FOREST COVER MAPPING

Volume 1
Yukon Forest Classification/Field Sampling

Volume 2
Photogrammetric Transfer, Digital Forest Cover Map Production

Prepared by

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Forest Resources

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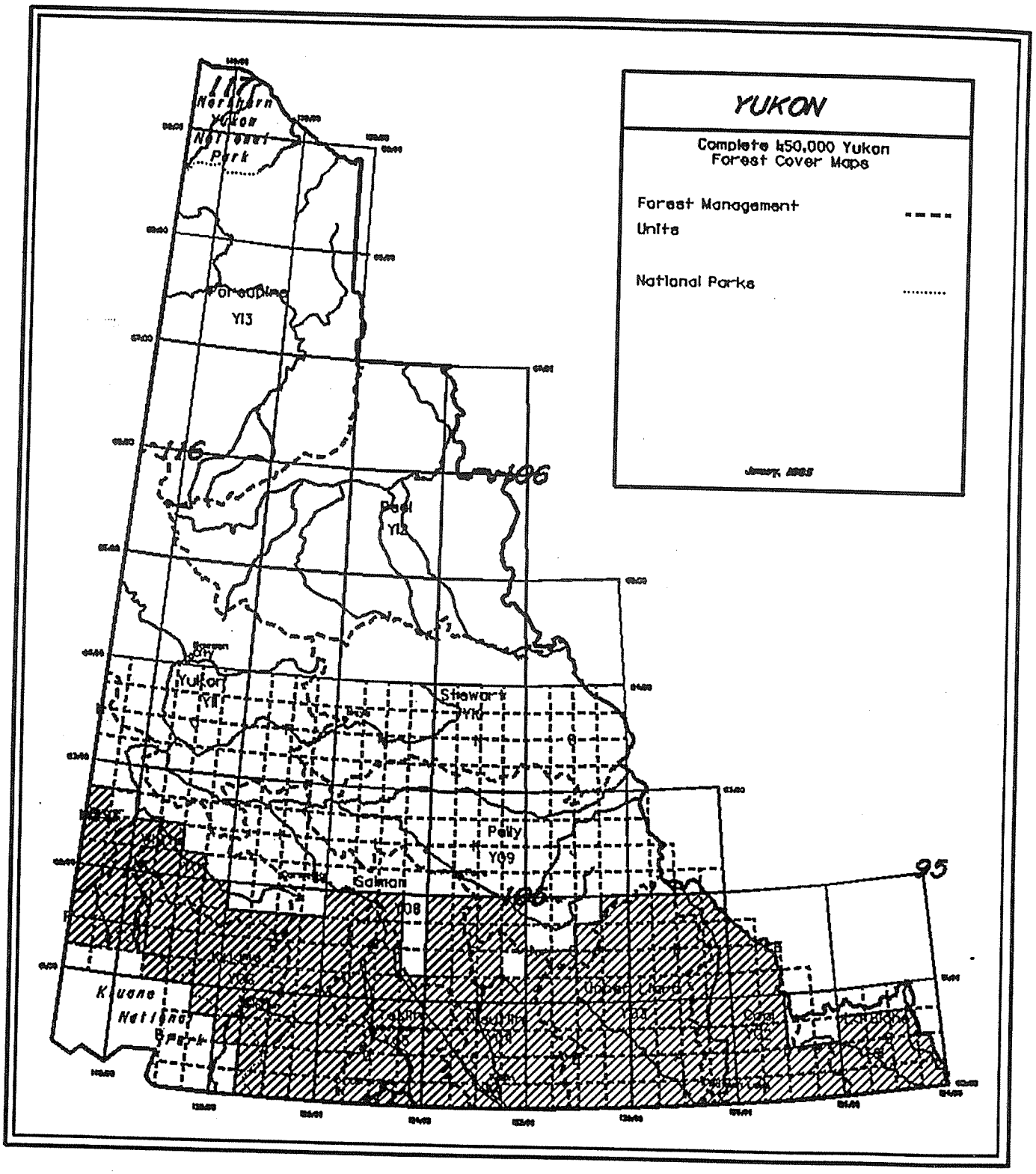
1.0 BACKGROUND ON YUKON FOREST INVENTORIES

The first forest inventories in the Yukon began in the 1950 and 1960's. These inventories were undertaken by the department of Fisheries and Forestry. A total of 58,000 km ^{2} was mapped at a variety of scales for the purpose of providing forest maps and volume data for the planning and control of industrial activity. Additional studies, centred in the Teslin and Watson Lake areas were undertaken during the fiscal year of 1968-69. These studies updated earlier estimates and provided more detail for operations.

The Gairns report of 1968 provided the first reconnaissance inventory of the Territory south of 66 degrees latitude. This inventory was based on previous reports and reconnaissance flights. The derived area and volume figures were adjusted for use in the national inventory in 1976 and 1981.

In 1982, the Northern Affairs Program, Forest Management Section evaluation identified, as a priority, the completion of a small scale reconnaissance inventory of the Yukon. In response to this, 1:250 000 forest cover maps were produced from medium scale photography (1:50,000-1:70,000) and satellite imagery. This inventory covered the entire Yukon and was completed by the Canadian Forestry Service and Forest Resources, DIAND with funding from the Energy From the Forest (ENFOR) program. The objectives of this inventory were to provide broad area, volume and biomass estimates for developing plans and policies; to identify areas for more intensive inventories; and to provide information for national inventory reporting. This inventory was completed between 1983 and 1986.

The 1982 Program evaluation also identified more detailed management type inventories as a second priority. In the fiscal year of 1985/86 approval was obtained to begin a management inventory at a scale of 1:50,000 to cover all land within the Yukon south of 64 degrees latitude. Figure 1 details forest cover mapping completed as of 1994.


YUKON
Complete 1:50,000 Yukon Forest Cover Maps
Forest Management Units
National Parks
Northern Yukon National Park
Porcupine Y13
Peel Y12
Yukon Y11
Stewart Y10
Pelly Y09
Selwyn
Kluane National Park
Quesnel Lake
95
106

1.1 Forest Classification

Forest Resource's forest classification methodology was developed in 1986 to guide the present forest cover mapping program. This methodology was based on British Columbia's Ministry of Forests Inventory Manual but has been modified to suit the needs of the Yukon.

1.2 General

The purpose of classification is to divide the land into recognizable homogeneous units based on well-defined criteria. In the Yukon, aerial photo interpretation for forest cover mapping utilizes 1:40,000 scale black and white aerial photography. Interpretation reflects a minimum polygon size of 25 ha which equates to an area of 1 cm^2 on the final forest cover map. Forest cover maps are produced at a scale of 1:50,000. Because 1:40,000 aerial photographs are used for forest interpretation, tree measurements are to a large extent obtained or estimated from several secondary sources including:

- ground samples
- air calls
- ground calls
- regeneration surveys
- LSP (Large Scale Photography) samples
- PSP (permanent sample plot) measurements
- previous vegetation mapping projects

Where current 1:40,000 coverage is not available, older photos of varying scales are used. At present, approximately 80% of the area scheduled to be inventoried within the Yukon has been flown within the last 8 years at a scale of 1:40,000.

1.3 Overview

The following document contains a description of criteria for classification of forested and non-forested land used by Forest Resources, Northern Affairs Program. Section 2.0 details definitions of and criteria for classifying forested land including productive forest land, not sufficiently regenerated land and non-productive forest land. Section 3.0 details definitions of and criteria for classification of non-forested land, section 4.0 addresses photo interpretation quality control, section 5.0 addresses field sampling and section 6.0 contains a brief discussion of how air photos are prepared for interpretation and how forest cover maps are produced.

2.0 FORESTED LAND

Land is classified as forest land if it is capable of, or is currently supporting a forest stand. Forest land is divided into 3 categories; productive forest, not sufficiently regenerated land and non-productive forest.

2.1 PRODUCTIVE FOREST LAND

A stand is defined as productive forest land if it is currently supporting a forest stand having a crown closure of greater than or equal to 15% (British Columbia Ministry of Forests, 1991). The following attributes are assigned to productive forest stands.

2.11 Species Composition

Species composition is the percentage of each tree species within the forest type. Species are listed in descending order according to their contribution to crown canopy. This is determined by estimates to the nearest 10% from the photo and where possible checked by flight calls and/ or ground truthing. Types are separated if species compositions differ by 10% or more. The species composition for each forest stand must sum to 100%.

Eight tree species are presently found in the Yukon. A single, unique, upper case letter describes each genus, and an upper and lower case letter describes the genus and species. The trees found in the Yukon are as follows:

TABLE 1: Tree Species Found With the Yukon Territory

Code	Species
A	trembling aspen (Populus tremuloides)
B	balsam poplar (Populus balsamifer)
F	fir (Abies lasiocarpa)
L	larch (Larix laricina)
P	lodgepole pine (Pinus contorta)
Sb	black spruce (Picea mariana) (map symbol s)
Sw	white spruce (Picea glauca) (map symbol S)
W	white birch (Betula papyrifera)

Species compositions are recorded on photo labels as a numeric subscript following the identified species. The subscript represents the percentage species composition divided by 10. For example, a stand composed of 80% white spruce and 20% lodgepole pine would be denoted by the label:

$$Sw_8\ P_2$$

2.12 Stand Height

Tree height is estimated for the leading tree species in the canopy based upon an average of dominant and codominant tree heights. Height is recorded to the nearest metre (+/- 1 metre) on the photo label. A stand will be separated into two or more types where the range of heights are 2 m or more (unless such a separation violates the minimum type size limitation). Tree heights are recorded on the photo as a single number for an even height stand or a range of heights with an average. For example:

Sw•12•30•120 - a stand comprised of greater than 90% white spruce 12 metres tall (± 1 metre) with a crown closure of 30% and an average age of 120 years

Sw•12(10-14)•30•120 - a stand comprised of greater than 90% white spruce with heights ranging from 10 to 14 metres, an average height of 12 metres, a crown closure of 30% and an average age of 120 years.

2.13 Crown Closure

Crown closure is the percentage of ground area covered by the vertically projected tree crowns. This percentage is estimated from photos and where possible checked by air calls and/or ground truthing. Stands are separated if the difference in the crown closure is greater than 5%. Crown closure is recorded to the nearest 5% on the photo labels. Stands are labelled with species composition, height, crown closure and age only if the crown closure is greater than or equal to 15%.

Note: see 2.4 for definitions of and labelling for stands having a crown closure of less than 15%.

2.14 Stand Age

Stand age is the average age of the dominant and codominant trees for the leading species. Age is determined to the nearest year when practical, otherwise to the nearest 10 years. Homogeneous strata are defined by 20-year differences, that is, separation between types is made if the difference in age is 20 years or more.

When ground or history information is not available, ages are estimated using qualitative site estimates and heights together with Yukon site index curves for spruce and pine and B.C.M.O.F curves for other species.

2.15 Stand Structure

Stand structure is the physical arrangement or pattern of organization within the forest stand. Stand structure is described and classified according to recognizable height differences.

The following stand structures are recognized:

1. Single-storied: An even aged stand which exhibits a more or less uniform canopy height. The stand usually originates from a short period of regeneration after a major disturbance. The majority of forest stands in the Yukon have a single-storied stand structure.

2. Two-storied: A stand with two distinct, homogeneous layers, each with at least 10% crown closure, between which there is a height difference of at least 10 metres. Such a stand can result when, following a disturbance aspen colonizes a site and after a period of years an understorey of spruce begins to develop. The stand is described by the attributes for the layer that has the greater basal area. The more important species is listed first, separated by a slash from the species in the other layer. The angle of the slash indicates which species is taller. For example:

A/Sw - Aspen overstory is of greater importance.
Sw\A - Spruce understory is of greater importance.

3. Complex: A stand characterized by trees of many ages or sizes occurring singly or in groups. Tree species are usually shade tolerant. Stocking is frequently patchy and uneven, and the number of trees in each size class often decrease as tree size increases. A complex stand is often caused by microsite variations such as soil drainage in permafrost areas or by rivers that frequently change their channels. To describe such stands one should identify the height and age of the "average tree". When sampling, select 5 to 6 sample trees representative of the stand and which approximate the contribution of the various height classes to crown canopy, and average the measurements obtained. Record the height range in brackets following the average height. For example:

Sw_{10}•20 (4-25)•15•100 - a stand comprised of greater than 90% spruce with heights ranging from 4 to 25 metres, an average height of 20 metres, a crown closure of 15% and an average age of 100 years.

2.3 NOT SUFFICIENTLY REGENERATED

Not Sufficiently Regenerated (NSR) areas are potentially productive sites which are presently understocked due to a disturbance (ie. fire, harvesting). These sites contain less than 750 well spaced seedlings or saplings per hectare in stands 20 years old or less.

After a major disturbance (fire, logging, windthrow) a site will be classified as NSR until a survey indicates that the site is stocked. The NSR label must include type of disturbance, the site class and if possible the year of disturbance. The site class of an NSR stand is estimated from residual vegetation, landform, elevation, slope and available moisture. The type of disturbance is illustrated using history symbols. Good (G), medium (M) and poor (P) NSR polygons are included in the productive forest land base because they will grow a merchantable stand of timber. NSR low (L) polygons are excluded from productive forest land.

2.31 Classification of Disturbances

A disturbance results from an event, such as fire or harvesting, that causes tree mortality or tree removal (British Columbia M.O.F., 1991).

