FOREST INVENTORY MANUAL

CHAPTER FIVE

PREPARATION OF FOREST COVER SOURCE MAPS FOR THE FOREST RESOURCE INFORMATION SYSTEM

1990

MINISTRY OF FORESTS
INVENTORY BRANCH
1450 GOVERNMENT STREET
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FOREWORD

The British Columbia Forest Act (1978) states that the Chief Forester shall develop and maintain an inventory of the land and forests in the Province, and shall assess the land in the Province for its potential for growing trees continuously, providing forest oriented recreation, producing forage for livestock and wildlife, and for accommodating other forest uses. Also, the Ministry of Forests Act (1978) requires a periodic resource analysis report containing a description of the inventory of the forest and range resources in the Province, a description of the location and extent of areas of forest land in the Province that have been denuded of timber through harvesting or otherwise and have not become restocked with a commercially valuable species of timber, or are producing timber at the rate that is substantially lower than their potential. In addition, the Minister of Forests is required to submit to the Lieutenant-Governor in Council an annual report which must include a summary of forest land in the Province, showing areas denuded of forest during the year, areas restocked during the year and areas the productivity of which has been improved during the year.

In order to meet the requirements of the current forest legislation, the Inventory Branch of the Ministry of Forests has acquired new technology and has developed new approaches for conducting forest inventory. The Forest Inventory Manual, consisting of twelve chapters, and the inventory handbooks, namely the Field Handbook, the Helicopter Camera Boom Instruction and Operation Handbook, the Black-and-White Stereogram Handbook, the Colour Stereogram Handbook, and the Stereocord Handbook, describe the procedures for planning, conducting and auditing provincial forest inventories.
CHAPTER FIVE

PREPARATION OF FOREST COVER SOURCE MAPS FOR THE FOREST RESOURCE INFORMATION SYSTEM

1990

Chapter five, "Preparation of Forest Cover Maps Source Maps for the Forest Resource Information System", of the Forest Inventory Manual is a description of forest cover mapping details and the procedures for preparing forest cover maps for input into the computer assisted mapping system.

For further information, please contact:

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5.1 INTRODUCTION

The inventory of the lands and forests of British Columbia is graphically portrayed on forest cover maps. Since 1979, the Inventory Branch has employed geographic information system (GIS) techniques on an Intergraph interactive computer graphics system (I.G.D.S.) to produce forest cover maps. The purpose of this chapter is to describe the procedures for the preparation of forest cover maps, or source documents, for input into the GIS system.

Up to 1976, the Branch produced forest cover maps at a scale of 1:15 840 or 1:31 680 using the interpretation of mid-scale aerial photographs supported by field data, stereoscopic plotting techniques, and hand-drafting methods. Since 1976, it has produced forest cover maps at a scale of 1:20 000 with a few sub-unit areas being mapped to a scale of 1:10 000. In 1979, computer assisted mapping was introduced and presently the Branch is building the digital data base for over 6700 6' x 12' forest cover maps for the province and is updating digitized maps on a regular basis.
5.2 METHODS FOR PREPARING GIS INPUT DOCUMENTS

The methods for updating and preparing forest cover maps for input into the GIS system fall into three categories:

A. Reinventoriry

A reinventory is the complete restratification of an area on recent, mid-scale aerial photographs based on extensive new field work. Type lines are plotted on the most recent planimetric base maps and a description of each type is entered on a forest cover and history attribute list (F.S. 810) for detailed forest cover data entry.

B. Direct Label Entry

Direct label entry is a procedure for keypunching coded labels for a previously undigitized area directly from a forest cover map into the data base. The input documents are forest cover maps from previous surveys and each map is usually updated for history before direct label entry. Only those types that are 20 years old or less and/or that have a recent data source are entered on an attribute list.

C. GIS Update

A GIS update is the updating of a digitized map for history and forest types field checked since the last inventory or update. All new, deleted or modified type labels are entered on an attribute list. New levels of information that were not previously entered may be placed in the file at this time, i.e. planning cells, biogeoclimatic zones, recreation polygons, etc.

Figure 5-1 is an illustration of the flow of forest cover maps through the mapping system. Mapping details pertaining to input maps in general are described in Section 5.5. For specific procedures on each method of preparing input maps, refer to Sections 5.6 to 5.8.
FOREST INVENTORY
PREPARATION OF FOREST COVER
SOURCE MAPS FOR THE FOREST
RESOURCE INFORMATION SYSTEM

FOREST COVER DATA ENTRY

REINVENTORY
- Total restratification
- New map compilation
  Attribute lists only

GIS UPDATE
- Minimal restratification
- Map revision
  Attribute lists only
  Updated for depletions

DIRECT LABEL ENTRY
- Minimal restratification
- Map revision
- Direct entry of coded map
  labels plus attribute lists
  for special situations

DISTRICT AND REGIONAL
QUALITY CONTROL

BRANCH QUALITY
CONTROL

GRAPHIC AND
ATTRIBUTE
PROCESSING

DIGITAL DATABASE

Figure 5-1 Flow of forest cover maps through the geographic information system
5.3 PREPARATION OF BASE MAPS FOR FOREST COVER MAPPING

5.31 PLANIMETRIC BASE MAPS

Forest cover detail is overlaid on planimetric base maps which portray toponymic and cadastral details. In the past, several different methods for the preparation of base maps have been used resulting in variations in their reliability. Presently, the Ministry of Crown Lands uses 1:60,000 aerial photographs for ground control in the preparation of standard 1:20,000 planimetric base maps for the entire province. To indicate progress of the base mapping program, a 'Base Mapping Catalogue' is prepared quarterly on microfilm and a read only base mapping catalogue file is kept current on the British Columbia Systems Corporation (B.C.S.C.) mainframe computer. Access to this file is available to other ministries.

Planimetric base maps, base mapping catalogues (MAPS - B.C. Catalogue and microfiche) and indices, and information on accessing the base mapping catalogue file are available from MAPS - B.C. of the Surveys and Resource Mapping Branch, Ministry of Crown Lands.

5.32 CONVERSION OF MAPS FROM NTS TO BCGS

With the introduction of a standard system of mapping in 1976, the format of forest cover maps was changed from the National Topographic Series (NTS) at scales of 1:15,840 (7 1/2' x 7 1/2") and 1:31,680 (15' x 15") to the British Columbia Geographic System (B.C.G.S.) at scales of 1:20,000 (6' x 12'), and occasionally, 1:10,000 (3' x 6'). Therefore, all maps submitted for digitizing must be to the B.C.G.S. format. The preferred scale is 1:20,000 or 1:10,000 but 1:15,840 and 1:31,680 may be accepted. For details on converting maps from N.T.S. to B.C.G.S. format, contact the regional draughting and inventory sections or the Forest Resource GIS Section of the Inventory Branch.

5.33 LOCATION OF PHOTO CENTRES

In order to transfer forest cover detail from aerial photographs to planimetric base maps, the centres of the appropriate photographs must be accurately located on the maps. For details on locating photo centres using the radial line method, refer to the Data Transfer Handbook.
5.4 DERIVATION AND TRANSFER OF POLYGON BOUNDARIES

Originally, the provincial forest inventory program consisted of surveys of Public Sustained Yield Units (P.S.Y.U.) on ten-year cycles. Forest and non-forest types were stratified via interpretation of mid-scale aerial photographs, supported by field information. The resultant forest cover types or polygons were then transferred from the photographs to planimetric base maps by means of optical plotting devices. For details on the stratification and description of the land base, refer to Chapter 3, 'Forest Classification', and for details on photo interpretation of stratification criteria, refer to Chapter 7, 'Photo Interpretation' and to the Black-and-White Stereogram Handbook.

Sections 5.41 to 5.43 describe various sources of information and line transfer methods used to place polygon boundaries on input maps. For details on the use of plotting instruments such as the Kail plotter and zoom transferscope, see the Data Transfer Handbook.

5.41 AERIAL PHOTOGRAPHS

The types of aerial photographs used in British Columbia for delineating polygon boundaries are mid-scale and small-scale conventional aerial photographs and, occasionally, 70 mm photographs taken from a helicopter equipped with a fixed-base camera boom.

5.4.11 Mid-scale

Mid-scale aerial photographs are commonly used for interpreting stand parameters (species composition, age, height, site, crown closure, stand structure, stand density, stocking, types and degree of disturbance, environmentally sensitive areas, and operability). Common mid-scales used in British Columbia are 1:10 000, 1:15 000, 1:15 840, 1:20 000 and 1:31 680. Transferring polygon boundaries from mid-scale aerial photographs is usually done via Kail plotter and/or epidiascope.

Note: 1:15 840 and 1:31 680 aerial photographs were used for forest classification prior to metrification. Although no longer taken, classification for much of the province remains on these scales of photographs.
5.412 Small-scale

Small-scale aerial photography commonly refers to scales of 1:40 000 and greater. In British Columbia, 1:40 000 to 1:60 000 aerial photographs are often used in forest inventory for mapping clearcut areas, crown fires and windfall. Boundaries of depletions or disturbances are delineated on 1:40 000 to 1:60 000 aerial photographs and then transferred to forest cover maps via zoom transferscope, epidiascope, Kail plotter or equivalent stereoscopic plotting instruments.

