describe the data). [Source: ESRI]

Patent Land

Patent land is land transferred from Her Majesty the Queen in the Right of Ontario to an individual, company or corporation in perpetuity. [FMPM]

Periodic Inventory

A periodic inventory refers to a forest resource inventory that is replaced by a new inventory on a periodic basis. Although every effort is made to ensure that this inventory is as accurate as technology of the time allows, there is no effort put into updating this product during its life cycle.

Polygon

- A closed shape defined by a connected sequence of x,y coordinate pairs, where the first and last coordinate pair are the same and all other pairs are unique. [Source: ESRI]
- A feature used to represent areas. [Source: AGI]

Polygon Forest

An information layer with a common area classification process used to delineate water polygons and land types into polygons based on the homogeneity of forest cover and vegetation. The area classification process creates a key forest cover description layer called the Polygon Forest. T he Polygon Forest contains water polygons and a description of the forest condition. [FIM]

Relative Positional Accuracy

Relative positional accuracy is a measure of the average discrepancy in distances between surveyed features approximately 60 meters apart.

Spatial Component

The spatial component of a geospatial data layer comprises the polygon geometry of polygon boundaries and labels. It has qualities that tie those polygons to a certain space on the world with a certain map projection (e.g., Transverse Mercator NAD83 with the ONT76 Adjustment).

Tabular Component

The tabular component of a geospatial data layer covers the associated attribute descriptions for each polygon that makes up the spatial component.