Disturbance boundaries must be delineated on the air photos and the type or cause of disturbance and the year of disturbance identified. When the cause of disturbance has been identified the stand is then assigned a history symbol and, if polygons are still NSR, a site class. Disturbance boundaries are defined using the most reliable source documents. These include:

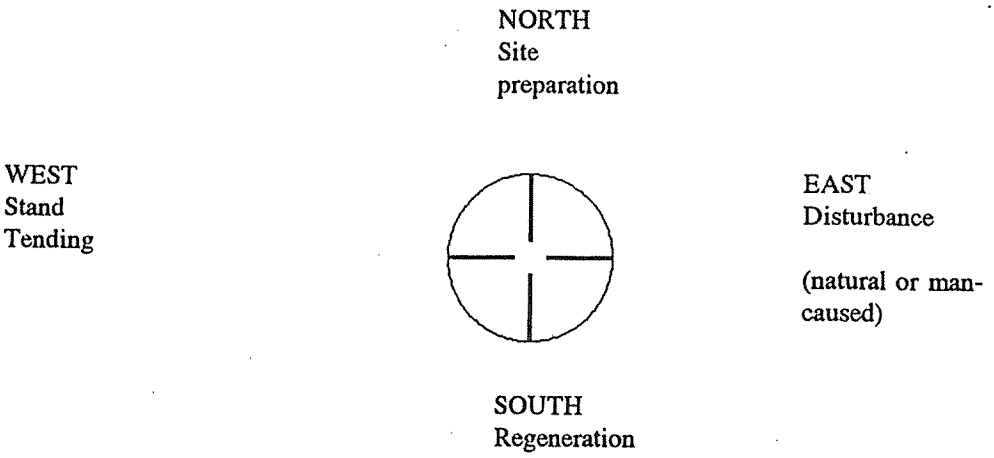
a) Recently flown aerial photography.
b) Satellite imagery.
c) Forest district history maps

Type and year(s) of disturbance may be determined by:

a) Ground truthing.
b) District fire history maps and history files.
c) Satellite imagery.

2.32 History Symbols

History symbols provide a simple graphic portrayal of the events that have occurred on an area over time. The basic structure of the history symbol is a circle with four radii, each representing a disturbance or treatment.



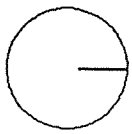
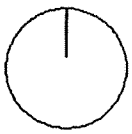
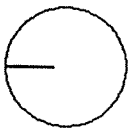
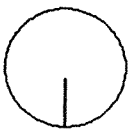
At the end of each radius the type and year of activity are shown by a letter code with a year:

For example:

L78 (logged in 1978)

The following is a listing of types of disturbances and activities recognized, together with their appropriate symbols and codes:

TABLE 7: Disturbance Symbols and Codes

CLASS AND SYMBOL	TYPE	CODE	COMMENTS
Disturbance			
	Logging	L	Includes all methods of logging
	Wildfire	B	Includes all natural burns and escapes from prescribed burns.
	Windthrow	W	
	Insect	I	See following for list of insects recognized.
	Disease	D	See following for list of diseases recognized.
	Slide	S	
	Flooding	F	
Site Preparation			
	Mechanical	M	
	Broadcast Burn	B	Prescribed burns only (not to include escapes)
	Spot burn	S	(as above)
	Chemical	C	
Stand Tending			
	Juvenile spacing	J	
	Brushing & weeding	W	
	Conifer release	R	
	Sanitation spacing	S	
	Pruning	P	
	Commercial	T	
	Fertilization	F	
Regeneration			
	Planted	P	Species planted or seeded shown in type label.
	Seeded	S	

The time of action can be shown in one of the three following ways for each of the activities:

A. Single date (1978): record as 78
B. Multiple date (1978, 1980): record as 78, 80
C. Continuous date (1978 - 1980): record as 78 - 80

For Example:

M75 (single date)

 L72-74 (continuous date)

P76,78 (multiple date)

When a NORTH or SOUTH radius has more than one activity, separate each one by a comma.

For Example:

M74,S75

P76,79

When an EAST or WEST Radius has more than one activity, list subsequent activities below the initial one.

For Example:

(Brushing and weeding)
W75
(Juvenile spacing) J84

B72 (Wildfire)
L73 (Logging)

2.33 History Codes for Insects And Disease

Unlike the effects from other disturbances, trees under attack by insects or disease may recover either partially or fully. The degree of recovery depends on such factors as stand age and condition, tree species, insect species, disease organism, intensity of attack, etc. The degree of insect infestation or the presence of disease is coded subjectively as follows:

TABLE 8: Degree of Disease Infestation

Light	1
Moderate	2
Heavy	3
Past Occurrence	4

When possible, the insect or disease responsible for the disturbance is also identified and entered as a code. See code list below for a description of each insect species.

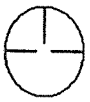
TABLE 9: Insect Codes

TYPE	INSECT SPECIES	CODE #
Defoliating Insects	Forest Tent Caterpillar - Malacosoma disstria	1
	Larch Budmoth - Zeiraphera improbana	2
	Larch Sawfly - Pristiphora erichsonii	3
	Large Aspen Tortrix - Choristoneura conflictana	4
	Aspen Leaf Miner - Phyllocnistis populiella	5
	Spruce Budworm - Coristoneura fumiferana	6
	Spruce Bark Beetle - Dendroctonus rufipennis	8
Sucking Insects	Balsam Wooly Aphid - Adelges piceae	9
	Cooley Spruce Gall Aphid - Adelges colleyi	10

TABLE 10: Disease Codes

DISEASE	CODE
Root Rots	1
Foliage Diseases	2
Needle Rusts (Chrysomyxa spp.)	3

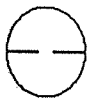
Descriptions for insect infestations or the presence of disease organisms are symbolized and coded as follows:



Activity, Years, (degree-species)

Activity - I for insect infestation or D for disease
Years - date of activity
Degree - degree of activity (1,2,3,4)
Species - insect or disease code.

For Example:



I, 78-79 (2-8) - An insect infestation in 1978-79 with moderate activity by the spruce bark beetle

2.34 Site Class

Site classes indicate the relative productivity of a forest site. The Yukon forest site classes are based on the site index of the predominant tree species (dominant and codominants) at reference age 100. Site index is the top height of the leading species at a specified reference age. Where ground information is available, site index may be determined from age over height according to Yukon site curves for spruce and pine or through reference to B.C.M.O.F curves for other tree species. Where there is no predominant forest cover on a potentially productive site, the site index of the tree species best suited to the site will be estimated. If no ground information is available site index and site class may be qualitatively estimated by an interpreter from landform, elevation, available moisture, species occurrence and tree appearance. Site Classes are defined as follows:

TABLE 6: Site Classes and Definitions

CODE	SITE CLASS	DEFINITION
G	Good	20m and over @ 100 yrs, recent alluvium, good drainage and fertility
M	Medium	15 to 19 @ 100 yrs, generally lower slopes, few limitations to growth
P	Poor	10 to 14m @ 100 yrs, generally uplands, growth limited by wet or dry sites, coarse textured soils, poor fertility or exposure
L	Low	Less than 10m @ 100 yrs, uplands or lowlands, limited by very wet or dry sites, low fertility, shallow or cold soils or exposure. Low sites with less than 15% crown closure are classified as non-productive forest.

Yukon site curves for spruce and pine are included in Appendix A and B.

2.4 NON-PRODUCTIVE FOREST

A forest stand is identified as non-productive if the crown closure is less than 15%. This stand is then assigned the attribute NP (non-productive). If the area has been burned a history symbol is assigned with details of when the area was burnt. The non-productive symbol is also used to classify areas having no trees but only if that area is grassed or is a shrub meadow (see section 3.0 for definitions of other non-forest land descriptions).

3.0 NON-FOREST LAND

In addition to non-productive forested land (forest stands with less than 15% crown closure), specific types of non-forested land are also identified for mapping. Non-forest land is land that is either incapable of growing a merchantable stand within a reasonable length of time or land that has been cleared and maintained for uses other than forestry.

Non-forest land is separated out into the following classes:

TABLE 11: Non-forest classes, descriptions and symbols

Class	Description	Symbol
Alpine	Land above timberline, glaciers, snow pack, rock	A
Wetlands	muskegs, bogs, swamps, marshes	W
Non-productive	grassland, brushland, sand or gravel with no forest land potential	NP
Rock	rock below alpine	R
Urban	Developed land: powerline, pipeline, road and railway right-of-ways, mines gravel pits, industrial sites, and municipalities	U
Cultivated	Land managed for agricultural purposes	C
* Lake	Lakes greater than 1cm^2	L
* River	Double line rivers	RIV

* Note: Lakes and rivers are not generally classified on the aerial photos unless the border of a lake or river is difficult to distinguish on the photo or if a border of water has changed significantly from the border found on the NTS base map. These symbols are generally only entered into forest cover database and will not be found on the photos.

4.0 QUALITY CONTROL STANDARDS FOR PHOTO INTERPRETATION

A field visit by the interpreter is required so that the interpreter may become familiar with the area. The field visit is to occur after the interpreter has reviewed the available ground information and photo observations. It is required that interpretation be based on information gathered through ground and air calls as well as field plot information.

Quality control for interpretation will be conducted as follows. 6 photos per mapsheet will be randomly selected for audit. The polygons on the south portion of these photos will be numbered and audited for both the location of polygon as well as the assigned polygon attributes. Interpretation will be judged by the following criteria:

Species composition $\pm$ 10% actual
Height $\pm$ 1 metre actual
Crown Closure $\pm$ 5% actual
Age $\pm$ 10 years actual
Stand Structure - must always be correct.
Non-forested identification (natural) - must always be correct.
Non-forested identification (anthropogenic) - must always be correct.
Polygon size - must always be correct
legibility - must be readable at all times

The acceptance accuracy from the photo interpretation audit must be $\geq$ 80%

Interpretation and field survey audit - submission #1

Contractor: Interpreter: Date of Audit: Page of

Attribute	Weight	NUMBER OF PHOTOS SAMPLED FOR AUDIT:																								Weighted (W)
		SUMMARY OF INTERPRETATION AUDIT Total number of polygons checked:____																								
Species composition	3.0																									
Height	1.5																									
Crown Closure	1.5																									
Age	1.5																									
Stand Structure	1.0																									
Non-forested identification (natural)	1.5																									
Non-forested identification (anthropogenic)	1.0																									
Polygon size	3.0																									
Legibility	3.0																									

This page: W =
Carried total: W =
Total: W = ____

Accuracy = [1 - ____W____] = %
Total # of polygons checked

Must be included with submission for acceptance. Comments:

Acceptance ≥ 80%

Plot # _____
Legibility _____
Increment cores _____
Correct age count _____
Tally sheets _____
Field plots _____

I hereby certify that this quality control audit has been completed and this work meets or exceeds the contract specifications.

Authorized Company Signing Official: _____ Date:_____

Increment cores gathered while field sampling will be recounted and field plot data will be checked for accuracy and completeness. Both will be compared to polygon attributes to ensure that the field data agrees with the interpreted attributes. If field data does not agree with interpretation, interpreted photos will be returned for editing.

Results of the audit will be tabled, summed and the work will be accepted or sent back to the contractor for correction based on the percentage correct. Interpretation will be accepted if the interpretation audit accuracy is 80% or greater.

Interpretation must extend 1/2 of an air photo past the 1:50,000 mapsheet border both horizontally and vertically.

All submissions of interpretation will include a quality control audit form which will be signed by the Contract manager (See page 18, Interpretation and field survey audit - submission #1).

5.0 FIELD SAMPLING

Contractor will be required to establish a number of variable radius plots which will be used by Forest Resources to audit forest cover interpretation.

Depending on the amount of forest cover up to 20 field plots will be established within each mapsheet to be interpreted.

Distribution of field plots within a 1:50,000 mapsheet are as follows:

% of Mapsheet Forested	Number of Plots Required
61+ %	20
41-61	12+
21-40	8+
0-20	4+

Field plots are to be distributed uniformly, in productive forest stands. The sampling must cover the variation in forest cover on the mapsheet.

Field plots are to be established in the following manner:

i. The selected tie point is to be flagged with two colours of flagging (orange and blue). The plot number, distance and bearing to the plot and the date are to be written on the flagging with indelible marker.

ii. The route into the plot is to be flagged sparingly with orange flagging.

iii. The plot centre is to be marked with a stake, a minimum of 1m in length, and flagged with two colours (orange and blue). The plot number is to written on the flagging.

iv. All field plots are to be variable radius plots. The basal area factor is to be selected so that a minimum of 7 trees are in the plot.

v. The following information is to be recorded about the plot:
- basal area factor
- forest management unit
- NTS mapsheet number
- plot number
- date
- stand number
- stratum
- UTM coordinates
- aerial photograph number
- ecoregion
- crew names
- distance and bearing from the tie point to the plot

Note: stand number and stratum code must be added after forest cover map has been produced and stratum codes have been generated.

vi. The following information is to be recorded for the trees in the plot:
- tree number
- species
- diameter breast height
- height, a minimum of three trees, two co-dominant and one dominant of the leading species, are to be measured, the remainder of the trees are to have their height estimated
- pathological remarks
- crown class
- age and ten year growth increment for two co-dominant and one dominant of the leading species

Field sheets will by supplied by Forest Resources. Tally sheets are to be completed neatly and legibly in full.

Increment cores obtained during field data collection are to be retained and delivered to the contract inspector upon completion of classification. Individual increment cores are to be delivered in a straw that clearly identifies tree number, plot number, 1:50,000 mapsheet, latitude and longitude. Increment cores collected must be included with each interpretation submission. All increment cores must be counted to within +/- 5 years of actual. All interpreter field tally sheets for field plots established in submission area must be included

with an interpretation submission. All contents of interpretation submission must be neat, clear and written legibly. If any writing is illegible the submission will be returned to the contractor for correction/clarification.

Field plot locations and plot numbers will be labelled on the 1:50,000 forest cover maps by the contractor.

Pin holes are made through the photos at each field plot location, and the plot number is recorded on the front and back of the photo. Plot numbers are consecutive six digit numbers with the first two digits being the year and the following four digits being the plot number (ie. '950001'). Forest Resources will provide the contractor with a series of plot numbers to be used. These numbers are to be inked in black on the base adjacent to a black "x". A standardized tally sheet is used to record field measurements. It is essential that the tally sheet be completed in full for each plot.

5.1 Field Sampling Standards

No trees in the plot may be blazed or cut; all tree marking will be done with paint.

Tree Measurement:

Species identification	• All trees must be identified correctly
Breast height	• ± 5 cm of the true breast height
Diameter at breast height	• (1.3 metres above the ground on the uphill side of the tree). A dbh stick should be used to ensure an exact determination of breast height. Diameter will be record to the nearest 1 mm. Maximum permissible error on any tree is ± 3mm.
Total height of Tree	• Total height of tree must be recorded to the nearest 0.1 metre. The maximum permissible error ± 1.0 metre for trees 19 metres in height and taller, and ± 5% for trees less than 19 metres tall.
Age	• Ages are measured to the nearest 1 year.