5.413 70 Millimetre

1:5 000 to 1:10 000 70 mm photographs taken from a high-flying helicopter, equipped with twin Hasselblad cameras mounted on a fixed base camera boom, can be a relatively accurate and inexpensive technique for mapping disturbances when used in conjunction with a zoom transferscope. An important prerequisite for boundary transfer via zoom transferscope is that some topographic details, for purposes of control, are recognizable on both the 70 mm photographs and the conventional aerial photographs.

In active areas where conventional aerial photography has not been obtained for a relatively long period of time, 70 mm photography may not be feasible. Also, this method is generally unsatisfactory for mapping large and complex disturbances that require more than two photographic flight lines.

5.42 SATELLITE DATA

Data on the earth's surface from earth orbiting satellites are available as photographic products (analogue) and on computer compatible tapes (digital). The photographic products are similar to very high elevation aerial photographs and are used in forest inventory for monitoring forest depletions and, for scales of 1:250 000 and larger, may be used for transferring depletion boundaries. Digital information on the computer compatible tapes is analyzed via an image analysis system and is presently being used by the Branch to map depletions.
5.421 Thematic Mapper (TM)

The Thematic Mapper (TM) is a high resolution sensor aboard Landsat 5 that focuses reflected light and thermal energy onto an array of detectors, each sensitive to 1 of 7 wavebands. TM data have a resolution of 30 metres and are available in both analogue and digital form. TM paper prints and transparencies at scales of 1:125 000 and 1:50 000 are presently being used for mapping depletions caused by harvesting, fires and insects. Boundaries of these disturbances are transferred from the TM photographic products to 1:20 000 forest cover maps via epidiascopes, zoom transferscopes or digitizing stations.

Geometrically corrected TM computer compatible tapes are also available for the same area (one-quarter of a 1:250 000 scale N.T.S. map).

TM digital data are analysed on the Branch's image analysis system for updating forest depletions. Also, with the increased resolution and number of wavebands, TM digital data may be used for confirmation of forest cover classification.

5.422 SPOT

SPOT is an earth observation satellite built in France in association with partners from Belgium and Sweden and launched in February, 1986. SPOT has two identical High Resolution Visible (HRV) imaging instruments which observe in three spectral bands (in the visible and near infrared portions of the spectrum) with a ground resolution of 20 metres, and in a broader spectral band (panchromatic black and white) with a ground resolution of 10 metres. This 10-metre resolution imagery should provide information on forest stand structure.

A key feature of SPOT satellites is a sidelaying capability that enables revisit coverage at intervals ranging from one to several days, thus allowing the monitoring of fast-changing phenomena. The sidelaying capability also provides stereoscopic pairs of images of a given scene which will enable the compilation of three-dimensional forest land information systems.
5.423 Satellite Image Analysis

In 1984, the Branch acquired a digital image analysis system to analyze satellite digital data. An Intergraph colour raster digitizing station was also acquired thus enabling the integration of satellite digital data with geocoded digitized forest cover map data. Presently, precision-coded Thematic Mapper digital data are enhanced on the image analysis system to highlight forest depletions. Enhanced images of individual 6’ x 12’ forest cover maps showing changes in forest cover are then loaded to the colour raster screen. Forest cover details from the GIS file for the same map are displayed as an overlay. Any new depletions showing on the satellite images that are not on the forest cover map are digitized on the colour raster station. A forest cover map showing updated depletion boundaries can then be produced. Descriptive labels for each disturbance are subsequently provided by the inventory section of the appropriate forest districts.

To date, the Branch has used both Landsat MSS and TM data for updating forest depletions via the image analysis system. However, SPOT, MEIS and radar data, which will provide even more information for updating forest cover maps, may be utilized as they become more readily available.

5.43 USE OF MICROCOMPUTERS

The Ministry of Forests has acquired several Geographic Information Systems. GIS is a computer-based mapping system capable of downloading, updating and uploading map design files and inventory data files. The GIS system is also capable of displaying and utilizing satellite images for updating forest depletion. With GIS, regional and district staff are able to update forest cover maps locally by digitizing depletions from local input maps, from thematic mapper photographic products, and from classified and downloaded satellite digital data.

5.44 DISTRICT HISTORY MAPS

A district history map is a current record of history (disturbance, site preparation, stand tending, regeneration) and is maintained for all forest cover maps in the province at the district level on matte film contact prints.
5.44 DISTRICT HISTORY MAPS CONT.

These maps, commonly referred to as history mylars or operational maps, are an integral part of maintaining a current forest inventory. In some cases, paper copies of these updated forest cover maps are used as input maps and, in other cases, history information is transferred to other maps which are being used as source documents (see Section 5.8). The boundaries of history are mapped from aerial photographs, satellite imagery, sketch maps or from ground traverses.

When transferring disturbance boundaries to history maps, three distinct line types are used to accommodate the different levels of accuracy inherent in each method (see Table 5-1).

**Planned and Assumed Boundaries**

Planned cutting permit limits may be shown on history maps in pencil. Upon completion of harvesting, the pencilled pre-logging boundaries are inked-in if they are assumed to be correct.

**Sketch Mapping and Closed Traverse Boundaries**

Sketches of disturbances are first done on aerial photographs and, occasionally, maps and then transferred to the history maps via radial line plotting. Sketching may be done from the ground by using tie-in measurements, by observing from a vantage point, or by aerial reconnaissance. The accuracy of sketch mapping depends on the number and nature of identifiable topographic features and on the skill of the mapper.

Locating the perimeter of openings by running a closed traverse has been a traditional means of updating history maps. However, this method is labour intensive and variable in accuracy, and is being replaced by remote sensing techniques.

**Aerial Photographs and Satellite Images**

Conventional aerial photographs, 70 mm photographs, and satellite images provide the most accurate means of mapping disturbance boundaries. Assumed, sketched, and traversed boundaries should be replaced with boundaries derived from aerial photographs or satellite images as soon as possible.
Table 5-1
Disturbance boundary accuracy by method

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>Method</th>
<th>Type Line</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Planned boundary (pencil)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assumed boundary (ink)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Sketch mapped</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Closed traverse</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Conventional aerial photographs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>70 mm photographs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Satellite images</td>
<td></td>
</tr>
</tbody>
</table>

For details on types of history see Chapter 3, 'Forest Classification'; for details on updating history on digitized maps, see Section 5.9.

5.5 MAPPING DETAILS

Mapping details that pertain to all methods of preparing forest cover maps for GIS input are described in Section 5.51 to 5.58. For complete mapping procedures on reinventory, direct label entry, and on GIS update, refer to Sections 5.6, 5.7 and 5.8, respectively.

5.51 POLYGON SIZE

When determining minimum polygon size, it is important to consider type significance, sources of information, polygon shape, complexity of descriptive label and map clutter. Suggested minimum type sizes for forest and non-forest polygons for different scales of classification photos and input maps are indicated in Table 5-2.

For recording silviculture details with openings there are no minimum polygon sizes.
### Table 5-2

<table>
<thead>
<tr>
<th>Photo Scale</th>
<th>Minimum Type Size</th>
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<tr>
<td>Forest</td>
<td></td>
</tr>
<tr>
<td>1:10 000</td>
<td>2 ha</td>
</tr>
<tr>
<td>1:15 000</td>
<td>5 ha</td>
</tr>
<tr>
<td>1:15 840</td>
<td>5 ha (existing photos only)</td>
</tr>
<tr>
<td>1:20 000</td>
<td>5 ha</td>
</tr>
<tr>
<td>1:31 680</td>
<td>20 ha (existing photos only)</td>
</tr>
<tr>
<td>Non-Forest</td>
<td></td>
</tr>
<tr>
<td>1:10 000</td>
<td>1 ha</td>
</tr>
<tr>
<td>1:15 000</td>
<td>2 ha</td>
</tr>
<tr>
<td>1:15 840</td>
<td>2 ha (existing photos only)</td>
</tr>
<tr>
<td>1:20 000</td>
<td>2 ha</td>
</tr>
<tr>
<td>1:31 680</td>
<td>8 ha (existing photos only)</td>
</tr>
</tbody>
</table>

Smaller polygon sizes may be justified for the following:

- Clearly defined, important types.
- Areas where detailed history records, such as silvicultural treatments, are available.
- Polygons along neat line joins (see Figure 5.2 for details).
- Small ponds and rocks or islets occurring in lakes, oceans and rivers (see Appendix 5-2). Polygon numbers are not required.
- Small swamps that are useful for ground control. Polygon numbers are not required.

### 5.52 POLYGON DESCRIPTIONS

Describing polygons on forest cover maps has changed considerably in past years. The most significant change was the conversion of the old coded labels to full attribute descriptions in 1979 when the forest classification system was redesigned with the introduction of computer assisted mapping and data storage.
The following procedures are intended to maintain standardized forest cover descriptions and thereby facilitate statistical summaries and to increase user acceptance of forest cover maps:

A. Reinventory and GIS update

1. Descriptive details are entered on a forest cover and history attribute list (F.S. 810) for each numbered polygon. Deleted and modified polygon descriptions for GIS update may also be entered on double-spaced attribute listings or directly into electronic attribute files. For details on polygon attributes and on the entering of attributes onto forest cover and history attribute lists, refer to Chapter 3, 'Forest Classification'.

2. Full descriptions for a polygon in a forested area should have these attributes:

   - Polygon number
   - The presence of a veteran component, when applicable
   - The presence and rank of multi-layers, when applicable
   - Species composition
   - Age
   - Height
   - Reference year
   - Site, which is shown only for stands of less than 20 years of age, suppressed stands released by disturbance, NCBR, DSD and NSR
   - Crown closure
   - Density, when applicable
   - Stocking, when applicable
   - Environmentally sensitive area codes, when applicable
   - Inoperable area code, when applicable
   - Data source codes
   - History record opening number, when applicable
   - History symbols and codes, when applicable

B. Direct label entry

1. Use the original coded labels with the addition of crown closure and data source codes on input maps (see Figure 5-17).

   Example: FPy 831-M7 (2,0)
2. For the following types detailed descriptions are entered on an attribute list rather than the original map label codes:

   a) Types having an age of 20 years or less referenced from the current year.

   b) Types having a history of disturbance or silvicultural activity within the last 20 years.

   c) Types having a ground call, ground sample, photo sample, 70 mm air call or any other reliable data source established since the last unit survey.

3. If desired, enter detailed descriptions on an attribute list to more fully describe:

   a) Residual types

      Example: BS 82 Resid-P

   b) Multi-layered stands

      Examples:

      PI 531-M, At 532-P, PI220-P, N.S.R.-M
      +F Vol +S Imm +S Vets +F S.T.

4. Cross out any coded labels on input maps that are not to be keypunched. This includes all map labels that are replaced with detailed descriptions entered on attribute lists and labels that are associated with polygons that are below minimum size.

C. Label formats (direct label entry) and detailed polygon descriptions (reinventory and GIS update) should be consistent throughout a defined project area such as a T.S.A., P.S.Y.U., Sub-unit or Timber Supply Block.

D. Standards for polygon descriptions within a mapsheet

1. Be consistent with descriptions (same type parameters) or maps having no adjoining projects on the same mapsheet.

2. For maps having two or more adjoining projects:

   a) Be consistent with descriptions within each project.
b) Ensure that the descriptions for polygons straddling two or more projects contain all the attributes required by each project. For more details on describing polygons straddling administrative boundaries, see Section 5.55.

E. Standards for polygon descriptions between mapsheets

Whenever possible, type boundaries and type descriptions should match along map neat lines. However, each segment of a type which has been cut by a neat line has its own record and mapsheets are summarized independently. Therefore, descriptive procedures along neat lines depend on whether or not the neat line is a project boundary and on the sequence of updating.

1. For map neat lines that represent a project boundary, type boundaries may match but descriptions can differ.

2. For map neat lines that interface within a project, type boundaries and descriptions must match.

3. For maps that are updated at different times, the type boundaries and descriptions along neat lines do not have to match.

5.53 POLYGON NUMBERING

Number the polygons on input maps as follows:

A. Assign a unique number to each polygon meeting minimum size requirements.

B. Enter the unique number in a logical, systematic order starting from number one.

C. Use a unique number once only on a mapsheet and enter the number once only in each polygon.

D. Do not use polygon numbers 2850 to 2949 as these numbers are reserved for Branch use only.

E. Enter the unique numbers in their respective polygons for the different types of input maps as follows:
1. Reinventory - enter in red ink.

2. Direct Label Entry:
   
a) For polygons with labels to be keypunched, enter in red ink next to label.
   
b) For polygons entered on an attribute list, enter in black ink and circle the number in red ink.

3. GIS Update - Enter new or relocated polygon numbers in black ink. Highlight new polygon numbers in red and highlight relocated numbers in green.

F. For types that are too small to have the polygon number written clearly inside them, box or bracket numbers and arrow them into the small types.

   Example: \[437\]

G. Do not number small ponds and rocks or islets in lakes, oceans and rivers that are smaller than suggested minimum sizes. All other non-forest types large enough to type must have a polygon number, (see Appendix 5-2).

H. Do not number the following non-forest types occurring within non-forest land or unproductive forest land (see Appendix 5-2):
   
   - Shifting gravel bars within double line rivers
   - Small, barren islands
   - Small lakes, ponds and swamps within non-productive forest and alpine forest zones

I. List on the edge of the map:
   
   - Polygon numbers that are out of sequence and reference them to a number that is in sequence
   - All polygon numbers not used
   - Blocks of polygon numbers used, the last number used and the date it was entered:
Example:

<table>
<thead>
<tr>
<th>Polygon Numbers</th>
<th>Not Used</th>
<th>Out of Sequence</th>
<th>Last Number Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>66</td>
<td>68 721</td>
<td>721 June 26, 1985</td>
</tr>
<tr>
<td></td>
<td>76</td>
<td>69 682</td>
<td></td>
</tr>
<tr>
<td></td>
<td>102</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- For GIS update maps, all deleted and added polygon numbers.

Note: For details on numbering polygons that straddle administrative boundaries, see Section 5.55.
5.54 POLYGONS ALONG NEAT LINES

A neat line is a line bordering the detail of a map. When mapping along neat lines:

A. Match the boundaries and type descriptions of polygons that straddle neat lines.

B. For reinventory projects, enter one full attribute description for each polygon along the east and south neat lines of each map to improve matching the descriptions along neat lines. Ensure that the description is entered on the attribute lists for all maps on which the type occurs.

C. Whenever possible, eliminate polygons that occur along neat lines that are smaller than the suggested minimum sizes indicated in Table 5-2.

Examples of eliminating or retaining small polygons along neat lines are given in Figure 5-2.

D. For type lines that run near to map neat lines, ensure that the outside edge of the type line is drawn at least 1 mm from the edge of the neat line (see Figure 5-3).

E. After each neat line is checked for polygon boundary and label joins, record along the map margin: N.L. checked, the initials of the checker, and the date.

5.55 ADMINISTRATIVE BOUNDARIES

Use these guidelines when numbering and preparing polygons that straddle T.S.A., P.S.Y.U., and Forest Inventory Zone (F.I.Z.) boundaries. Treatment depends on the presence or absence of digitizing and on the type of administrative boundary.

A. Polygons that straddle the boundary of a digitized T.S.A. (partially digitized polygons)

1. Clearly separate the area currently being surveyed from the area that has been digitized.

2. Ensure that all type lines are connected and that there are no hanging type lines between the two T.S.A.s.
<table>
<thead>
<tr>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationalize the polygon type lines. Delete small types as required.</td>
<td>![Diagram showing deletion of small lines]</td>
</tr>
<tr>
<td>Reduce the minimum size requirements if the type line separates forest land from non-forest land. Assign a polygon number.</td>
<td>![Diagram showing assignment of polygon number]</td>
</tr>
<tr>
<td>Reduce the minimum size requirements if the polygon is a topographic feature, such as a lakeshore or double line river.</td>
<td>![Diagram showing retention of small polygons along neat lines]</td>
</tr>
</tbody>
</table>

Figure 5-2  Elimination or retention of small polygons along neat lines.
3. Because a polygon that straddles a T.S.A. boundary can only have one unique number and description, use the unique number and description previously entered in the data base unless better information is available. Enter the unique number in black on the digitized side of the boundary. Do not re-enter this polygon on an attribute list (see Figure 5-4).

![Diagram of type lines near neat lines](image)

**Figure 5-3** Type lines near neat lines

![Diagram of polygon straddling T.S.A. boundary](image)

**Figure 5-4** Polygon straddling a T.S.A. boundary
4. To change the description of a polygon that has been digitized previously, make entries on forest cover and history attribute lists (F.S.810) or double-spaced attribute listings as follows:

a) F.S. 810

i) First: Enter the polygon number followed by the word "DELETE" entered under the column NP FOREST or NON-FOREST COVER CLASS.

ii) Second: Enter the same polygon number followed by the new type description.

b) Double-spaced attribute listing. For details on the use of double-spaced attribute listings, refer to Appendix 5-1C3b.

5. To remove a polygon number and its associated description from the data base, enter on the forest cover and history attribute list (F.S.810) the polygon number and the word "DELETE" under the column NP FOREST or NON-FOREST COVER CLASS, (see Figure 5-5). When using double-spaced attribute listings, simply cross out the polygon number and its description in red.
Figure 5-5 Polygon crossing a T.S.A. boundary several times

In Figure 5-5, the forest type crosses a T.S.A. boundary several times to form three polygons on one side and one on the other. Because a type can only have one unique number and description, two of the numbers must be removed from the map and from the database as described above. All deleted polygons must be listed on the map edge under "Deleted Numbers".