Ten Year Growth	• Measure and record the radial increment of the last 10 years to the nearest millimetre.
Crown Closure	• ± 10% for ground measurements

Mapping:

Bearing	• ± 2 degrees when using a staff compass or ± 4 degrees when using a Silva compass.
Distance	• ± 2% of the true horizontal distance.

Audits on field work must show accuracy of ≥ 90% for acceptance.

6.0 PREPARATION OF PHOTOS AND PRODUCTION OF FOREST INVENTORY MAPS

6.1 Photo Preparation

1. Orient photos. Mark each photo with north arrow indicating direction of true north
2. Mark principal (pp) and conjugate points (cpp) on each photo.
3. Delineate area to be interpreted on every other photo (see 6.2)
4. Stereoscopically transfer and extend type boundaries from adjacent photos to ensure consistent typing.

6.2 Delineation of Photo Effective Area

1. Draw straight vertical line through the right hand conjugate principal point on starting photo.
2. Stereoscopically transfer this vertical line to left side of the next photo to be interpreted (every other photo is interpreted working in an east to west line).
3. Draw a straight horizontal line on the north side of the air photo half way between the borders of and the sidelap of the adjacent lines. Transfer this line stereoscopically to the south portion of the adjacent photo.

6.3 Photo Interpretation Steps

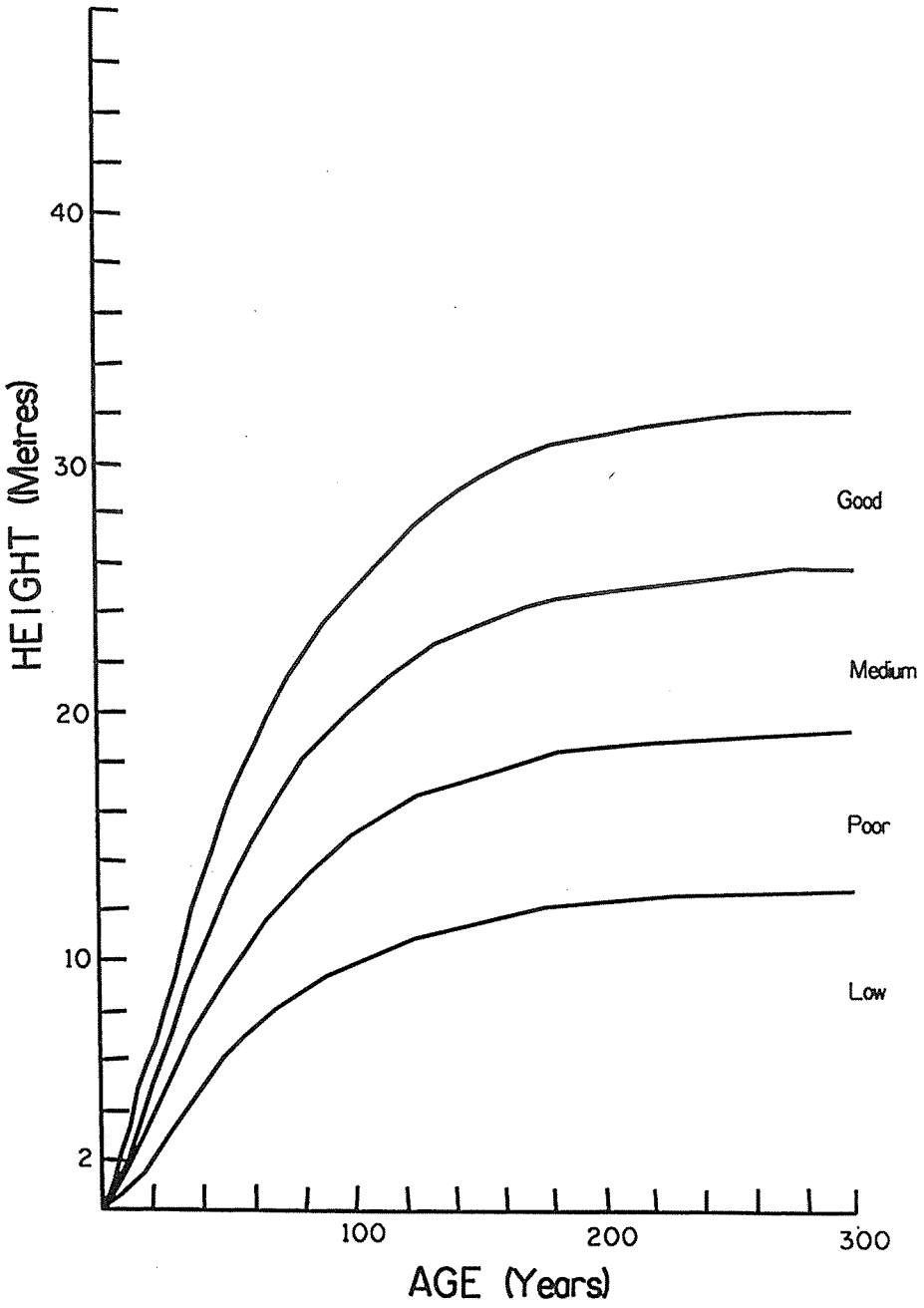
1. Draw flight lines on the airphotos to be interpreted and on the 1:250 000 NTS mapsheet covered by the air photos.
2. Make preliminary flight along flight lines checking vegetation types. Stands will be ground truthed at photo interpreters discretion.
3. Begin interpretation by delineating stand boundaries and assigning polygon attributes
4. Draw new flight lines if needed on photos and accompanying 1:250000 NTS mapsheet.
5. Ground truth, and refly area checking accuracy of stand boundaries and stand attributes.
6. Edit photos

6.4 Production of Forest Inventory Maps

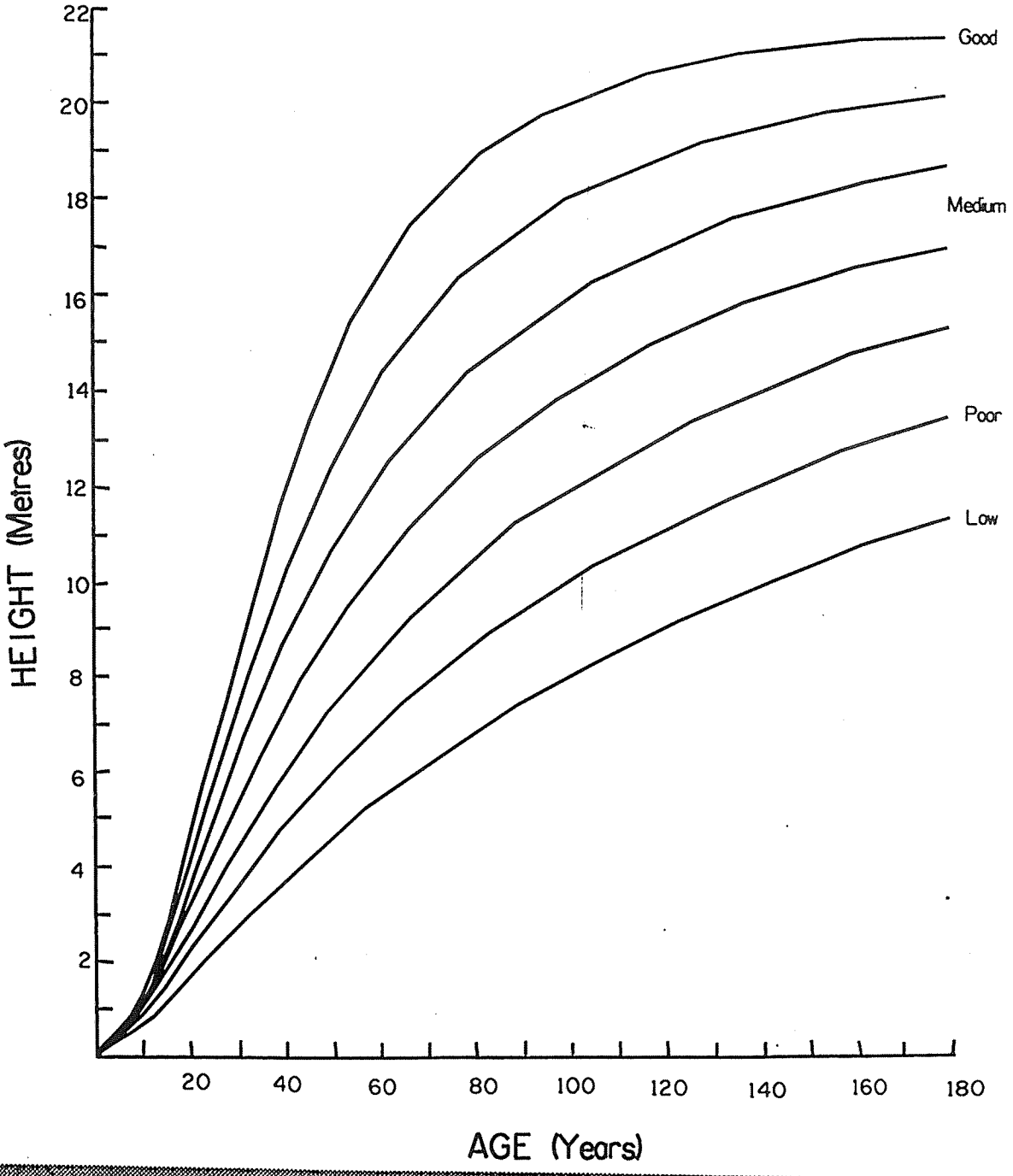
1. Transfer data from 1:40,000 interpreted photos to 1:50,000 base map using transfer technology acceptable to Forest Resources .
2. Prepare map for digitizing and assigning of attributes by editing linework eliminating all unnecessary detail and clutter.
3. Enter polygon attributes into database using Forest Resources software and specifications.
4. Digitize 1:50,000 base map with transferred polygons into digital form in PAMAP format.
5. Join digital data with attribute database.
6. Create raster cover from forest cover using a pixel resolution of 30 metres and a reduction factor of 5 ensuring that each forest cover polygon contains one and only one database tag with forest cover attributes attached.
7. Print final mylar copy of 1:50000 forest inventory map.

NOTE: SEE VOLUME 2 PHOTOGRAMMETRIC TRANSFER, DIGITAL FOREST COVER MAP PRODUCTION FOR COMPLETE ACCEPTABLE SPECIFICATIONS AND METHODOLOGY FOR 6.4.

APPENDIX A: SPRUCE SITE INDEX CURVE



APPENDIX B: LODGEPOLE PINE SITE INDEX CURVE



FOREST COVER MAPPING

Volume 2
Photogrammetric Transfer, Digital Forest Cover Map Production

Forest Resources

January, 1994

TABLE OF CONTENTS

1.0 PHOTOGRAMMETRIC TRANSFER

1.1 MAP PREPARATION

Information from 1:40,000 aerial photos must be transferred onto a 1:50,000 NTS base with corrections made for displacement due to relief. The Kail radial arm plotter is presently used in house by Forest Resources and has been accepted to date - however where feasible a method of transferring data from the airphotos directly into a computer map base for G.I.S. may be acceptable, subject to conditions controlling suitable accuracy. All final digital product must be in PAMAP format.

The following information must be transferred from photos onto a 1:50,000 NTS basemap: trails, forest cover polygons together with complete forest cover polygon attributes, field plot centres with label and air photo centres with roll and photo number. If a direct method of transfer is used contractor must complete coding sheets containing all forest cover polygon attributes and polygons must be numbered directly on air photos using red ink.

Once information has been transferred from the air photos onto a map base it is then necessary to prepare the maps for digitizing and assigning of attributes. The maps must be made as simple and presentable as possible by eliminating all unnecessary detail and clutter without sacrificing the information or accuracy required for a 1:50,000 inventory.

1.11 Map Simplification And Clean Up

a. Eliminate all polygons less than 1 cm^2 (except for small lakes and map edge polygons) and join areas to the most similar adjacent polygon. Polygons less than 1 cm^2 which exist along the neat lines will remain and be assigned a polygon number only if the polygons width is greater than 2mm. Polygons less than 2mm wide will be pulled onto the adjacent mapsheet and closed off. Lakes smaller than 1 cm^2 will not be assigned a polygon number and during the process of digitizing will be placed onto level 5.

b. Join any polygons with the same or very similar forest cover by eliminating lines or bridging small gaps between polygons.

Note: The low and non-productive sites, often have too many polygons to be of any use. Simplify the typing in these areas as much as possible by joining polygons. Remember a low site with less than 15% crown closure is considered non-productive.

c. Reduce map clutter by simplifying lines.

d. Clean up map lines by ensuring there is a 2 mm gap between all polygon forming lines (eg. forest type lines, double line rivers, lakes, and neat lines).

e. Correct line transfer mistakes, such as omitted lines or incorrect polygon shapes.

1.12 Polygon Numbering

a. Polygons are created by forest cover type lines, double line rivers, lakes, and neat lines.

b. Each polygon within each mapsheet must be assigned a unique number. Always start with the photo in the northwest corner and numbering from one, work photo by photo through the mapsheet.

c. Number polygons consecutively and in a sequential manner so that it is easy to follow the numbering. Use square brackets and an arrow to number small or narrow polygons.

d. Each mapsheet will have a progress chart attached to the right hand margin. See APPENDIX C Margin Progress Chart. **This chart must be completed in full.**

e. Polygons numbered out of order on the basemap must be listed on the margin progress chart together with an identifying locator polygon which is in sequence.

f. Unused polygon numbers and last number used must be documented on margin progress chart

g. When numbering and attributing has been completed, initial and date the lower right hand corner and mark off the progress chart accordingly.

1.2 FINAL PRODUCTS FOR PHOTOGRAMMETRIC TRANSFER

The following products must be submitted to Forest Resources by the contractor in a complete and legible format:

- One original copy of each completed N.T.S. basemap utilizing NAD 27 data with complete transfer of labelled polygons, airphoto centres, and plot centres at 1:50,000 scale.