B. Polygons that straddle the boundary between two previously undigitized unit surveys, each with a different reference year (see Figure 5-6).

1. Clearly draw a line separating the two unit surveys.
2. Clearly enter the year of survey (reference year) for each unit survey in the map margin.
3. Ensure that all type lines are connected and that there are no hanging type lines between the two units.
4. Enter one polygon number only inside the unit with the most accurate type label.
5. For direct label entry maps, add crown closure and a data source.
Figure 5-6 Polygons that straddle two previously undigitized unit surveys

C. Polygons that straddle a F.I.Z. boundary that separates coastal from interior forest zones.

A F.I.Z. boundary that separates coastal from interior forest zones must be used as a type boundary because different site index equations and loss factors are used for coastal and interior types. This rule only applies to any portion of a coastal F.I.Z. A, B, C, that interfaces with an interior F.I.Z. D, H, J, (see Figure 5-7).

Figure 5-7 Polygons that straddle a coastal-interior F.I.Z. boundary

5.56 HISTORY RECORD OPENING NUMBERS

Each opening number is unique within a mapsheet and is assigned by silviculture staff as soon as a History Record file is opened for a particular site or area. On input maps, opening numbers are written in black ink inside hexagonal symbols placed directly above the polygon number of each polygon that occurs within the treatment area or disturbance.
Opening numbers and the mapsheet to which they are referenced are also entered onto history attribute lists (F.S. 810(2)). Because the referencing of opening numbers in the province has only been partially converted from N.T.S. to B.C.G.S. format, the following situations may arise when recording opening numbers on input documents:

A. Openings referenced to B.C.G.S. format

1. Opening is situated on a single B.C.G.S. mapsheet.

For each polygon that occurs within the opening, place the opening number and symbol above the polygon number on the input maps (see Figure 5-8) and enter the opening number and B.C.G.S. mapsheet number onto a history attribute list (F.S. 810(2)).
2. Opening is situated on two or more B.C.G.S. mapsheets.

Assign an opening number unique to the B.C.G.S. mapsheet that contains the largest portion of the opening and for that map sheet record on the input map and history attribute list as described in Section 5.56 A.1. For mapsheets that contain smaller portions of the opening, place an 'X' (for cross reference) in front of the opening number as illustrated in Figure 5-9. When completing the history attribute lists for these maps, enter the B.C.G.S. mapsheet to which the opening is referenced (the mapsheet containing the largest portion of the opening). The history attribute lists in Figure 5-10 illustrate the cross referencing procedure for the opening shown in Figure 5-9.

Figure 5-9  Cross referencing of an opening that occurs on several B.C.G.S. mapsheets
Figure 5-10  History Attribute Lists (F.S. 810 (2)) for an opening situated on four B.C.G.S. mapsheets.
B. Openings referenced to N.T.S. format

Although all maps submitted for input into the GIS system must be in B.C.G.S. format, silvicultural openings are still referenced to N.T.S. format for many areas of the province. To indicate that an opening number is referenced to an N.T.S. mapsheet on input maps, place an 'N' (for N.T.S.) behind the opening numbers (see Figure 5-11). Also, list the N.T.S. mapsheet on the history attribute list rather than the B.C.G.S. mapsheet. An example of recording an N.T.S. referenced opening on input maps and on history attribute lists is illustrated in Figure 5-11. Here, opening number 12 occurs on two N.T.S. mapsheets, 92K-13-a and 92K-14-d. On the history attribute list, the opening is referenced to mapsheet 92K-14-d because a larger portion of the opening falls on this mapsheet than on 92K-13-a.

5.57 MAP MATERIAL

Input maps are usually matte film contact prints or paper copies obtained from original source documents, such as existing forest cover maps or District history mylars. The recommended mediums for the different types of input maps are:

Reinventory - Matte film contact prints
Direct Label Entry - Matte film contact prints or paper prints
GIS Update - Paper prints

5.58 COLOUR CODES

A. Type lines

1. Reinventory: To Kail plot type lines use regular lead and to hand-draw type lines use lead pencil.

2. Direct label entry: To add type lines, use black ink. To delete type lines, scrape them off or highlight them with a continuous line using a red erasable pencil.

3. GIS Update: To add type lines, use black ink and then highlight them on the paper prints with a continuous line using a green erasable pencil. To delete type lines, simply erase them or highlight them with a continuous line using a red erasable pencil.
Figure 5-11  Cross-referencing on input documents an opening that is referenced to N.T.S. format.
B. Polygon numbers

1. Reinventory: To add polygon numbers, use red ink. Erase invalid polygon numbers.

2. Direct Label Entry: To add polygon numbers for polygons having type labels that are to be keypunched directly from the input map, use red ink. To add polygon numbers for polygons having descriptions entered on attribute lists, use black ink and circle them in red ink. Neatly cross out unwanted map labels with black ink. Erase invalid polygon numbers.

3. GIS Update: To add or relocate polygon numbers use black ink. Highlight new polygon numbers with a small red circle or box using an erasable red pencil. Highlight relocated polygon numbers with a green box or circle using an erasable green pencil. When using paper prints for input maps, delete invalid polygon numbers by drawing a red line through them. Erase invalid polygon numbers from history mylars.

Note: When required, bracket or box polygon numbers and arrow them into the appropriate polygons (see Figure 5-12) using red ink.

Figure 5-12 Arrowing-in bracketed or boxed polygon numbers.
C. Polygon descriptions

1. Reinventory: Do not enter polygon descriptions on input maps.

2. Direct label entry: To add or modify map labels, history symbols and opening numbers to be directly keypunched from input map, use black ink. For example, add crown closure for each forest type in black ink. To cancel unwanted labels, specifically those that are already on an attribute list and therefore are not to be keypunched directly from the map, cross out using black ink. Do not enter labels that are on attribute lists onto input maps.

3. GIS Update: Do not enter polygon descriptions on input maps. However, for polygons that have descriptive changes only, box or circle the polygon number using a green erasable pencil.

D. Data sources

For all types on input maps, enter data source symbols, reference numbers and year of origin in green ink.

E. Roads

For all types of input maps, draw a solid or dashed single line in orange pencil to indicate new roads. Label each type of road along its course as in this example.

- Main road (Solid)
- Secondary Road (10 mm dash)
- Logging road (2 mm dash)

Note: The symbology for roads on input maps does not have to conform to the Cartographic Manual. In fact, it is easier to digitize from a single line than from the imaginary center of a double line road.
F. Trails

For all types of input maps, draw trails with a dashed single line in violet ink or violet pencil. Label each trail along its course as in this example:

```
<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>__________</td>
</tr>
<tr>
<td>Trail (2 mm dash)</td>
</tr>
</tbody>
</table>
```

Violet may also be used to identify old logging roads which have been downgraded to trails. Place the violet single dash between the existing black double dashes.

G. Fisheries Symbols

For all types of input maps, draw fisheries symbols in violet ink or violet erasable pencil. For details on fisheries symbols see Chapter 2, 'Environmentally Sensitive Areas'.

H. Opening numbers

For all types of input maps, add opening numbers and hexagonal symbols in black ink.

I. Toponymic, planimetric and cadastral detail

For toponymic, planimetric and cadastral detail (except roads and trails), make additions, deletions and changes in red ink or red erasable pencil. Clearly indicate deletions with a series of small "x"s or as a solid line, whichever is appropriate.

J. Ownership and administrative boundaries

Except as noted, show all ownership and administrative boundaries in pencil on input maps as single, solid lines. Use large, heavy-coloured numbers to identify ownership and administrative polygons and their respective codes. For details on ownership and administrative overlays see Chapter 12.

For Inventory Region and Compartment, use magenta pencil.
- For Range Unit, use magenta pencil. Show boundaries as a line of long dashes and label all boundaries as in the example:

  Unorganized  
  __________  __________ (20 mm dash, 5 mm gap) 
  White Meadow Unit

- For Stock Range, use light blue pencil. Show boundaries as a line of long dashes and label all boundaries as in this example:

  Unorganized  
  __________  __________(20 mm dash, 5 mm gap) 
  Tatla Stock Range

- For T.S.A. and Supply Block, use a red erasable pencil.
- For Ownership, use a brown erasable pencil.
- For Forest Region and District, use a light blue pencil.
- For P.S.Y.U. and Sub-unit, use an emerald green pencil.
- For Agricultural Land Reserves, use a deep yellow pencil.
- For Provincial Forests, use an orange pencil.
- For Planning Cells, use a navy blue pencil.
- For Operability, use a red pencil.
5.6 REINVENTORY

A reinventory is the complete reclassification of a digitized or undigitized area using recent mid-scale aerial photographs. First, field information from all previous surveys is transferred to the new photographs. The area is then stratified into homogeneous strata, followed by a field survey which includes the estimation and measurement of forest attribute values from the ground, from the air, and from fixed-base, low-level, 70 mm photographs.

Upon completion of the fieldwork, and final stratification of the photos, type lines are transferred from the photographs to planimetric base maps using photogrammetric plotting instruments or they can be directly entered into existing digital files with instruments adapted for that process. Following line transfer, all polygons are numbered sequentially, either manually or electronically, and a full attribute description for each stratum is written on a data entry form FS 810 forest cover attribute list together with its polygon number. Field data, local knowledge and photo interpretation are the basis for the detailed polygon descriptions.

Reinventories are conducted on a 10-year cycle. Recommended priorities are for areas where classification standards of the previous survey do not meet present standards; where changes in history and stand structure are extensive; and where poor quality photography was used for the previous survey. For details on forest classification procedures, refer to Chapter 3. 'Forest Classification'.

5.7 DIRECT LABEL ENTRY

Direct label entry is the preparation of forest cover maps from previous surveys for digitizing and for direct entry of coded labels into the data base. Direct label entry is done to accelerate initial data entry of previously undigitized unit surveys. Restratification and field work is usually restricted to areas having new history since the last survey. Most type labels are keypunched directly from the forest cover maps of the last inventory. However, all types that have a recent reliable data source, that are 20 years old or less, or that have recent history are fully described on attribute lists (F.S.810).

Direct label entry is recommended for previously undigitized unit surveys in areas where the primary requirement is to have the digital data base completed within a given time period.
5.8 GIS UPDATE

A GIS update is the preparation of previously digitized maps for updating harvest depletions and other disturbances, usually on a two-year cycle. Each map is updated for history and for forest types field-checked since the last inventory or GIS update. Except for regeneration surveys, new fieldwork is usually minimal. All new, deleted, or modified polygon descriptions are entered on attribute lists (F.S. 810 or double-spaced listing). The addition of new information that was not previously in the file can be input at the update phase, i.e. planning cells, biogeoclimatic zones, range information, etc. Revision of digital information already captured may also be carried out.

A current record of history is maintained on matte film contact prints of forest cover maps (commonly referred to as history mylars or operational maps) at the Forest District. Appendix 5-5 is a description of the procedures for transferring disturbances and for making classification changes to previously digitized forest cover history mylars. Highlighted paper prints of these updated history mylars may be used as GIS update input maps for updating on the computer assisted mapping system (refer to Appendix 5-5.2).

A second method of preparing GIS update input maps is described in Appendix 5-5.3. For this method, input maps are prepared on paper prints of original digitized forest cover maps. Updated information is transferred to these paper prints from current history mylars.

5.9 OVERLAY PREPARATION

Refer to Chapter 12, 'Map Overlays'.

5.10 QUALITY CONTROL

The computer assisted mapping program is extremely dependent on clear and accurate input maps and attribute lists. To this end, a thorough check of input attribute lists and of forest cover, overlay and planimetric and cadastral detail of input maps is required.

For each input map and its accompanying attribute lists, a 'Summary of Quality Check for Input Data Completeness Form' (F.S. 1077) should be completed (see Appendix 5-8). Copy 2 of F.S. 1077 should accompany source maps when released for digitizing.
Note: When checking input maps and attribute lists, one can assume that the classification and polygon description of the forest resource is correct. For details on forest classification guidelines, standards and quality control, refer to Chapter 3, 'Forest Classification'.
CHAPTER FIVE

PREPARATION OF FOREST COVER SOURCE MAPS FOR THE FOREST RESOURCE INFORMATION SYSTEM

APPENDICES
A 5-1.1 INPUT SOURCE MAPS

A. Planimetric base maps

For reinventory, use the most recent planimetric base maps (refer to Section 5.31).

B. Map material

Depending on the method of input map preparation, use matte film contact prints or paper prints (refer to Section 5.57). All input maps must be in good condition.

C. Map symbols

All Inventory map symbols must conform to those shown in Chapter 11, Appendix 11-1.

D. Map grids

1. For every input map, the four grid points must be accurately and clearly indicated and they must be connected by thin lines. These lines will form the neat lines of the map.

2. The west longitude must be equivalent to the east longitude (tolerance ± 1.0 mm).

3. The north latitude must not exceed the south latitude tolerance ± 1.0 mm).

E. Notations

1. The B.C.G.S. mapsheet number must be clearly indicated at the bottom right corner of each input map.

2. The approximate scale (usually 1:20 000, 1:15 840, or 1:10 000) should be noted below the B.C.G.S. mapsheet number.

3. The southwest grid point should be annotated with its correct latitude and longitude as shown in Figure 5-13.
Neat lines of map 82K.018

50° 06' 00"

116° 36' 00"

Figure 5-13  Annotation of latitude and longitude for input maps.

F. Legibility

All details entered onto input maps must be complete, neat and legible.

G. Flight lines and photo centres

The centres and numbers of all relevant aerial photographs must be clearly and precisely indicated on all source maps. Notations of very old photographs which are no longer required should be lined out in red using an erasable pencil.

H. Data sources

All data source symbols and numbers must be clearly and precisely indicated on all input maps. For details on documentation of field data, refer to Chapter 3, "Forest Classification".

I. Polygons

Each polygon must be closed and must have a unique number. This unique number corresponds to the description in the forest cover and history attribute list (F.S. 810). However, it is not necessary to assign a polygon number to very small water bodies and many non-forest types (2 ha or less) occurring within types classified as non-forest or unproductive forest land (refer to Sections 5.51 and Appendix 5-2).
The accuracy of plotting polygon boundaries varies with the source of information from which the boundaries are determined. Using conventional aerial photographs, the accuracy of plotting shall be ±1 mm at compilation scale except for those lines or features unavoidably displaced for symbolization.

Slightly greater tolerances are allowed where photo centres have been spotted, where the quality of photography is substandard or questionable, or where disturbance boundaries are derived from 70 mm photographs or satellite images. Plotting standards at 1:20 000 scale are listed in Table 5-3.

Table 5-3

<table>
<thead>
<tr>
<th>Source of Information</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-scale and small-scale aerial photographs</td>
<td></td>
</tr>
<tr>
<td>a) controlled mapping</td>
<td>± 1 mm</td>
</tr>
<tr>
<td>b) spotted photo centres</td>
<td>± 3 mm</td>
</tr>
<tr>
<td>70 mm vertical photographs</td>
<td>± 4 mm</td>
</tr>
<tr>
<td>Satellite images</td>
<td>± 5 mm</td>
</tr>
</tbody>
</table>

J. Administrative Boundaries

Where applicable, the following administrative boundaries should be accurately located and labelled on source maps:

1. Inventory Regions and Compartments
2. Timber Supply Area and Supply Block
3. Forest Region and Forest District
4. Public Sustained Yield Unit or Sub-unit

5. Provincial Forest

6. Tree Farm Licences and Tree Farms

7. Large Parks, Wilderness Areas and Conservancies

8. Land Districts

9. Municipalities

10. Stock Range and Range Unit

K. Neat Lines

Forest cover type lines and administrative boundaries must join across map neat lines. Forest cover polygon descriptions must also join across neat lines.

A 5-1.2 ATTRIBUTE LISTS

A. All entries on an attribute list must be clearly legible.

B. The mapsheet number, T.S.A., and project number must be the same for all pages.

C. All polygon numbers should be recorded in ascending numerical order according to the standards and procedures indicated in Chapter 3, 'Forest Classification'.