- Each original copy shall have one photo copy accompanying it to be used for quality checking by Forest Resources.

- The method of transferring interpreted data from air photos to a base map shall be approved by Forest Resources prior to awarding the contract.

- a method of transferring data from the airphotos directly into a computer map base for G.I.S. may be acceptable, subject to conditions controlling suitable accuracy. Final digital product must be in PAMAP format.

- If a direct method of transfer (from air photos directly into digital format) is used the contractor must provide Forest Resources with completed coding sheets containing all forest cover polygon attributes and polygons must be numbered directly on air photos using red ink.

1.3 PHOTOGRAMMETRIC TRANSFER QUALITY CONTROL

Polygons selected for audit of interpretation will also be audited for quality control of line transfer.

All polygon boundaries will not have a displacement greater than 1 mm (50 metres ground distance), measured perpendicularly to the polygon line and the extent of the displaced line should not exceed 1/3 of the polygon line. The polygon line is defined as the portion of the polygon boundary between two adjacent line connections.

Accuracy of polygon boundaries shall be within 1.0mm equalling $\pm$ 50 metres at 1:50,000 scale measured perpendicularly to the polygon line. The extent of the displaced polygon line must be no greater than 1/3 of the line segment length.

Polygon boundaries will also be edge checked with polygon boundaries of adjacent maps. A polygon will not be accepted if tie-in lines with adjacent mapsheets are off by more than 1mm.

Field plot centres, photo centres and annotations concerning photo lines (photo number) must be correct at all times.

Minimum size polygon of 25ha does not apply along map borders (ie. polygons smaller than 25ha or 1cm^2 may exist along map border). However, if a transferred polygon border lies less than 2mm from the neatline the polygon's border must be pulled and closed off on the adjacent map sheet.

Polygon numbering will be completed according to procedures outlined in 1.12 Polygon Numbering. Polygon numbering is unacceptable if a polygon:

- has been assigned two or more different polygon numbers.
- has not been assigned a polygon number
- has been assigned a duplicate polygon number (ie. two polygons on one mapsheet with the same number).
- has been assigned an illegible polygon number

A progress chart must be attached to the right hand margin of all basemaps (see Appendix C). **Progress chart must be completed in full.**

All submissions of completed line transfer bases will include a quality control audit form (see page 7 Table 1: Photogrammetric transfer and attribute database work audit - submission #2) signed by the Contractor manager.

The audit process will include 15% of the polygons on each 1:50,000 mapsheet. These polygons will be the same polygons selected for audit of interpretation. These polygons will be examined for the following discrepancies:

- polygon boundary, polygon number, field plot centre, airphoto centre, and tie-in with adjacent photo base when necessary.

A polygon considered unacceptable will be assigned a "1" in the appropriate row/column on the audit form. A weight is assigned to each class of discrepancy. The percent accuracy on each mapsheet will be calculated as:

$$\text{Accuracy} = \frac{[1 - \text{Total weighted discrepancies}]}{\text{Total \# of checked polygons}} * 100$$

Photogrammetric transfer - acceptance accuracy $\geq$ 90%. Mapsheets with accuracy below 90% will be sent back to the contractor to be corrected. Base map labelling accuracy is 100% for acceptance.

T. : Ph imm rans id at e dat wor it - ssion

Contractor: Interpreter: Date of Work:

Number of polygons on mapsheet:
Number of polygons checked on this mapsheet (sample intensity ≥ 15%):
Mapsheet:

PHOTO DETAIL TRANSFER TO BASE	Weight	Polygon Number - Discrepancy Noted/Counted	Total Discrepancies Weighted (d)
Polygon boundaries	1.5		
Polygon numbering	1.5		
Field plot centre	1.0		
Photo Centre	1.0		

BASE MAP LABELLING	Value	Audit Score
Photo roll number	10	
Photo line number	10	
Photo print numbers	10	
Omitted/additional poly #'s	10	
Forest Polygon labels	10	
Tie-in to adjacent bases	10	
Interpreter's name	10	
Company's name	10	
Interpretation date	10	
Mapsheet boundaries	10	
100 required for approval **Total Value**		_____

Accuracy = [1 - _____d_____] 100 = % d
total # of checked polygons

Acceptance = ≥ 90%

COMMENTS:

Quality Control - Creation of Digital Data Base

Accuracy = [1 - ____# of errors____] x 100 = %
# of polygons on mapsheet

Acceptance = ≥ 99%

I hereby certify that this quality control audit has been completed and this work meets or exceeds the contract specifications.

Authorized company Signing Official: _____ Date: _____

2.0 DIGITAL MAP PRODUCTION

2.1 MAP ELEMENTS

The following map elements must be included in the digital and final hardcopy maps:

- International borders with labels
- Provincial borders with labels
- Park boundaries with labels
- Forest Management Unit boundaries with labels
- Double line rivers, single line rivers and streams with labels (unnamed rivers and streams will be included as line elements with no label)
- lakes with labels (unnamed lakes will be included with no label)
- Highways and secondary roads with labels
- trails
- railways
- Other manmade features such as seismic lines and power lines
- Forest Polygons with labels
- Air photo centres with labels
- Legend merged into map
- Plot locations with labels
- UTM 10km grid with annotation
- Geographic coordinate annotation and ticks (map corners labelled and ticks every 5 minutes)

Note: Forest Management Units delineate watersheds. Lines must not cross creeks and only rarely cross rivers.

The following map levels, line indexes, text indexes, database types and database levels must be used when creating maps for Northern Affairs Program, Forest Resources:

	Level	Line Index	Text Index	Database Type and Level	Comments
UTM grid	2	1	1		UTM annotation must be legible (ie. not overlie latitude and longitude annotation)
International Borders	1	26	1		International borders must be labelled using uppercase.
Provincial Borders	1	27	1		Provincial borders must be labelled using uppercase.
Park Boundaries	16	23	33,34,35		Choose the most appropriate sized text index for naming the park. Parks are labelled horizontally in an uncluttered area within the park using capital letters.
Forest Management Units Boundaries	11	29	77	Polygonal 11	Text must be in uppercase (ie. FMU Y06). Each unit is labelled on appropriate side of line with labels for each unit placed directly opposite each other. The management unit name (ie. KLUANE) must be placed further along on the line.
Lakes	6	8	17,18,19		Use the appropriate sized text for the size of lake being labelled (TI=19 is the biggest). Lakes are always labelled using uppercase (ie. ATLIN LAKE).
Rivers	6	7	14,15,16		Double and single line rivers are labelled using uppercase (ie. TESLIN RIVER). Text must follow the line of the river.
Streams	5	6	11,12,13		All permanent streams will be digitized and labelled. Unnamed streams will be digitized and left unlabelled.
Highways	7	9	17,18,19		Highways are labelled using uppercase (ie. ALASKA HWY)
Trails	7	12			Trails are not labelled
Secondary Roads	7	10			Secondary roads are named using upper and lower case symbols (ie. Atlin Road)
Other manmade features					See Appendix A and B for a complete listing of text and line indexes.
Forest Cover Polygons and tags	9	19	71	Polygonal 9	Labels must be legible. If polygon is too small to fit the label or the area is too cluttered the label will be placed outside the polygon with a arc line segment (using line index 1) pointing from the label to inside the polygon.
Air Photo Centre	17		45,46		Note: The air photo centre symbol is represented by the tilde(~). If labelling photo 79, type "~ 79" (note the space between the tilde and the number). Roll numbers are indicated once on each line of photography. (Font # 25 is used)
Sample Plots	18		96		See below for list of plot types and ascii characters used.

Note: Waterbodies inputted digitally for control which are less than 1cm^2 must be placed on level 5

The following symbols are used when inputting Sample Plots:

Plot Type	ASCII Character	ASCII Value
Prism	@	64
Code Point	^	94
Fixed Area Ground	{	123
LSP	|	124
PSP	}	125
LSP+PSP	~	126

Select the appropriate type of symbol for the plot to be entered. Type the required ASCII character and if a number or label is to be attached to the point, place a space between the symbol and the text. (These symbols are used with Font #25)

Note: See Appendix A and B for complete definitions of line and text indexes.

2.2 LABELLING FORESTED POLYGONS

2.21 Productive Forest

Species composition, height (average and/or range), crown closure and age of each stand is recorded on the aerial photographs in detail by the photo interpreter. These polygon descriptions are entered manually into attribute databases and linked to the digital forest cover map. This detailed information then forms the basis from which labels are created. The labels contain generalized polygon attribute information based on the following classes and generalizations:

Species appear in the order of greatest to least percentage within the stand. If percentage composition of two species within a stand are equal they will appear in the order in which they were entered into the attribute database.

TABLE 2: Species codes

Code	Species
A	trembling aspen (Populus tremuloides)
B	balsam poplar (Populus balsamifer)
F	fir (Abies lasiocarpa)
L	larch (Larix laricina)
P	lodgepole pine (Pinus contorta)
s	black spruce (Picea mariana) (map symbol s)
S	white spruce (Picea glauca) (map symbol S)
W	white birch (Betula papyrifera)

TABLE 3: Height Classes

Height Class	Height Range
1	0 - 4 metres
2	5 - 9
3	10 - 14
4	15 - 19
5	20 - 24
6	25 +

TABLE 4: Crown Closure Classes

Crown Closure Class	Crown Closure Range
A	1 - 24%
B	25 - 49%
C	50 - 74%
D	75% +

TABLE 5: Age Classes

Age Class	Age Range
1	1 - 20 years
2	21 - 60
3	61 - 100
4	101 - 140
5	140 +

TABLE 6: Site Classes

Site Index Class	Site Index
L	0 - 9.9 metres
P	10 - 14.9
M	15 - 19.9
G	20+

All productive forest polygon labels must contain a unique polygon number, species code(s), height class, crown closure, age class and site class. For example the following aerial photo label:

> Sw_7At_3•9•20•110 - (A 70% white spruce, 30% trembling Aspen forested stand with an average height of 9 metres, 20% crown closure and an average age of 110 years)

would be entered into a database and the following map label would be generated.

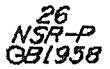
111	polygon #
SA	Species
5B4M	Height Class, Crown Closure, Age Class and Site Class

Forest Resources provides data entry and label generation software which is written in and requires dBase software to run. The generalization from the entered attribute data to label is completed within Forest Resources attribute entry and label generation program. All labels must be legible. If labels do not fit within a polygon or if other map elements lie over a polygon obstructing a label, the label must be moved outside the polygon and an arc added connecting the label clearly to a forest cover polygon.

Section 2.4 (Volume 2) Stratum Codes contains a summary of height, age and crown closure classes used to generate labels.

2.12 Not Sufficiently Regenerated

Polygons classified as NSR should contain information on type/cause of disturbance, year of disturbance and site class. All NSR map labels must contain a unique polygon number, NSR, site class, history symbol and year of disturbance. For example, a polygon classified as burned in 1958 with a poor site class would be assigned the following label:



Note: See section 2.34 (Volume 1 Yukon Forest Classification/Field Sampling), table 7 for a description of disturbance symbols and codes. See section 2.32 (Volume 1 Yukon Forest Classification/Field Sampling) table 6 for description of site class, codes and definitions.

2.13 Non Productive Forest

All non- productive stands will be assigned a unique polygon number and identified as non-productive using the symbol: NP

2.2 LABELLING NON-FORESTED POLYGONS

All non-forested polygons must be identified with a unique polygon number and the appropriate symbol with the exception of lakes and double line rivers. Section 3.0 (Volume 1) table 11 contains a listing of non-forest classes, descriptions and symbols. Lakes greater than 1 cm^2 and double line rivers will be assigned unique numbers only. If the NTS 1:50,000 basemap contains a geographical name that name will be added as text on level 6. Section 2.1 (Volume 2) Table 1 Map Elements contains a listing of appropriate levels, line indexes and text indexes for all map elements.

2.3 FOREST RESOURCES G.I.S. LEVEL DESCRIPTIONS

Vector Level	Description
1	**Neat line**
2	**UTM grid, annotation**
3	**Geographic ticks and annotation (Latitude and Longitude)**
4	**Legend**
5	**Single line creeks, single line rivers and lakes smaller than $2cm^2$ in size**
6	**Double line creeks, rivers and lakes greater than $2cm^2$ in size**
7	**All roads, highways and trails**
8	**Other manmade features (ie. seismic lines)**
9	**Forest cover polygons including polytags**
10	**Forest cover label arrows**
11	**Forest Management Unit polygons including polytags**
12	Crown land polygons including polytags
13	Private land polygons including polytags
14	Leasehold polygons including polytags
15	Municipality polygons including polytags
16	Park and park reserve polygons including polytags
17	Aerial photograph centres
18	**Sample plots**, air and ground calls
19	Right-of-way polygons including polytags
20	Other reserve polygons including polytags
21	Timber Harvesting Agreement polygons including polytags
22	Mineral claim polygons including polytags
23	Other Yukon Territorial Government reserve polygons including polytags
24	Final Land claim polygons including polytags
25	Constraint polygons including polytags
26	Fire boundaries and polytags
27	Elevation Contours

Database Level	Description
9	**Forest Cover**
11	**Forest Management Units**
24	First Nations Final R-Block selections
30	UTM grid cell polygons

Surface Level	Description
27	Digital Elevation Model

Polygonal Level	Description
9	**Forest cover**
11	**Forest Management Unit cover**
12	Crown land cover
21	Timber Harvest Agreement

NOTE: Levels which must be completed during forest cover mapping contracts have been identified in bold.