D. The pages of an attribute list must be stapled together in ascending numerical order.
Examples of when and when not to identify polygons for different topographic, cadastral, environmental or historical situations.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Example (1:20 000)</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>River entering lake or sea</td>
<td>![River Diagram]</td>
<td>Draw a straight line across the river mouth and assign two numbers</td>
</tr>
<tr>
<td>Sandbars and beaches</td>
<td>![Sandbars Diagram]</td>
<td>Ignore as distinct polygons</td>
</tr>
<tr>
<td>Islets and rocks in lakes or oceans</td>
<td>![Islets Diagram]</td>
<td>All islets and rocks form discrete polygons. Note the minimum size range at a scale of 1:20 000. Note: Unnumbered islets will still be shown but will not contain a descriptive label</td>
</tr>
<tr>
<td>Snag line in flooded lake</td>
<td>![Snag Line Diagram]</td>
<td>Ignore the flooded area having snags</td>
</tr>
<tr>
<td>Split single line stream</td>
<td>![Split Stream Diagram]</td>
<td>Ignore, not a polygon</td>
</tr>
<tr>
<td>Braided stream</td>
<td>![Braided Stream Diagram]</td>
<td>Treat as a single polygon (4). Collectively the braided segments form a double line river</td>
</tr>
<tr>
<td>Creeks alternating as a single and double line creek</td>
<td>![Creeks Diagram]</td>
<td>Assign each double line section a number</td>
</tr>
<tr>
<td>Small swamps and lakes (other than muskeg conditions)</td>
<td>![Swamps Diagram]</td>
<td>All lakes form discrete polygons. Note the minimum size range at a scale of 1:20 000. Do not number lakes and swamps below 2-3 ha</td>
</tr>
<tr>
<td>Problem</td>
<td>Example (1:20 000)</td>
<td>Solution</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>-------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Alpine lake having an indefinite shoreline (ice-covered at time of photography)</td>
<td><img src="image1" alt="Lake Example" /></td>
<td>Treat as a normal lake but do not number lakes in alpine less than 10 ha in size</td>
</tr>
<tr>
<td>Glacier or snowfield in alpine areas</td>
<td><img src="image2" alt="Glacier Example" /></td>
<td>Ignore as a distinct polygon. Treat as part of alpine</td>
</tr>
<tr>
<td>P.S.Y.U. and T.S.A. boundaries traversing common types on a single mapsheet</td>
<td><img src="image3" alt="Boundaries Example" /></td>
<td>Use one number only</td>
</tr>
<tr>
<td>Boundaries of parks, reserves, and municipalities traversing common types</td>
<td><img src="image4" alt="Park Example" /></td>
<td>Ignore boundary and assign one polygon number for each type</td>
</tr>
<tr>
<td>Environmentally Sensitive Areas (E.S.A)</td>
<td><img src="image5" alt="ESA Example" /></td>
<td>E.S.A.'s form discrete polygons</td>
</tr>
<tr>
<td>Forest types differing only by E.S.A. designation</td>
<td><img src="image6" alt="Forest Types Example" /></td>
<td>Each area having a different E.S.A. designation forms a discrete polygon</td>
</tr>
<tr>
<td>Openings</td>
<td><img src="image7" alt="Openings Example" /></td>
<td>A new opening caused by a disturbance can have one or more polygons. Assign numbers as required</td>
</tr>
<tr>
<td>Problem</td>
<td>Example (1:20 000)</td>
<td>Solution</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Roads</td>
<td><img src="image" alt="Roads Example" /></td>
<td>Single line or double line roads do not create a polygon</td>
</tr>
<tr>
<td>Roads bordered by Urban</td>
<td><img src="image" alt="Roads bordered by Urban Example" /></td>
<td>Treat the urban area as one polygon.</td>
</tr>
<tr>
<td>Urban</td>
<td><img src="image" alt="Urban Example" /></td>
<td>Ignore the road</td>
</tr>
<tr>
<td>Roads (bridges) crossing double line rivers</td>
<td><img src="image" alt="Roads crossing double line rivers Example" /></td>
<td>Treat the river as one polygon</td>
</tr>
<tr>
<td>Roads bordered by Urban crossing double line rivers</td>
<td><img src="image" alt="Roads bordered by Urban crossing double line rivers Example" /></td>
<td>Treat the river as one polygon. The river divides polygon 202 from 203.</td>
</tr>
<tr>
<td>Dams (Urban Area) crossing double line rivers</td>
<td><img src="image" alt="Dams crossing double line rivers Example" /></td>
<td>Treat the urban as one polygon. The dam divides the river into two polygons.</td>
</tr>
</tbody>
</table>

**Differences in history**:  

(a) ![Differences in history Example a](image)  
If radii are different separate polygons are justified. Draw a type line

(b) ![Differences in history Example b](image)  
If radii are identical but the disturbances and/or treatment is different, separate polygons are justified
If radii and the disturbance and/or treatments are identical, but the dates are different, say within 5 years, separate polygons are generally not justified.

1. These examples are given with the understanding that separating polygons on the basis of history alone should be resolved by each Forest District. However, minimum type size is an important factor which must be considered at all times.
MAPPING PROCEDURES

To prepare GIS input documents for a reinventory, consider these points (see Figure 5-14):

A. Source maps

Prepare reinventory input maps on matte film contact prints of recent planimetric base maps.

B. Photo centres

Accurately locate the centres of all classification aerial photographs on the planimetric base maps.

C. History update

Transfer the boundaries of disturbances that have taken place between the date of photography and the time of reinventory and internal boundaries of openings from the various sources of information (see Section 5.4) to the classification photos.

D. Type lines

Use photogrammetric instruments to plot type lines.

E. Data sources

Enter the symbol, reference number and year of origin for all data sources in green ink.

F. Roads

Draw all roads with an orange pencil as illustrated in Section 5.58E.
G. Trails

Draw trails with a single dashed line using violet drawing ink or erasable pencil as illustrated in Section 5.58F.

H. Polygon numbering

Enter in red ink a unique number for each recognized polygon. For details on polygon identification and on polygon numbering, refer to Appendix 5-2 and Section 5.53, respectively.

I. Polygon descriptions

For each numbered polygon, write the detailed description on a forest cover and history attribute list (F.S. 810). To improve matches along neat lines, enter in the map margin a detailed description for each polygon cut by the east and the south neat lines (See Figure 5-14). For details on forest cover and history attributes and on the completion of attribute lists, refer to Chapter 3, 'Forest Classification'.

J. Opening numbers

Enter in black ink the opening number and the hexagonal symbol directly above the polygon number of each polygon within the opening. For details on the referencing of openings on input documents, see Section 5.56.

For further mapping details on polygon size, polygon descriptions, polygon labelling, polygon numbering, polygons along neat lines, polygons along administrative boundaries, opening numbers, map material and colour codes, refer to Section 5.5.
POLYGON NUMBERS

<table>
<thead>
<tr>
<th>NOT USED</th>
<th>OUT OF SEQUENCE</th>
<th>LAST NUMBER USED</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>No.</td>
<td>150 Feb.09/83</td>
</tr>
<tr>
<td>33</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td></td>
<td>48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

LEGEND

3 Polygon Number

Logging Road

--- New road

x6-20(65) Data source

[23] Polygon number entered outside its boundary

Figure 5-14 Example of a reinventory input map.
MAPPING PROCEDURES

To prepare GIS input documents for direct label entry, consider these points (see Figure 5-19):

A. Source maps

Prepare direct label entry maps on matte film contact prints or on paper prints of forest cover maps of the last unit survey.

B. Photo centres

Accurately locate on the existing forest cover maps the centres of all recent aerial photographs required for delineating disturbance boundaries. Use green ink to draw and number photo centres.

C. History update

When available, delineate on recent, mid-scale aerial photographs all history that has taken place since the previous unit survey. Otherwise, determine history boundaries from other scales of aerial photographs, from satellite images, from sketch mapping, or from ground surveys (refer to Section 5.4).

D. Type lines

Plot or draw all new or modified polygon boundaries in black ink. Delete incorrect and unnecessary type lines from matte film contact prints by scraping them off and from paper prints by using white correction fluid.

E. Data sources

Place the symbol, reference number and year of origin for all data sources onto input maps in green ink.

F. Roads

Draw all new roads with an orange pencil as illustrated in Section 5.58 E.
G. Trails

Draw new trails with a single dashed line using violet ink or erasable pencil as illustrated in Section 5.58 F.

H. Polygon labels and detailed descriptions

1. Coded map labels for direct keypunching

The majority of polygon labels for direct label entry maps are keypunched from the input maps. Prepare coded map labels as follows:

a) Use one label only for each polygon.

b) Make all label changes, additions or deletions in black ink. Also, using black ink cross out all coded labels that are not to be keypunched. This includes all map labels that are replaced with detailed descriptions entered on attribute lists (see Appendix 5-4 H2) and labels that are associated with polygons that are below the minimum size.

c) When placing labels and numbers onto input maps, keep printing small and legible.

d) When a polygon straddles a neat line of a map that has been converted to 6' x 12' format, its label may appear outside the map area. For clarity, either print or arrow the label inside the map boundary (see Figure 5-15).

Figure 5-15 Clarifying labels of polygons that straddle neat lines on direct label entry maps
e) Polygon attribute codes

i) Species composition

Check for obvious errors and correct. Species are entered exactly as the map label shows, in the form of major and minor species.

ii) Age and height

Check for obvious errors and correct. Also for units surveyed prior to 1972, species preference rules were in effect. For these projects, check the age and height classes assigned to lodgepole pine-coniferous and deciduous-coniferous mixed stands.

iii) Site

In 1978/79, the current site equations and curves were introduced. Consequently, some of the site classes derived from former site tables are no longer correct. Therefore, for each productive forest type on direct label entry input maps, ensure that the site class is correct on the current site curves by using the mid-point of the assigned age class and the ranges of the assigned height class.

iv) Crown closure

Estimate crown closure to the nearest 10 percent for each forest type. Using black ink, record crown closure after the site class for labels not entered on an attribute list, and close to the polygon number for hooked types (see Figure 5-16).
### Figure 5-15  Addition of crown closure to forest types on direct label entry maps

- **Polygon number (red ink)**
- **Crown closure (black ink)**
v) Environmentally sensitive areas

Whenever possible, update former environmental protection forest (E.P.F.) and environmental protection area (E.P.A.) lines to current environmentally sensitive area (E.S.A.) standards as described in Chapter 2, 'Environmentally Sensitive Areas'. However, direct label entry input maps may be submitted with earlier environmental sensitivity classifications provided that the same standards are applied to the entire project.