2.4 STRATUM CODES

Stratification of the forest is done using the species composition, height , crown closure and age of a stand. The stratum code summarizes these characteristics using a four digit number. The following table explains the purpose and values for each digit:

Stratification of Forest Cover Types							
Growth Type (First Digit)		Height Class (Second Digit)		Crown Closure (Third Digit)		Stand Age (Fourth Digit)	
Code	Species Group	Code	Height	Code	Range	Code	Age
1	Spruce	1	0-4m	1	1-24%	1	1-20 yrs.
2	Pine	2	5-9	2	25-49	2	21-60
3	Hardwood	3	10-14	3	50-74	3	61-100
4	Spruce/Pine	4	15-19	4	75+	4	101-140
5	Spruce/Hardwood	5	20-24			5	140+
6	Pine/Spruce	6	25+				
7	Pine/Hardwood						
8	Hardwood/Spruce						
9	Hardwood/Pine						

Notes:
- A pure stand is comprised of 81% or greater of one species
- Hardwood includes aspen, balsam poplar and birch.
- Spruce includes white spruce, black spruce, alpine fir and larch.

Forest Resources dBaseIV attribute entry program automatically generates these stratum codes.

2.5 FOREST RESOURCES DIGITAL FOREST COVER DATABASE DESCRIPTIONS

2.51 Forest Cover database Structure

Structure for database: C:\MAPS\NTS105\105B0609.DBF
Number of data records: 36
Date of last update : 12/16/94

Field	Field Name	Type	Width	Dec	Index
1	LABELTEX_1	Character	20		N
2	LABELTEX_2	Character	20		N
3	LABELTEX_3	Character	20		N
4	LABELTEX_4	Character	20		N
5	CARTO_ANA	Character	1		N
6	ANA_X	Numeric	12		N
7	ANA_Y	Numeric	12		N
8	CART_X	Numeric	12		N
9	CART_Y	Numeric	12		N
10	ANATEXTIDX	Numeric	6		N
11	ANAROTN	Numeric	11		N
12	GRA_GROUP	Numeric	6		N
13	OCCURNMBR	Numeric	6		N
14	ERRORTHEME	Numeric	2		N
15	TAGID	Character	4		N
16	POLY_AREA	Numeric	12	3	N
17	PERIMETER	Numeric	12	3	N
18	MAP_NUM	Character	6		N
19	TYPE	Character	3		N
20	STRATUM	Character	4		N
21	SPC1_CODE	Character	2		N
22	SPC1_COMP	Numeric	3		N
23	SPC2_CODE	Character	2		N
24	SPC2_COMP	Numeric	2		N
25	SPC3_CODE	Character	2		N
26	SPC3_COMP	Numeric	2		N
27	SPC4_CODE	Character	2		N
28	SPC4_COMP	Numeric	2		N
29	AVG_HT	Numeric	2		N
30	MIN_HT	Numeric	2		N
31	MAX_HT	Numeric	2		N
32	CC	Numeric	3		N
33	AGE	Numeric	3		N
34	REF_YEAR	Numeric	4		N
35	SITE_CLASS	Character	1		N
36	SITE_INDEX	Numeric	2		N
37	ACT1_CODE	Character	2		N
38	ACT1_YEAR	Character	4		N
39	ACT2_CODE	Character	2		N
40	ACT2_YEAR	Character	4		N
41	ACT3_CODE	Character	2		N

42	ACT3_YEAR	Character	4	N
43	ACT4_CODE	Character	2	N
44	ACT4_YEAR	Character	4	N
45	FIELD_PLT	Numeric	6	N
46	COLOUR1	Numeric	3	N
47	COLOUR2	Numeric	3	N
48	COLOUR3	Numeric	3	N
** Total **			277	

NOTE: Fields 1 through 17 are PAMAP system attributes. Fields 18 through 48 are user attributes which must be manually entered. Forest Resources dBaseIV program automatically generates site_class and site_index for all polygons with the exception of NSR site_class which must be manually entered.

2.52 Forest Cover Database Description

1. MAP_NUM: NTS mapsheet number (ie. 105A14)

2. TYPE: Type of forest cover in polygon.

CODE	LAND TYPE
FOR	Forest
NSR	Not sufficiently regenerated
NP	Non-productive
RIV	River
L	Lake
C	Cultivated
W	Wetland
R	Rock
U	Urban
A	Alpine

3. STRATUM: Four digit code summarising the forest cover.

First digit - Growth type (reflects species composition), 9 classes
Second digit - Height class, 4 classes.
Third digit - Crown closure, 3 classes
Fourth digit - Age class, 5 classes

4. SPC1_CODE:
6. SPC2_CODE:
8. SPC3_CODE:

10. SPC4_CODE: Codes representing the dominant tree species in the polygon.

Code	Species
A	Trebling Aspen
B	Balsam Poplar
F	Sub-alpine fir
L	Western Larch
P	Lodgepole Pine
Sb	Black Spruce
Sw	White Spruce
W	White Birch

5. SPC1_COMP:
7. SPC2_COMP:
9. SPC3_COMP:
11. SPC4_COMP: Composition of each corresponding species expressed as a percentage. All values are multiples of 10. Total of all four fields equals 100.

12. AVG_HT: Average tree height (in metres).

13. MIN_HT: Minimum tree height (in metres).

14. MAX_HT: Maximum tree height (in metres).

15. CC: Crown Closure (density) in percentage. Values are multiples of 10.

16. AGE: Stand age in years.

17. REF_YEAR: The year of photography used to delineate the polygon.

18. SITE_CLASS: Derived from the value calculated for SITE_INDEX.

CODE	SITE	INDEX RANGES
L	Low	0-9.9
P	Poor	10-14.9
M	Medium	15-19.9
G	Good	20 +

19. SITE_INDEX: Site index base age 100 using the following equations:

$H = b_1 S (1 - e^{b1A})^{b3}$
$S = H / b_1(1-e^{b2})^{Ab3}$
where: H is total height in metres,
S is site index in metres at reference age 100 years,
A is age in years, and
b_1 , b_2 , b_3 are regression coefficients at reference age 100 years.

Genus/Species	Common Name	b_1	b_2	b_3
Abies Sp. (interior)	Balsam/Alpine	1.3832	-0.0155	1.3597
Betula papyrifera	Common Paper Birch	1.1580	-0.0175	0.7687
Larix sp.	Larch	1.1637	-0.0215	1.2243
Picea sp.	Spruce	1.2883	-0.0181	1.4177
Pinus contorta	Lodgepole pine	1.0236	-0.0465	2.4269
Populus balsamifera	Balsam poplar	1.1318	-0.0226	1.1233
Populus tremuloides	Aspen	1.2025	-0.0158	0.7994

20. ACT1_CODE:
21. ACT2_CODE:

22. ACT3_CODE:
23. ACT4_CODE: Activity code indicating the history of activities on the site.

CODE	DISTURBANCE
DB	Burn
DL	Logging
DW	Windthrow
DI	Insect
DD	Disease
DS	Slide
DF	Flooding

24. ACT1_YEAR:
25. ACT2_YEAR:
26. ACT3_YEAR:
27. ACT4_YEAR: Years of activities referenced in the corresponding activity code field.

28. FIELD_PLT: The plot number of first field plot (psp, lsp or prism plot) within polygon

29. COLOUR1
30. COLOUR2
31. COLOUR3: Fields used for colour theming. These fields contain temporary data only.

Note: Fields 3-19 are completed only for forested polygons (except field 18 which may be filled for NSR polygons.

2.53 Forest Management Unit Database Structure

```
Structure for database: C:\MAPS\NTS105\105B1311.DBF
Number of data records:        2
Date of last update    : 01/03/95
Field  Field Name  Type       Width     Dec     Index
    1  LABELTEX_1  Character     20               N
    2  LABELTEX_2  Character     20               N
    3  LABELTEX_3  Character     20               N
    4  LABELTEX_4  Character     20               N
    5  CARTO_ANA   Character      1               N
    6  ANA_X       Numeric       12               N
    7  ANA_Y       Numeric       12               N
    8  CART_X      Numeric       12               N
    9  CART_Y      Numeric       12               N
   10  ANATEXTIDX  Numeric        6               N
   11  ANAROTN     Numeric       11               N
   12  GRA_GROUP   Numeric        6               N
   13  OCCURNMBR   Numeric        6               N
   14  ERRORTHEME  Numeric        2               N
   15  TAGID       Character      4               N
   16  POLY_AREA   Numeric       12       3       N
   17  PERIMETER   Numeric       12       3       N
```

2.54 Forest Management Unit Database Description

1. TAGID: Field contains three digit code identifying Forest Management Unit.

CODE	FMU	CODE	FMU
Y01	La Biche	Y08	Salmon
Y02	Coal	Y09	Pelly
Y03	Upper Liard	Y10	Stewart
Y04	Atlin	Y11	Yukon
Y05	Teslin	Y12	Peel
Y06	Kluane	Y13	Porcupine
Y07	White		

2.6 FINAL PRODUCTS FOR DIGITAL FOREST COVER MAP PRODUCTION

- Digital maps must be in PAMAP format on DAT2000 tape or 3 1/2", 1.4 Megabyte diskette or tapes compatible to QIC-80 tape backup system (DC 2080, DC 2080 Ximat, DC 2120, DC 2120 Ximat).

- Maps must be vector clean with documentation of quality control to Forest Resources specifications (edge checked, polygons numbered sequentially one number per polygon, all numbers unique to mapsheet) and must utilize NTS 1:50,000 NAD27 series basemap information. Map must also contain attached database in Forest Resources specified format completed to Forest Resources Specifications, including areas generated during polygon formation.

- Maps must contain polygonal forest cover level and a forest management unit level using 30 metre resolution and a reduction factor of 5.

- Final maps plotted on mylar (E-size, double matte, polyester film) using pen size 0.25mm with permanent black ink (eg. Staedtler Mars Plot Sprint Pen, Film).

- All aerial photography must be returned with active area identified, delineated stand boundaries, labels, polygon numbers, principle points and conjugate principle points using pen size 0 (.35).

- Prism plot field notes, increment cores and map of field plot locations must be submitted.

2.7 DIGITAL MAP PRODUCTION QUALITY CONTROL

A minimum of two Audits will be conducted during the completion of this work:

1. Digital database attribute database - acceptance accuracy $\geq$ 99%
2. Digital map production

2.71 Polygon Attribute Entry

Quality control of digitally entered attributes will be completed by the contractor. Digital attributes must have less than 1% error per mapsheet. An error in coding of attributes is considered to be one or more codes in single record coded incorrectly.

All quality control reports of coding attributes for mapsheets are to be supplied to Forest Resources by the Contractor.

2.72 Digital Map Production

Digitizing of polygon boundaries and base information must conform to Forest Resources Standards as outlined in this document.

Polygons selected for audit of interpretation will also be audited for quality control of digitizing. 90% of all forest cover type lines digitized shall be accurate to with 50 metres (1mm at map scale) of their true position. All topographic features, forest polygons management boundaries must be digitized to an accuracy of 1mm or less that which is on the source document. All topographic features and management units must be labelled correctly. All forest polygons must have unique numbers. Forest Cover polygon labels must be positioned such that each label is legible and such that it is readily obvious which label belongs with which polygon. Flight lines and photo numbers must be digitized in correct location and labelled correctly. Geographic grid and map number and map title must be present and correct. All base map information must be labelled in such a way that labels do not conflict with forest attribute labels and such that all labelling is legible and appropriate in size. All polygon joins must be clipped and neat (no overhangs).

All polygons shall be explicitly closed on themselves, the map neatline, double line rivers, lakes greater than 1cm in size, roads greater than 30 metres wide, national parks, Provincial boundaries or international boundaries. Interpretation will be limited to outside national parks and inside the Yukon Territory.

Maps must be vector clean with documentation of quality control to Forest Resources specifications (edge checked, polygons numbered sequentially one number per polygon). Map must also contain attached database in Forest Resources specified format completed to Forest Resources Specifications. All files associated with the map must be checked to ensure that there are no corrupt elements.

Final digital product must be in PAMAP format with 30 metre resolution with a reduction factor of 5 and must contain complete polygon levels with associated database for the forest cover on level 9.

All final digital maps will attached forest cover databases will include a quality control audit form signed by the Contractor Manager (see Page 29, Digital Map production audit - Submission # 3)

Contractor: Digitizer: Date of Work:

Number of polygons on mapsheet:
Number of polygons checked on this mapsheet (sample intensity ≥ 15%):
Mapsheet:

PHOTO DETAIL TRANSFER TO BASE	Weight	Polygon Number - Discrepancy Noted/Counted	Total Discrepancies Weighted (d)
Polygon boundaries	1.5		
Polygon numbering	1.5		
Field plot centre	1.0		
Photo Centre	1.0		

BASE MAP LABELLING	Value	Audit Score
Photo roll, line, print number	10	
Omitted/additional poly #'s	10	
Forest Polygon labels (placement)	10	
Forest Polygon labels (content)	10	
Tie-in to adjacent bases	10	
Geographic grid, coordinate location	10	
Legend	10	
Company's name	10	
Mapsheet boundaries	10	
Neat linework (no overhangs/double linework)	10	
Polygons closed and map vector clean	10	
All information present and labelled on appropriate level	10	
120 required for approval **Total Value**		

Accuracy = [1 - $\frac{d}{\text{total \# of checked polygons}}$] 100 = % d

Acceptance = ≥ 90%

COMMENTS:

I hereby certify that this quality control audit has been completed and this work meets or exceeds the contract specifications.
Authorized company Signing Official: _____ Date: _____

ANY EDITS PERFORMED DURING THE COMPLETION OF WORK MUST BE TRANSFERRED TO ALL MATERIALS (ie, photo, basemaps, databases etc.)