Add fisheries symbols using violet drawing ink or erasable pencil. Place applicable fisheries symbols just inside the 6' x 12' neat lines on maps that have been converted from 7 1/2' x 7 1/2' format.

vi) History symbols

Convert all pre-1979 history symbols to current history symbols.

vii) Reference year

For most forest types, the year of the last unit survey is used as the reference year for age and height projections, including types with data sources established prior to the last unit survey. To reduce map clutter, just enter the reference year once for the unit survey along the map margin.

viii) Data source

Using black ink, record in brackets the data class and origin codes at the end of each map label (see Figure 5-17). The code for photo interpretation does not have to be placed on the input maps.
Figure 5-17  Recording data class and origin codes on to direct label entry maps

2. Detailed polygon descriptions to be entered on attribute lists (F.S.810).

Enter a full attribute description onto an attribute list for the following types:

a) Types having an age of 20 years or less referenced from the current year.

b) Types having a history of disturbance or silvicultural activity within the last 20 years.

c) Types having a ground call, ground sample, photo sample, 70mm air call or other reliable data source established since the last survey.

d) If desired, full descriptions may also be entered on an attribute list for residual types (Resid) and for stands with a secondary older or younger element (+S.T., +Vets, +Vol, +Imm).

For details on forest cover and history attributes and on the completion of attribute lists, refer to Chapter 3, 'Forest Classification'.
1. Use of hooks
   
   1. Rather than re-writing the entire label in each polygon, hooks may be used on direct label entry maps to indicate:
      
      a) Nearby types that have identical species composition, age class, height class, stocking class, and site class.
      
      b) Adjacent types that are separated only on the basis of having different E.S.A. designations.
   
   2. Draw hooks in black ink.
   
   3. Using black ink, enter the crown closure and the data class and data source codes for each hooked type just below the polygon number (see Figure 5-18). Do not enter a data code for photo interpreted types.

![Figure 5-18 Use of hooks on direct label entry maps](Image)
J. Polygon numbering

Enter a unique number in each recognized polygon as follows:

1. For polygons having labels to be keypunched directly from the map, enter the polygon number in red ink next to the label.

2. For polygons having detailed descriptions entered on attribute lists, enter the polygon number in black ink and circle the number in red ink. Cross out in black ink all coded labels that are not to be keypunched directly from the map.

3. Number consecutively types that are hooked (see Figure 5-18).

For details on polygon identification and on polygon numbering for input maps, refer to Appendix 5-2 and Section 5.53, respectively.

K. Opening numbers

Using black ink, enter the opening number and hexagonal symbol directly above the polygon number of each polygon within the opening. For details on the referencing of openings on input documents, see Section 5.56.

For further details on polygon size, polygon identification, polygon descriptions, polygon numbering, polygons along neat lines, polygons along administrative boundaries, opening numbers, map material and colour codes, refer to Section 5.5.
### Polygon Numbers

<table>
<thead>
<tr>
<th>NOT USED</th>
<th>OUT OF SEQUENCE</th>
<th>LAST NUMBER USED</th>
<th>DELETED NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>No. Near</td>
<td>148 Feb.09/83</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>47 42</td>
<td>149 Feb.12/83</td>
<td></td>
</tr>
<tr>
<td></td>
<td>48 49</td>
<td>150 Feb.20/83</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50 17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Legend

- **Age class**
- **Species**
- **Height Class**
- **Stocking Class**
- **Data Source Class**
- **History Symbol**

- 3 - Polygon number (label keypunched directly from map)
- 5 - Polygon number (label entered on attribute list)
- x6-20(65) - New road
- [22] - Data Source
- Polygon number entered outside its polygon boundary

**Figure 5-19** Example of a direct label entry input map
A 5.5.1 UPDATING MATTE FILM CONTACT PRINTS OF DIGITIZED FOREST COVER MAPS

To maintain a current record of history and to make classification changes on matte film contact prints of digitized forest cover maps (history mylars), consider these points:

A. Photo centres and numbers

Accurately locate the centres of all recent aerial photographs required for delineating disturbance boundaries or for reclassification on the mylar. Use black ink to draw and number photo centres.

B. Polygon boundary changes

1. Using black ink, draw all new or modified type lines resulting from reclassification onto the mylar with a single dot-single dash symbology (·-···).

2. Transfer new disturbance boundaries in pencil onto the mylar. This is a precautionary step to avoid inadvertent and unnecessary erasures. Determine history boundaries from aerial photographs, from satellite images, from sketch mapping, or from ground surveys (refer to Section 5.4).

3. When transferring disturbances, use the type line symbology shown in Section 5.44 and in Table 5-1 to indicate the level of accuracy of the method of obtaining opening configuration.

4. Using black ink, add a silvicultural opening number for each disturbance as described in Section 5.56.

5. Using black ink, relocate all displaced and chopped-off type labels and polygon numbers which are still valid and must be retained.

6. Erase all former type lines inside the boundary which are directly affected by the disturbance or restratification. At the same time be careful to retain any non-forest type lines and their polygon numbers, such as rock, swamp or cultivated areas. Similarly, retain topographic detail, place names, roads, and surveyed lot lines. Obviously, undisturbed forest types surrounded or enclosed by a single, larger disturbance, such as a wildfire, are retained in full. It may also be desirable to retain selected type lines in order to identify site class differences based on the former forest cover.
7. List in the mapsheet margin under the heading "Deleted Numbers" the polygon numbers for any completely deleted types.

8. Erase former type labels and polygon numbers wholly within the new boundary.

9. Erase type lines and labels of any leftover type islands below minimum polygon size located on the outer fringe of the openings.

10. Erase any timber sale numbers, block numbers, and cutting permit letters that are no longer required.

11. Identify in the map margin the last used polygon number.

12. Using black ink, add a new polygon number for each new opening. Unless other information is available, assume each opening is a recent disturbance and has only one polygon.

13. Using black ink, add new polygon numbers to any types created by the new boundary that are large enough to retain, generally 5 hectares or more. Use the next highest sequential numbers and do not reassign deleted polygon numbers.

14. For disturbances, ink-in the pencilled type line according to the level of accuracy indicated.

15. List in the mapsheet margin under the heading "Added Numbers" the newly assigned polygon numbers. The last number on the list automatically becomes the last used polygon number for the map. In addition, show the date after the last number. At this point the forest and history attribute list (F.S. 810) should be filled in for each type given a new polygon number.

16. Enhance opening boundaries (optional) by drawing a thick line in carmine ink inside the opening boundary. The object here is to produce a paper print on which openings or changes can be easily detected by the presence of a thick, grey, translucent line rather than a heavy, black, opaque line.

17. Recheck for missing labels, missing polygon numbers, conflicting labels, incomplete labels, and poor joins around the perimeter of the new polygon and across map neat lines.
FOREST INVENTORY
PREPARATION OF FOREST COVER
SOURCE MAPS FOR THE FOREST
RESOURCE INFORMATION SYSTEM

C. Polygon attribute changes

1. Using black ink, place polygon numbers on the mylar immediately after placement of
the new boundary. It is strongly recommended that the attribute list is completed at this
time for all areas assigned a new polygon number. However, attribute lists remain
unaffected for polygons which have boundary changes only with no change in original
attributes.

2. Enter the description for all new polygons on a forest cover and history attribute list (F.S.
810). Inventory data may be obtained from Silviculture's F.S. 922 Forest Cover Attribute
Form.

3. Deleted polygons and modified polygon descriptions are indicated on forest cover and
history attribute lists or on double-spaced attribute listings as follows:

   a) Forest cover and history attribute lists (F.S. 810)

      i) Enter on the attribute list all deleted polygon numbers (already listed in
         the mapsheet margin) followed by the word "DELETED" in the NP
         FOREST or NON-FOREST COVER CLASS column.

      ii) To change the label of existing polygons, make two consecutive entries
          on the attribute list as follows:

          First: Enter the polygon number followed by the word DELETE
          entered under the column NP FOREST or NON-FOREST
          COVER CLASS.

          Second: Enter the same polygon number followed by the entire new type
          description. When applicable, describe all history and show the
          secondary element "S" if separate silvicultural records are kept.

   b) Double-spaced attribute listing

      To lessen the workload of making changes to polygon forest cover attribute
descriptions, the Branch will provide, upon request, a double-spaced listing of
original polygon attribute descriptions at reference year. Any existing record
field on this printout can be fully or partially deleted or changed.
An example of a double-spaced attribute listing with deleted polygon numbers and with modified attribute descriptions is illustrated in Appendix 5-7.

To update polygon attributes using double-spaced listings:

i) Make all changes in red.

ii) To delete a polygon number and associated attributes, cross out the polygon number and its description.

iii) To change a polygon number but to keep its attributes, cross out the polygon number only and re-enter the new number immediately below the old one.

iv) To change the content of attribute fields such as species composition and reference year, cross out the original species composition and reference year and enter the new ones immediately below the old ones.

v) To add new fields to the existing polygon descriptions such as environmentally sensitive areas (E.S.A.), enter the information in the appropriate column(s) in the same row as the existing attributes.

vi) To add opening numbers and history to polygon descriptions, indicate in the history column (in the same row as the existing attributes) that history information is being added and enter this information on history attribute lists (F.S. 810(2)).