PAMAP GIS Text Index Definition Screen

INDX	--NAME--	FONT	PEN	TYPE	COLOUR	WGHT	VJS	HJS	HEIGHT	VSPC	HSPC	WMLT
7	FREGION	22	1	0	9	40	0	CN	LF	16250	500	0	1000
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9	GEOGRAPH	61	1	0	2	0	0	BT	CN	9500	500	0	1000
10	EXTRA1	61	1	0	2	0	0	BT	LF	9500	500	0	1000
11	CREEKS	23	1	0	9	40	0	BT	LF	16250	500	0	1000
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PAMAP GIS Text Index Definition Screen

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20	TOWNSHIP	22	1	0	13	37	1	BT	LF	25000	500	0	1000
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PAMAP GIS Text Index Definition Screen

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39	TIMBERBE	22	1	0	8 118	0	BT	LF	12500	500	0	1000
40	TIMBERBE	22	1	0	8 118	0	BT	LF	20000	500	0	1000
41	TIMBERBE	22	1	0	8 118	0	BT	LF	25000	500	0	1000
42	MINERALC	22	1	0	5 4	0	BT	LF	12500	500	0	1000
43	MINERALC	22	1	0	5 4	0	BT	LF	20000	500	0	1000
44	FLGHTLIN	23	1	0	13 37	0	BT	LF	16250	500	0	1000
45	PHOTOCEN	99	1	0	3 5	0	CN	CN	12000	500	0	1000
46	PHOTOTEX	25	1	0	3 5	0	BT	LF	10000	500	0	1000
47	WINGPNTS	99	1	0	6 26	0	CN	CN	100000	500	0	1000
48	DITCHES	22	1	0	2 121	0	BT	LF	12500	500	0	1000

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PAMAP GIS Text Index Definition Screen

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51	RAILWAYS	22	1	0	8 118	0	BT	LF	12500	500	0	1000
52	INTRNATN	21	1	0	3 5	0	CN	LF	25000	500	0	1000
53	INTRPROV	21	1	0	6 16	0	CN	LF	25000	500	0	1000
54	LANDDIST	22	1	0	2 121	0	BT	LF	16250	500	0	1000
55	DAMFALRP	22	1	0	8 10	0	BT	LF	12500	500	0	1000
56	DAM	99	1	0	8 10	1	CN	CN	100000	500	0	1000
57	INTERNAT	22	1	0	9 92	0	BT	LF	16250	500	0	1000
58	POSTOFFI	99	1	0	7 96	0	CN	CN	100000	500	0	1000
59	POSTOFFI	23	1	0	7 96	0	BT	LF	13750	500	0	1000
60	FSOFFICE	99	1	0	7 96	0	CN	CN	100000	500	0	1000
61	FSOFFICE	23	1	0	7 96	0	BT	LF	14500	500	0	1000
62	LOOKOUTS	99	1	0	7 96	1	CN	CN	100000	500	0	1000
63	MNTRANGE	22	1	0	8 10	0	BT	LF	16250	500	0	1000
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PAMAP GIS Text Index Definition Screen

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68	GLACIERS	23	1	0	7	96	0	BT	LF	12500	500	0	1000
69	GLACIERS	23	1	0	7	96	0	BT	LF	16250	500	0	1000
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71	FCLABELS	25	1	0	4	21	0	CN	CN	10000	500	0	1000
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73	SLIDES	99	1	0	8	10	0	CN	CN	100000	500	0	1000
74	TSA	22	1	0	13	37	0	BT	LF	16250	500	0	1000
75	TSB	22	1	0	6	26	0	BT	LF	16250	500	0	1000
76	PSYU	22	1	0	9	92	0	BT	LF	16250	500	0	1000
77	FREGION	22	1	0	9	40	0	CN	LF	16250	500	0	1000
78	FMU	22	1	0	5	6	3	CN	LF	25000	500	0	1000
79	INVREGN	22	1	0	2	121	0	BT	LF	16250	500	0	1000
80	INVCOMPT	22	1	0	14	80	0	BT	LF	16250	500	0	1000

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83	PROVFORE	22	1	0	7	96	0	BT	LF	16250	500	0	1000
84	RNGEUNIT	22	1	0	7	96	0	BT	LF	16250	307	0	1000
85	STCKRNGE	22	1	0	7	96	0	BT	LF	16250	307	0	1000
86	ALR	23	1	0	2	121	0	BT	LF	62500	500	0	1000
87	COMPT	23	1	0	2	121	0	BT	LF	62500	500	0	1000
88	TSA	23	1	0	2	121	0	BT	LF	62500	500	0	1000
89	PSYU	23	1	0	2	121	0	BT	LF	62500	500	0	1000
90	OWNERS	23	1	0	2	121	0	BT	LF	62500	500	0	1000
91	FDISTRCT	23	1	0	9	40	0	BT	LF	62500	500	0	1000
92	PROVFORE	23	1	0	2	121	0	BT	LF	62500	500	0	1000
93	UTM2000M	23	1	0	2	121	0	BT	LF	62500	500	0	1000
94	RANGE	23	1	0	2	121	0	BT	LF	62500	500	0	1000
95	INVSAMPS	99	1	0	7	96	0	CN	CN	100000	500	0	1000
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98	GRNDCALL	22	1	0	8	118	0	BT	LF	8750	500	0	1000
99	FISHSYMB	99	1	0	8	10	0	CN	CN	100000	500	0	1000
100	FISHSYMB	23	1	0	8	10	0	BT	LF	8750	500	0	1000
101	MILEPOST	22	1	0	5	4	0	BT	LF	13750	500	0	1000
102	MILEPOST	99	1	0	5	4	0	CN	CN	100000	500	0	1000
103	NOTE2	22	1	0	5	4	0	BT	LF	12500	500	0	1000
104	NOTE	22	1	0	5	4	0	BT	LF	12500	500	0	1000
105	MAPNO	22	1	0	5	4	2	BT	RT	75000	500	0	1000
106	ISLRES	22	1	0	5	4	0	BT	LF	12500	500	0	1000
107	COMPTEXT	22	1	0	5	4	3	BT	LF	22500	500	0	1000
108	REGTEXT	22	1	0	5	4	1	BT	LF	16250	500	0	1000
109	REGNUMB	22	1	0	5	4	0	BT	LF	16250	500	0	1000
110	COMPCIRC	99	1	0	5	4	3	CN	CN	100000	500	0	1000
111	GENRLSYM	99	1	0	5	4	0	CN	CN	100000	500	0	1000
112	BNDRYTXT	22	1	0	5	4	0	BT	LF	13750	500	0	1000

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PAMAP GIS Text Index Definition Screen

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114	RNGETITL	22	1	0	5	4	2	BT	LF	25000	500	0	1000
115	PLANTITL	22	1	0	5	4	2	BT	LF	25000	500	0	1000
116	RNGSYMBS	6	1	0	13	37	0	BT	LF	40000	500	0	1000
117	RNGIMPRV	22	1	0	5	6	0	BT	LF	10000	500	0	1000
118	PLANCELL	23	1	0	2	121	0	BT	LF	62500	500	0	1000
119	TRANLINE	22	1	0	13	37	0	BT	LF	10000	500	0	1000
120	OWNTEXT	22	1	0	9	40	0	BT	LF	16250	500	0	1000
121	SPARE4	22	1	0	5	4	0	BT	LF	10000	500	0	1000
122	SPARE5	22	1	0	5	4	0	BT	LF	10000	500	0	1000
123	SPARE6	22	1	0	5	4	0	BT	LF	10000	500	0	1000
124	SPARE7	22	1	0	5	4	0	BT	LF	10000	500	0	1000
125	SPARE8	22	1	0	5	4	0	BT	LF	10000	500	0	1000
126	SPARE9	22	1	0	5	4	0	BT	LF	10000	500	0	1000
127	SPARE10	22	1	0	5	4	0	BT	LF	10000	500	0	1000
128	SPARE11	22	1	0	5	4	0	BT	LF	10000	500	0	1000

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PAMAP GIS Text Index Definition Screen

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131	SPARE14	22	1	0	5	4	0	BT	LF	10000	500	0	1000
132	SPARE15	22	1	0	5	4	0	BT	LF	10000	500	0	1000
133	SPARE16	22	1	0	5	4	0	BT	LF	10000	500	0	1000
134	SPARE17	22	1	0	5	4	0	BT	LF	10000	500	0	1000
135	SPARE18	22	1	0	5	4	0	BT	LF	10000	500	0	1000
136	SPARE19	22	1	0	5	4	0	BT	LF	10000	500	0	1000
137	SPARE20	22	1	0	5	4	0	BT	LF	10000	500	0	1000
138	GEOGRAPH	1	2	0	2	0	2	BT	LF	30000	500	0	1000
139	HEADER	0	2	0	2	0	2	CN	RT	40000	500	0	1000
140	TITLE	0	2	0	2	0	3	BT	CN	50000	500	0	1000
141	SCALE1	0	2	0	2	0	0	CN	LF	30000	500	0	1000
142	SCALE2	0	2	0	2	0	0	CN	RT	20000	500	0	1000
143	LEGTEXT	0	1	0	2	0	0	CN	LF	10000	500	0	1000
144	FCLABELS	25	1	0	2	126	0	CN	CN	10000	125	0	1000

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146	SPARE4	0	2	0	5	4	0	CN	LF	16000	500	0	1000
147	PHOTOCEN	25	1	0	13	37	0	CN	LF	10000	500	0	1000
148	PHOTOCEN	99	1	0	13	37	0	CN	CN	12000	500	0	1000
149	SPARE4	7	1	0	5	4	0	BT	CN	20000	500	0	1000
150	TOWNSHIP	22	1	0	13	37	0	BT	CN	15000	500	0	1000
151	SPARE4	25	1	0	5	4	0	CN	LF	8000	500	0	1000
152		61	1	0	2	0	0	CN	RT	40000	500	0	1000

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PAMAP GIS Line Index Definition Screen

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52	FCARROW	0	1 4	21	0	-24
1	NEATLINE	0	1	2 126	0	0
2	SKEW1	0	1	13 37	0	0
3	RESRVD2	0	1	2 0	0	0
4	RESRVD3	0	1	2 0	0	0
5	RESRVD4	0	1	2 0	0	0
6	CREEK	0	1	6 49	0	0
7	RIVER	0	1	12 17	1	0
8	LAKE	0	1	5 56	1	0
9	HIGHWAY	0	1	3 5	3	-1
10	SECROAD	3	1	14 39	2	-2
11	LOGROAD	2	1	3 5	2	-3
12	TRAIL	2	1	9 40	0	0
13	PWERLINE	4	1	13 15	2	-4
14	PIPELINE	4	1	7 107	0	-5
15	RAILWAY	0	1	13 37	1	-6
16	ABNDRAIL	0	1	13 37	0	-7

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PAMAP GIS Line Index Definition Screen

INDX	--NAME--	TYPE	PEN	COLOUR	WEIGHT	PATTERN
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17	DTCHFLME	3	1	8 34	0	-8
18	GLACIER	2	1	11 77	0	0
19	TYPELINE	1	1	4 21	0	0
20	TOWNSHIP	0	1	3 25	2	0
21	SRVYDLOT	0	1	8 24	0	0
22	UNSRVLOT	3	1	10 8	0	0
23	PARK	3	1	8 7	0	0
24	RESERVE	3	1	10 8	0	0
25	MUNICIPL	1	1	11 76	2	0
26	INTRNATN	4	1	3 5	7	-9
27	INTRPROV	4	1	6 18	5	-10
28	LANDISTR	4	1	8 58	2	0
29	FRSTREGN	4	1	6 105	6	0
30	FMU	4	1	9 92	4	0
31	TSA	1	1	3 19	7	0
32	TSB	1	1	5 6	4	0

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press <ESC> twice to continue or quit...

PAMAP GIS Line Index Definition Screen

NDX	--NAME--	TYPE	PEN		COLOUR	WEIGHT	PATTERN
2	FCARROW	0	1	4	21	0	-24
33	PSYU	2	1	10	114	2	0
34	SUBUNIT	3	1	5	70	0	0
35	INVREGN	0	1	8	89	5	0
36	INVCOMP	2	1	9	73	5	0
37	PROVFORE	3	1	11	123	4	0
38	STCKRNGE	3	1	12	17	7	0
39	RNGEUNIT	4	1	13	15	4	0
40	RIVERFC	1	1	9	92	1	0
41	FNCNOC	0	1	6	26	0	-11
42	PRIVFNC	0	1	9	92	0	-12
43	FENCE	0	1	9	40	0	-13
44	PRIVFEN	0	1	5	6	0	-14
45	BARRIER	0	1	14	80	0	-15
46	FNCROAD	0	1	5	4	0	-16
47	SANDBAR	1	1	9	92	0	0
48	PLANCELL	4	1	14	39	6	0

[ ] Previous [ ] Begin = [ ] Next [ ] Exi

press <ESC> twice to continue or quit...

PAMAP GIS Line Index Definition Screen

INDX	--NAME--	TYPE	PEN		COLOUR	WEIGHT	PATTERN
2	FCARROW	0	1	4	21	0	-24
49	INDEFCRK	3	1	9	40	0	0
50	INDEFRIV	3	1	9	92	0	0
51	INDEFLAK	3	1	5	4	0	0
52	FCARROW	0	1	4	21	0	-24
53	EXTRA7	0	1	2	0	0	0
54	TSA/IREG	1	1	6	26	1	-18
55	TSB/IREG	1	1	9	92	0	-19
56	INVREG	0	1	5	6	5	-20
57	ALROV	0	1	8	100	0	0
58	INVCMPOV	2	1	8	68	5	0
59	INVREGOV	0	1	13	67	5	0
60	PLANCLOV	4	1	14	39	6	0
61	BIOGEOOV	3	1	2	54	5	0
62	SLOPEOV	0	1	14	80	0	0
63	TSAOV	1	1	8	36	7	-18
64	TSBOV	1	1	2	38	4	-18

[ ] Previous [ ] Begin = [ ] Next [ ] Exi

ress <ESC> twice to continue or quit...

PAMAP GIS Line Index Definition Screen

DX	--NAME--	TYPE	PEN		COLOUR	WEIGHT	PATTERN
	FCARROW	0	1	4	21	0	-24
65	PSYUOV	2	1	8	29	2	0
66	ASPECTOV	0	1	16	81	0	0
67	ELEVOV	0	1	13	82	0	0
68	OWNEROV	0	1	8	124	0	0
69	OPEROV	0	1	6	31	0	0
70	FORREGOV	4	1	2	51	6	0
71	FORDISOV	4	1	8	52	4	0
72	PROVFROV	3	1	8	118	4	0
73	UTMOV	0	1	8	50	0	0
74	STOCKROV	3	1	12	17	7	0
75	RANGEUOV	4	1	13	15	4	0
76	PASTUROV	0	1	2	0	1	-23
77	RIVER	0	1	9	92	1	0
78	RIVER	0	1	9	92	0	0
79	RIVER1	0	1	9	92	0	0
80	TYPELINE	0	1	6	26	0	0

] Previous [ ] Begin = [ ] Next [ ] Exi

ress <ESC> twice to continue or quit...