4. If required for local use, labels of new polygons may also be entered on the history mylar. In such cases, coded labels are preferred to detailed type descriptions. Place the type labels directly below the polygon numbers and add history symbols and dates directly below the type labels.

D. Changes to other information

Add all new photo centres and numbers, polygon numbers, data sources, opening numbers, roads and trails to the history mylar using black ink. For GIS input, this information is then colour enhanced on paper prints of updated history mylars as described in Appendix 5-5.2.
A 5.5.2 PREPARATION OF PAPER PRINTS OF UPDATED HISTORY MYLARS FOR GIS INPUT

To use paper prints of updated history mylars as GIS update input maps, colour enhance the changes as follows:

A. Type lines

Highlight new type lines with a continuous line using a green erasable pencil.

B. Polygon numbers

Highlight new polygon numbers in red using an erasable pencil. Highlight relocated polygon numbers in green using an erasable pencil. Box or circle the polygon number of existing polygons having label changes only, in green using an erasable pencil.

C. Data sources

Highlight all new data sources in green using an erasable pencil or green ink.

D. Photo centres and numbers

Highlight new photo centres and numbers in green using an erasable pencil or green ink.

E. Roads

Highlight all new roads with an orange pencil.

F. Trails

Highlight new trails in violet using an erasable pencil.

G. Fisheries symbols

Highlight new fisheries symbols in violet using an erasable pencil.

H. Toponymic, planimetric and cadastral detail

Highlight all additions, deletions and changes affecting toponymic, planimetric and cadastral detail in red using an erasable pencil.
A 5-5.3 PREPARATION OF PAPER PRINTS OF ORIGINAL DIGITIZED FOREST COVER MAPS FOR GIS INPUT

The recommended procedure for preparing input maps for a GIS update utilizes paper prints of original digitized forest cover maps. These paper prints are updated for history by transferring information from current history mylars.

To prepare a GIS update input map using paper prints of original digitized forest cover maps, consider these points:

A. Type Lines

1. Add new type lines in black ink using a single dot-single dash symbology (―·―·) and highlight with a continuous green line using an erasable pencil.

2. Delete old type lines by simply highlighting them with a continuous red line using an erasable pencil. Do not erase type lines and do not use correction fluid. Delete polygons created by a new disturbance that are smaller than the suggested minimum type size (refer to Section 5.51) and retain non-forest types within new disturbances.

B. Polygon numbers

1. Delete polygon numbers and any unwanted reference numbers by drawing a red line through the numbers using an erasable pencil or red ink. Do not erase numbers and do not use correction fluid.

2. Add new or relocated polygon numbers in black ink. Highlight new polygon numbers with a small red box or circle and highlight relocated polygon numbers with a small green box or circle.

C. Polygon descriptions

1. For existing polygons having descriptive changes only, including history, surround the polygon number with a small green box or circle using an erasable pencil.

2. Enter the description for all new polygons on a forest cover and history attribute list (F.S. 810).
3. Enter deleted polygons and modified polygon descriptions on forest cover and history attribute lists or on double-spaced listings. For details on the use of double-spaced listings, refer to Appendix 5-5.1 C 3 b.

D. Data sources

Add new data sources and new data source numbers in black ink and highlight in green using an erasable pencil. Green ink alone may also be used.

E. Photo centres and numbers

Add new photo centres and numbers in black ink and highlight in green using an erasable pencil. Green ink alone may also be used.

F. Roads

Add all new roads with an orange pencil.

G. Trails

Add all new trails in violet using an erasable pencil.

H. Fisheries symbols

Add fisheries symbols using violet drawing ink or violet erasable pencil.

I. Opening numbers

For each new opening, enter in black ink the opening number and hexagonal symbol directly above the polygon number of each polygon within the opening. Highlight the opening number in red using an erasable pencil. For details on the referencing of openings on input documents, see Section 5.56.

J. Toponymic, planimetric and cadastral detail

Make additions and changes affecting toponymic, planimetric and cadastral detail in black ink and highlight in red using an erasable pencil. For deletions, put a series of red "x"s over the symbology to be deleted.
A 5-6.1 ATTRIBUTE LISTS

For quality control of forest cover and history attribute lists (F.S.810) and of double-spaced attribute listings, check:

A. Clarity and completeness.

B. Incorrect entries and blank columns. All attributes must be recorded as described in Chapter 3, 'Forest Classification'.

C. Identical map number, T.S.A. name and Project Number on all pages.

D. Missing or additional pages. After corrections the pages may require renumbering.

A checker indicates approval of the clarity and completeness of an attribute list by placing his signature and the date on the lower right hand corner of the first page.

A5-6.2 INPUT MAPS

A. Forest Cover

For quality control of the forest cover detail on input maps, check:

1. Clarity and completeness.

2. Indistinct type lines and labels and re-enforce where necessary.

3. Polygon numbering duplications or omissions and hanging type lines. Ensure all missing numbers, deleted numbers, numbers out of sequence and numbers they are near, and the last number used are listed on the map margin.

4. Polygons that should be deleted because they are smaller than the suggested minimum sizes.

5. Matching type lines and attributes along all neat lines. After checking that each neat line matches the adjacent map sheet, enter "Tied In" and the classifier's initials in the map margin along the neat line.

6. Missing data sources and air photo numbers.
7. The presence and continuity of fisheries symbols.

8. Missing or incomplete labels for direct label entry maps.

9. Missing or wrong arrows and hooks, when applicable.

B. Map Overlays

For quality control of overlay detail on input maps, check:

1. Incorrect or missing overlay shapes, incorrect or missing polygon numbers and wrong codes for:
   - Inventory Regions and Compartments
   - T.S.A.'s and Supply Blocks
   - Ownership
   - Forest Regions and Forest Districts
   - P.S.Y.U.'s, Parks, Ecological Reserves, etc.
   - Agricultural Land Reserves
   - Provincial Forests
   - Stock Range, Range Unit and Pasture
   - Planning Cells
   - Operability
   - Biogeoclimatic Zones
   - Recreation

Note: All areas on a mapsheet must be accounted for by one or more polygons representing each overlay.
2. Incorrectly labelled administrative and management boundaries for:
   - T.S.A.'s and Supply Blocks
   - Forest Regions and Forest Districts
   - P.S.Y.U.'s, T.F.L.'s, T.F.'s, Sub-units
   - Provincial Forests
   - Parks, Wilderness Areas, Recreation Areas
   - Land Districts
   - Municipalities

3. Matching boundaries and labels along map neat lines. After the overlays are checked along each neat line enter "O.L.'s joined" in the map margin along the neat line.

C. Planimetric and cadastral detail

For quality control of planimetric and cadastral detail, check:

1. Incorrect or missing labels for major reserves, such as parks, U.R.E.P.'s, watershed reserves, ecological reserves.

2. Missing or misspelled Indian Reserve names. Indian Reserve names are shown in lower case lettering in brackets directly below the Indian Reserve number. The reference for correct spelling is "Schedule of Indian Reserves and Settlements".

3. Cadastral information according to that shown on the status reference maps. Watch for transposition of lot numbers and township surveys.

4. Incorrect plotting or updating of old temporary tenures, specifically Timber Leases, Pulp Leases, Timber Licences, Pulp Licences and Timber Berths. Boundaries must be outlined and new "T" numbers assigned according to the latest reversions (date of status for project) supplied by Timber Harvesting Branch.
5. Missing, unlabelled or incorrect planimetric detail and related features, such as trails, roads, railways, pipelines, powerlines, various symbols (bridges, mines, dams, lookouts, post offices), photo centres and numbers, flight line numbers, place names, and topographic features. Reference material includes geographic sheets, name sheets, Gazetteer of Canada, and nautical charts.

6. Missing map notations, such as "Island reserve, see file "0186760" or "1978 photo centres superimposed on existing planimetric base".
<table>
<thead>
<tr>
<th>SHEET NO.</th>
<th>NO. (I/P FROM SITE DESC)</th>
<th>SPECIES COMPOSITION</th>
<th>AGE &amp; HT AT REF.</th>
<th>LGR/NR STOCK/OTH LSA</th>
<th>CLAUS</th>
<th>DENSIT</th>
<th>TOLDR</th>
<th>PRINT/THIN/THICK/THIN</th>
<th>AGE</th>
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For actual field length see forest cover attribute list.
**FOREST INVENTORY**
PREPARATION OF FOREST COVER SOURCE MAPS FOR THE FOREST RESOURCE INFORMATION SYSTEM

**SUMMARY OF QUALITY CHECK FOR INPUT DATA COMPLETENESS**

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<th>Project Name</th>
<th>Year of Survey</th>
<th>Date Checked</th>
<th>Total Polygons</th>
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Class of Map
- Re-inventory
- Inventory Update
- Direct Label Entry
- CAM Update

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Total
Total % of Total Polygons

**REMARKS, RECOMMENDATIONS**

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FS 1077 NV 6/26