PAMAP GIS Line Index Definition Screen

NDX	--NAME--	TYPE	PEN		COLOUR	WEIGHT	PATTERN
	FCARROW	0	1	4	21	0	-24
81	HIGHWAY	0	1	13	37	0	-1
82	TRAIL	2	1	14	80	0	0
83	NEATLINE	0	1	2	0	0	0
84	RIVER2	0	1	9	92	0	0
85	DTCHFLME	0	1	2	121	0	-8
86	TRAIL1	2	1	14	80	0	0
87	TYPELINE	1	1	6	26	0	0
88	RAILWAY	0	1	8	118	0	-6
89	PIPELINE	0	1	5	6	0	-5
90	PWERLINE	0	1	13	37	0	-4
91	HIGHWAY1	0	1	13	37	0	-1
92	SECROAD	3	1	8	10	0	-2
93	CREEK	0	1	9	40	0	0
94	LAKE	0	1	5	4	1	0
95	UNSRVLOT	3	1	2	121	0	0
96	MUNICIPL	1	1	7	96	2	0

] Previous [ ] Begin = [ ] Next [ ] Exi

ess <ESC> twice to continue or quit...

PAMAP GIS Line Index Definition Screen

NDX	--NAME--	TYPE	PEN	COLOUR	WEIGHT	PATTERN
⌣2	FCARROW	0	1	4 21	0	-24
97	SRVYDLOT	0	1	2	121	1	0
98	PARK	3	1	14	80	2	0
99	RESERVE	3	1	16	81	1	0
100	INTRNATN	7	1	9	92	6	-9
101	INTRPROV	6	1	9	40	5	-10
102	LANDISTR	4	1	2	121	2	0
103	FRSTREGN	4	1	13	37	4	0
104	TSB	1	1	9	92	4	0
105	PSYU	2	1	9	40	2	0
106	BORDER	0	2	13	37	2	0

] Previous [ ] Begin = [ ] Next [ ] Exi

press <ESC> twice to continue or quit...

APPENDIX C: MARGIN PROGRESS CHART

Mapsheet Number_____

MAPSHEET STATUS

Interpreter_____

Int. Date

Polygons transferred from photo
and labelled_____

Int. Date

Edge checked side

N_____

Int. 2 Date

S_____

Int. 2 Date

E_____

Int. 2 Date

W_____

Int. 2 Date

Polygons checked_____

Int. Date

Polygons numbered_____

Int. Date

Data entered into computer by:

_____

Int. Date

Numbers not used:

Out of sequence

Near

Last number used Int. Date

_____

_____

_____

APPENDIX D: POLYGON ATTRIBUTE ENTRY

The following document outlines the software used by Forest Resources to enter Forest Cover polygon attributes and to generate stratum codes, site index, site class and labels for digital forest cover maps. This software was written in DbaseIV and therefore requires that user have a copy of Dbase on their computer to run this program. This program has been provided to assist with attribute input and label generation but it is not essential that this specific program be used. However, the database associated with Forest Resources digital forest cover maps must and labels on the digital maps must follow Forest Resources specifications.

Getting Started

The program for attribute entry and labelling of new mapsheets is called **SUPPORT**. In dBase type **DO SUPPORT** to start the system. This will bring the user to the main menu. The options of the main menu are *Stratums/Labels*, *Attribute Entry*, *Utilities* and *Quit*. The first pulldown menu, *Stratums/Labels*, contains options that generate stratums and labels for completed databases. The second pulldown menu, *Attribute Entry*, contains options for creating attribute files and entering attribute information. The *Utilities* menu has an option for listing a directory of data files. The *Quit* menu lets the user quit to the dBase dot prompt.

Attribute Entry

Note: These procedures assume that attribute entry is occurring independently of map file creation. Using these methods means that the attribute database must be joined to the PAMAP exported map database file using dBase's join command. (The joining process is not covered in this document.)

To begin attribute entry of a new mapsheet a new database file must first be created. From the *Attribute Entry* menu select *Create New Database*. This procedure will ask for an 8 letter name for the new file (a .DBF file extension is added automatically). A message will appear on the screen telling the user that the file has been created. This procedure copies a database template file to the user entered file name.

After creating the database file, information may be entered using the *Forest Attribute Entry* procedure of the *Attribute Entry* menu. This procedure prompts the user to enter the database file name (without an extension). The selected database file must already have been created (using the *Create New Database* procedure). The *Forest Attribute Entry* procedure will work with new and old databases, so the user may enter information during multiple sessions. The information from each session is added on to the end of all previously entered data for that file. The next prompt from the program allows the user to browse (dbase editing facility, refer to dbase manual) previously entered data. Typing a 'Y' will enter browse and typing an 'N' will bypass the browse facility. The user may want to browse at the beginning of a session if they are working on a file for the second time and did not correct mistakes before quitting the first time (ie. they quit for lunch and are continuing).

The main function of the *Forest Attribute Entry* procedure is to save the user as many keystrokes as possible. The program achieves this at the expense of flexibility. One way in which the program saves keystrokes is by predefining function keys 2 through 9 (F1 is reserved by dbase). At the bottom of each entry screen, except field samples, is a box showing function key assignments. Some of the function key definitions initiate a set of defined steps which reduce the flexibility of the system. For example, selecting *F6* for Wetlands on the polygon data screen will enter the polygon type and skip over all of the screens which do not relate to Wetlands information.

The attribute entry part of the program is composed of five screens, Polygon Data, Species Data, Stand Data, Site History and Field Samples. The sequence of screen displays is governed by the polygon type as shown in table 1.

Table 1. Data entry screens used for different polygon types.

Polygon Type	Polygon Data	Species Data	Stand Data	Site History	Field Samples
Forested	Yes	Yes	Yes	Yes	Yes
NSR	Yes			Yes	
All Others	Yes				

Polygon Data

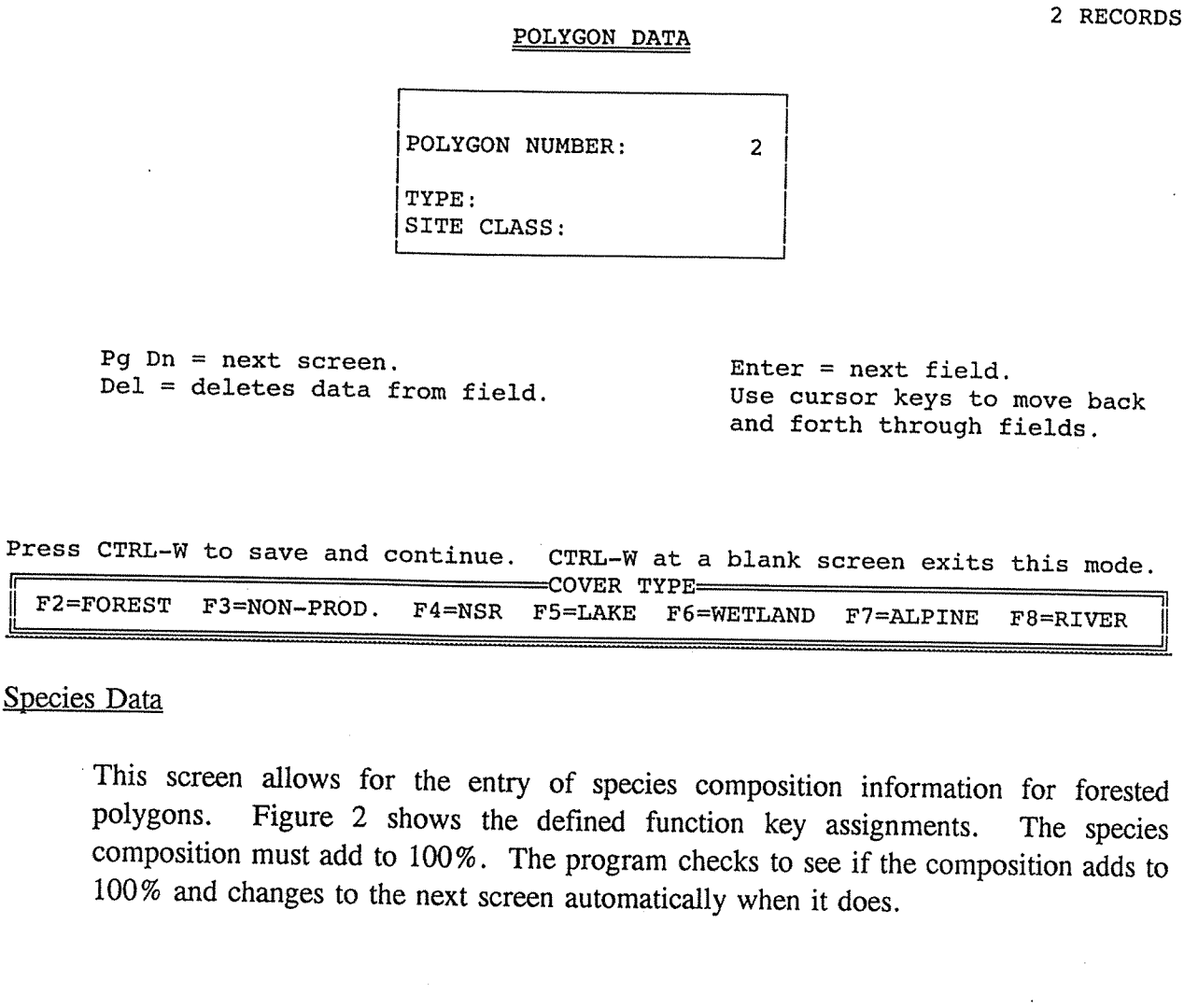
The polygon data screen consists of information on polygon number, type and site class. Figure 1 shows the function key definitions for this screen. The polygon numbers are input automatically and sequentially by the system. However, if a polygon number is to be skipped a new value can be entered in the field and subsequent numbering will be sequential starting at the entered value.

The polygon type field uses Forest Resources standard codes as defined in the Classification Manual. The most common types are predefined on function keys. Part of the definition of the function keys are instructions about what subsequent entry screens are relevant to the entered type. For example, if Lake, Wetland, Alpine or River are entered the system will skip all of the other data entry screens and return the user to the polygon data screen ready for the next polygon. In cases where there is other information to enter in these types the browse utility must be used for editing (keep notes of edits required and do them all during the process of exiting from the *Forest Attribute Entry* procedure).

NOTE: When entering NP disturbance burn because the program will automatically skip to the next polygon number after entering NP the user must then page up and enter the disturbance burn information in ACT1_CODE field.

Site class is only to be entered for NSR polygons. Site class for forested polygons is calculated by software from the entered age and height.

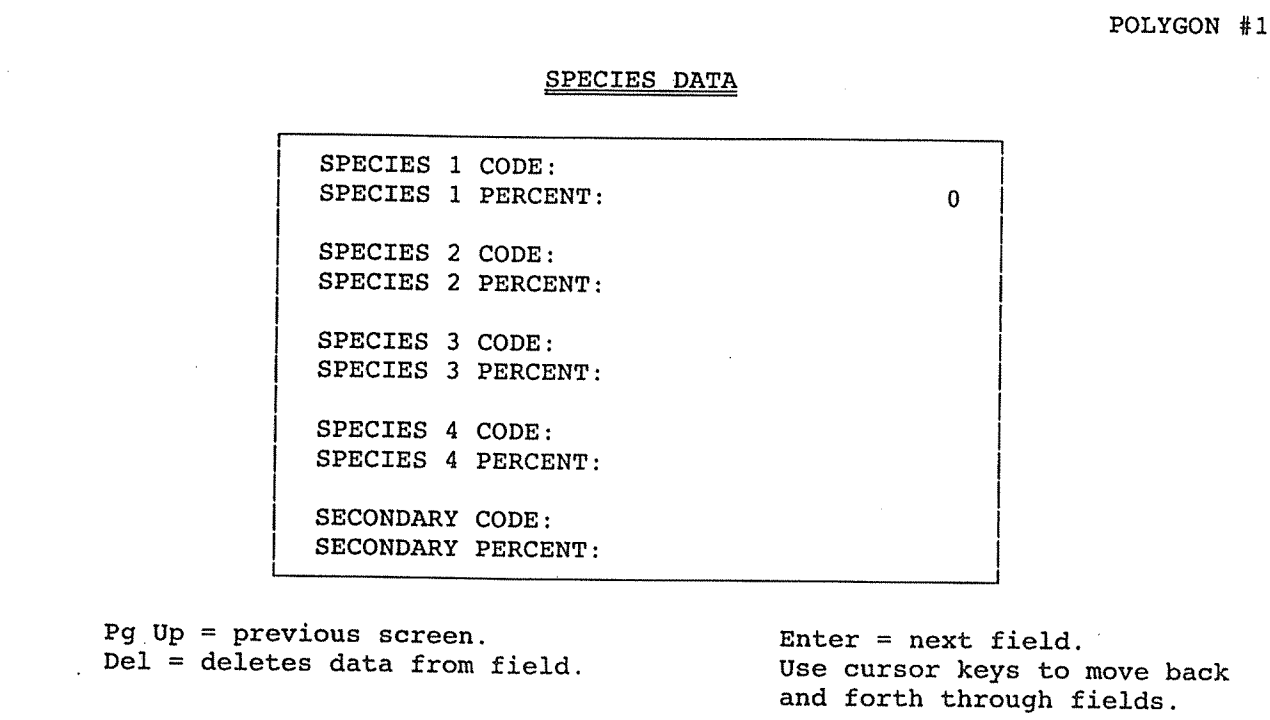
Figure 1: Polygon entry screen and function key assignments.



Species Data

This screen allows for the entry of species composition information for forested polygons. Figure 2 shows the defined function key assignments. The species composition must add to 100%. The program checks to see if the composition adds to 100% and changes to the next screen automatically when it does.

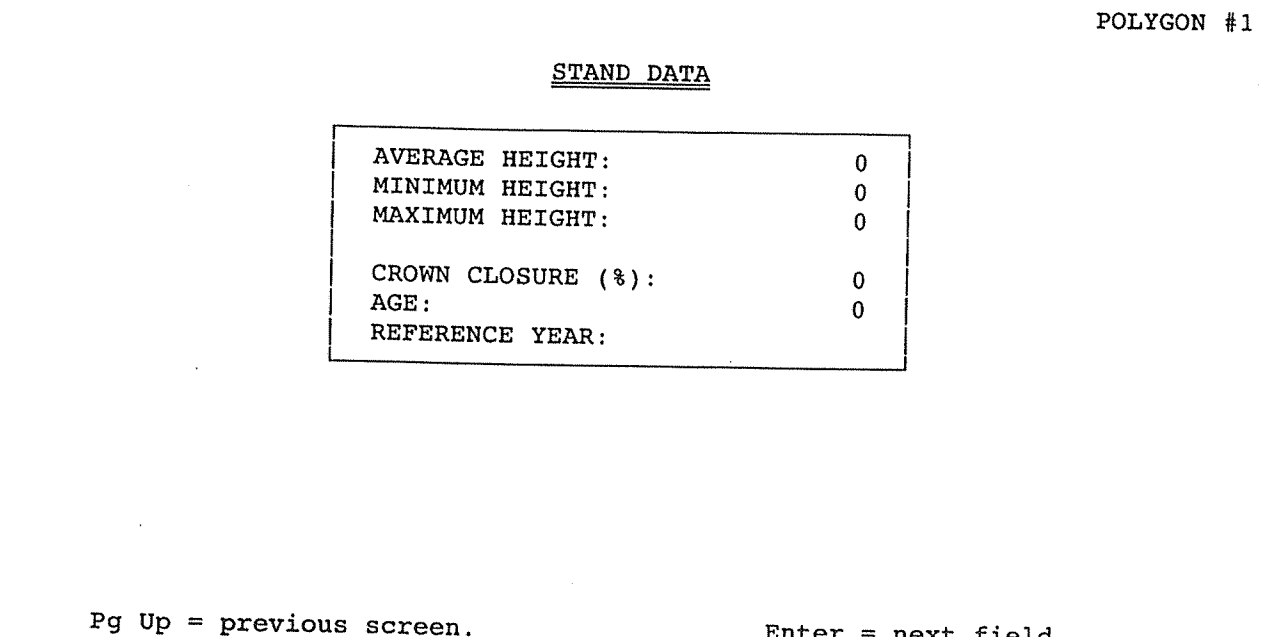
Figure 2: Species data entry screen and function key assignments.



Stand Data

This screen allows for the entry of stand height, crown closure and age information. There are no predefined function keys for this information.

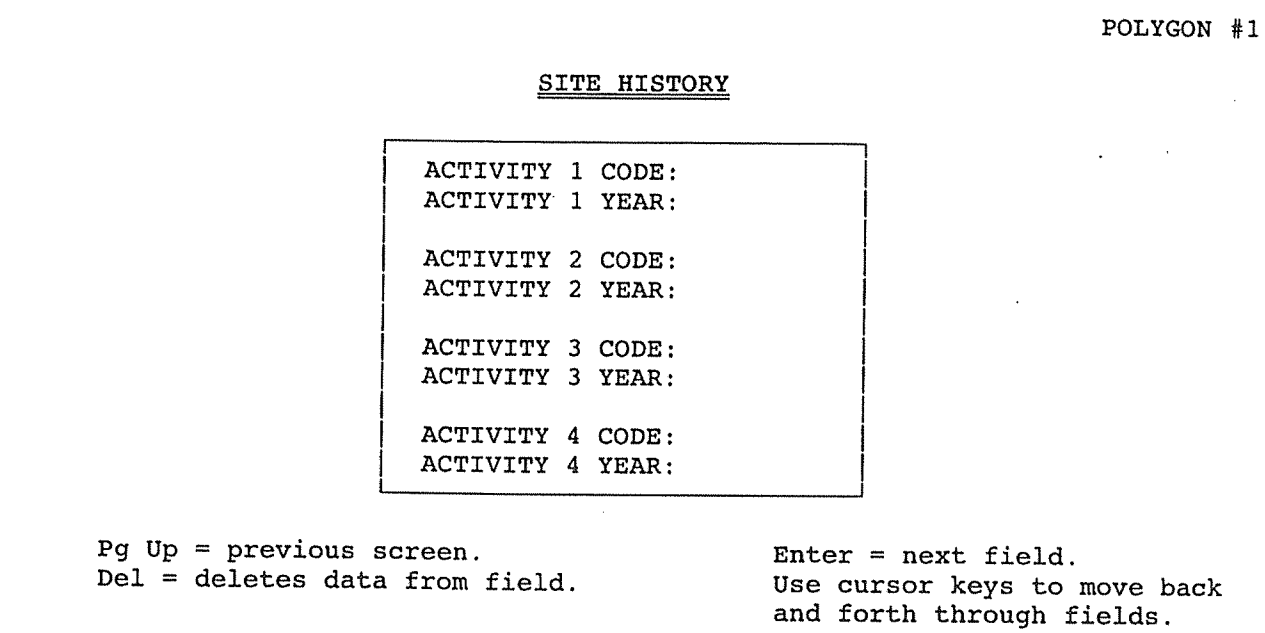
Figure 3: Stand data screen.



Site History

This screen allows the entry of site history information for a stand. The information is recorded using codes for the type of disturbance, and a year (if it is known). The codes are *DB*,*DL* and *DF* representing disturbance burn, logging and flooding respectively. The predefined function keys are shown in Figure 4.

Figure 4: Site history entry screen and function key assignments.



Field Samples

Field sample numbers are entered using a combination of the plot numbers and continuation symbols. The continuation code is either a comma (',') or a dash ('-'). Commas indicate additional, non-contiguous samples in the stand, while dashes represent a series of contiguous samples within a stand. For example, if a stand had plots 910012 through 910015, 910023 through 910024 and plot 910027 the field sample information would be represented as: *910012-910015, 910023-910024, 910027.*

Figure 5: Field sample screen.

POLYGON #1

FIELD SAMPLES

FIELD SAMPLE 1 NUMBER:	910012
FIELD SAMPLE 1 CONT:	-
FIELD SAMPLE 2 NUMBER:	910015
FIELD SAMPLE 2 CONT:	,
FIELD SAMPLE 3 NUMBER:	910023
FIELD SAMPLE 3 CONT:	-
FIELD SAMPLE 4 NUMBER:	910024
FIELD SAMPLE 4 CONT:	,
FIELD SAMPLE 5 NUMBER:	910027
FIELD SAMPLE 5 CONT:	0
FIELD SAMPLE 6 NUMBER:	0
FIELD SAMPLE 6 CONT:	0
FIELD SAMPLE 7 NUMBER:	0

Stratum and Label Generation

Note: This procedure is used only after the attribute entry database has been joined to the PAMAP exported database.

The *Stratum and Label Generation* option of the *Stratums/Labels* menu is used to generate site indexes, site classes, stratum numbers and polygon labels. This procedure first displays a list of file names and requests the user to enter the name of a file. The procedure then runs an error checking/editing routine and a labelling routine. This program also automatically replaces all NSR site class low with NP disturbance burn.

The error routine places a code in a field called *NOTE* when errors are found. The following table outlines the codes and associated error conditions:

Code	Error Condition
TYPE	Missing or invalid polygon type
COMP	Composition does not sum to 100%
AVG_H	Average height missing
AGE	Age missing
CC	Crown closure missing
S_C	Site Class missing (NSR polygons)

When errors are found the user is placed into dBase's edit mode to correct the errors. The error routine only detects one error at a time and therefore additional errors can be found after the initial ones are corrected. The program will loop through the error routine until no errors are detected.

The labelling routine manipulates the error free database and generates site indexes, site classes, stratums and labels. The user is returned to the menu when execution is completed.

APPENDIX E: LEGEND MERGING

The following document outlines the methodology Forest Resources uses to merge a forest cover map legend into a forest cover map. Forest Resources uses the GIS software PAMAP to create forest cover maps. The legend template was also created within PAMAP. This document assumes that the software being used is PAMAP and that the user has digital copies of the files **LEGEND7.HRD, LEGEND7.DFL, LEGEND7.VFL, LEGEND8.HRD, LEGEND8.DFL AND LEGEND8.VFL.** The legend7 files are to be used when working with maps that lie within UTM zone 7 and the legend8 files are for UTM zone 8 maps

Legend merging involves moving and rotating a legend template in geographic space so that it lines up with the target map. The legend is then merged into the target map.

Before beginning this procedure make a back up copy of the target map and create a working copy of the legend template in your working directory. VFLANA is the utility that will be used for much of the legend merging procedure. Unfortunately, VFLANA is not documented and can easily corrupt maps if incorrect information is entered or incorrect options are selected. Therefore, making backup copies are essential.

The different processes of legend merging use two different coordinate systems and require conversions. PAMAP MAPPER, Query outputs locations in UTM coordinates which are expressed in metres (with two decimal places). VFLANA expresses locations in Units of Resolution (UORs). The UOR for a map is set during CREATE MAP. Forest Resources' 1:50,000 forest cover maps have the UOR set to centimetres. To convert between metres and UORs, multiply the value in metres by 100.

i. Backup the TARGET map files.

ii. Make a working copy of the appropriate legend template file.
   - Use DOS to copy the files into your working directory.
   - The legend template file is a map file containing only the legend. There are separate legend files for each UTM zone. For example, the legend template for zone 7 maps is found in LEGEND7.HDR, LEGEND7.VFL and LEGEND7.DFL.

- The legend template files have a text angle of 0.000° and centre coordinates of:
  LEGEND7 - Zone 7 - 64900006, 675100051 UOR's
  LEGEND8 - Zone 8 - 46000000, 680000000 UOR's
  This location information is used in the merging process.

iii. Determine the location of the centre of the TARGET map (the map into which you are merging the legend).

- The centre is found by using 2D-STRING to draw an x across the map, snapping to the corners, and querying the junction point. This query will give you a location in metres (not UOR's). These coordinates must be multiplied by 100 for use in VFLANA.

iv. Digitize a box in TARGET to allow clipping during the legend merge.

- On level 64, use 2D-STRING to create a box equal to the full size of the range rectangle. The work window may have to be expanded to display the entire range rectangle prior to drawing the box.

v. Determine the text angle of TARGET.

- In MAPPER, use the TX ANGL option of the SET menu to query the text angle.

vi. Use VFLANA to set scan criteria for LEGEND.

- Scan criteria define what elements will be modified during VFLANA operations. Scan criteria must be set so that only the legend information is modified.
- In VFLANA use option 2, OPEN MAP, 8, RESET SCAN CRITERIA, to empty the scan buffer. Use option 7, ADD SCAN CRITERIA, and specify level 4, lines and text. All other options should be left blank. Use option 21, READ SCANNED ELEMENTS, to scan the file and select all elements matching the scan criteria. Use the PAUSE key to pause the screen and determine how many elements were scanned (you must be quick for this, 399 or 400 elements should be scanned, depending on which legend you are using).

vii. Rotate LEGEND to match the text angle of the TARGET map.

- In VFLANA use option 31, ROTATE ELEMENTS, to specify the angle and origin for the rotation. The angle of LEGEND is 0, so that if the angle of TARGET is 1.95, the angle of rotation is also 1.95. The origin for the rotation is the centre of LEGEND (not TARGET). By specifying the centre of LEGEND, the legend will rotate without being displaced during the process.
- The legend centre point must be specified in UOR's (centimetres for forest cover maps, the above figures for the centres of LEGEND7 and LEGEND8 are in UOR's).

viii. Offset LEGEND to coincide with the location of the TARGET map.

- This step is the most prone to error and should be done carefully because a mistake here means starting over from the beginning.
- In VFLANA use Option 12, MODIFY ELEMENT INFO, to offset the legend to the location of TARGET. LEGEND will have to be offset in both the x and y directions. The direction and magnitude of the offsets are critical. Ensure that all locations are expressed in UORs.
- To calculate the offset values subtract the LEGEND coordinates from the TARGET map coordinates. For example:

	X	Y
TARGET	62,406,201	669,516,712
LEGEND	46,000,000	680,000,000
OFFSETS	16,406,201	-10,483,288

- To double check the calculated offsets draw the relative locations of TARGET and LEGEND and see if the offsets make sense. In the above example, the positive x offset indicates that the TARGET map is to the east of LEGEND and the negative y offset indicates that TARGET is to the south of LEGEND. Double check your calculations before completing this step.

ix. Close LEGEND and exit VFLANA

x. Merge LEGEND into TARGET.

- Use PAMAP's MAP MERGE to merge LEGEND into the TARGET map. The following settings should be used on the configuration screen.

Area of interest: Start level: 64
End level: 64
Use interior or exterior area of interest: I
Clip: Y
Input scan criteria: Start level: 4
End level: 4
Input element types: 2D line, Text
Output specs.: Level: 4

- Check the MAP MERGE output screen to ensure the proper number of elements merged. If no elements merge or too few elements merge, then the rotation or offsets were probably incorrect and should be checked. If errors were made then make a new working copy of LEGEND and begin at step vi.

xi. Use MAPPER to view the results.

xii. Edit the Legend to match the map.

- The map title and number must be changed. Edit the text using MAPPER's MODIFY TEXT feature.

Potential Hangups:

1. Specify rotation origin and offset in UOR's not metres (querying a point or distance in mapper gives a figure in metres).

2. If the rotation doesn't work the original text angle can be double checked by re-creating the mapsheet in a temporary file and querying the text angle.

3. If the legend seems to be in the right place but will not merge with the output map, create the map again (in a temporary directory) and double check its location and rotation. (The output map may have been moved inadvertently. If it is moved to the edge of the zone, so that part of the map has negative coordinates, the merge will not work.)

4. If the legend is in the right place at the right angle but merging gives an error due to a degenerate polygon, check for extra elements on the level with the clipping box. If this fails try placing the clipping box on another level which is unused in both the target and the legend files.