Alberta Vegetation Inventory Interpretation Standards

Version 2.1.1
March 2005

Chapter 3 –
Vegetation Inventory Standards and Data Model Documents

Resource Information Management Branch,
Alberta Sustainable Resource Development

UPDATES

Alberta Vegetation Inventory Interpretation Standards, Version 2.1.1, March 2005 was incorporated as Chapter 3 of the Alberta Vegetation Inventory Standards and Data Model Documents in June 2006. Subsequent revisions to the document are summarized below:

Date	Type of Revision	Version No.	Sections Revised
	None to date		

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1 Introduction to Chapter 3

The following document “Alberta Vegetation Inventory Interpretation Standards, Version 2.1.1” forms ‘Chapter 3 - Vegetation Inventory Standards and Data Model Documents’.

“Alberta Vegetation Inventory Interpretation Standards” describes the specifications associated with Alberta Vegetation Inventory (AVI), which is the inventory accepted by Alberta Sustainable Resource Development for forestry and other related applications.

Subjects addressed in this document include:

- Photo interpretation procedures
- Cover type specifications
- Orthophoto base map requirements
- Attribute loading
- Editing and quality control.

The data model associated with the AVI standard is described in “AVI Data Model, Version 2.1”, (Chapter 8, Section 1 - Vegetation Inventory Standards and Data Model Documents).

2 Photo Interpretation

The following section describes the steps to be taken before/during photo interpretation whether inventories are funded by the Department (in-house or under contract) or by some other agency.

2.1 Steps Prior to Photo Interpretation

2.1.1 Preparation

- Assemble the aerial photos (medium-scale for vegetation mapping), flight index maps, base information and other reference materials including older inventory maps, previously interpreted photos and existing ground plot data related to the area to be interpreted. Usually an area equivalent to four townships is done at one time. The appropriate Phase 3 Forest Inventory material and any existing AVI for the area must be referenced during the interpretation process.

- Obtain copies of 1:60 000 or 1:40 000 air photos of the area to be interpreted. These are used to interpret origin classes for the project area as the boundaries of old disturbances, particularly forest fires, are more easily determined on photos of that scale.

- Obtain all existing interpreted photos and any other relevant data and information from previously inventories, particularly those completed to AVI standards (or previous versions of AVI e.g., Collective Vegetation Inventory) for adjacent areas to enable the new inventory to be tied to any existing coverages. Requirements for tying to existing coverages should be confirmed by Resource Information Management Branch.

- Obtain copies of any other maps of the area to be inventoried that may assist the project. The 1:250 000 access series maps are recommended. These maps provide a general overview of the area. Information such as aerial photo centres, locations of previous sample plots and the progress of the photo interpretation can be recorded on these maps.

- If ground access is limited, arrangements must be made for alternate field transportation (e.g., helicopter, all-terrain vehicle or boat).

- Request existing information that will aid in interpretation from the appropriate sources. This information may include data and summaries from previous temporary sample plots, cutblock and regeneration survey maps, permanent sample plot data, provincial ecological boundaries and fire records. These data will help to determine tree species composition, age, height, silviculture treatments on harvested areas, etc. Such information will reduce field time and improve interpretation accuracy. Updates from previous timber harvests obtained from Phase 3 maps, existing AVI and reforestation records **must** be incorporated into all new AVI interpretations.

- Obtain a copy of the most current version of the Historical Spatial Wildfire Data from Forest Protection Division's external website. It can be accessed using the following Alberta Government website address: http://www3.gov.ab.ca/srd/wildfires/fpd/index.cfm. Once at the "Forest Protection" website, the user follows the links: Alberta Government > Sustainable Resource Development > Wildfires > Forest Protection > Wildfire Information > Historical Information > Historical Spatial Wildfire Data. A metadata file is associated with every e00 file. Also, inside the zip files themselves there are metadata files that describe the data attributes. Digital files for all of the recent forest fires that burned at least 12 ha of productive land (and many that burned areas as small as one ha) are listed on this site.

2.1.2 Interpreter Field Plots

- After interpreters have reviewed available inventory and ground and photo information, interpreters must make field visits to enable them to become familiar with the area and to collect detailed vegetation data from sample plots. Familiarity with local vegetation conditions will enable them to substantially improve the quality of their work.

  There are three main sources of information on current vegetation conditions: ground plots established by the interpreters themselves, air calls, and past plots and surveys. Each will be discussed in turn.

- Interpreter plot locations are normally determined using a GPS (global positioning system) device. They are marked on the photography used for interpretation and on the base map. Locations are recorded by legal description to at least the legal subdivision level in each interpreter's field notes.

- Depending on the amount of forest cover, up to 20 field plots are established within each township equivalent within the area to be interpreted, based on the guidelines in Table 2-1.

  These are the minimum numbers of plots to be established. More plots can be measured if the interpreter wants further confirmation of the vegetation or other conditions present. Normally such plots are distributed fairly evenly across the vegetated portion of each township, so that the variation in vegetation cover can be sampled.

Table 2-1. Minimum requirements for field plot establishment.

Forested Area (% per township)	Minimum No. Field Plots
> 60% forested	20 plots/township
41% to 60% forested	12 plots/township
21% to 40% forested	8 plots/township
10% to 20% forested	4 plots/township
< 10% forested	2 plots/township

Field plot data consists of records of vegetation species composition and height for any locations visited, as well as tree crown closure, height and diameter and age at breast height (dbh and bh_{age} where breast height is defined as 1.3 m above ground level) for one dominant and two codominant trees of the leading species. An AVI label (e.g., “$mC23Sw_9Pj_1/87\text{-}M$”) for the area representing the field plot is assigned and recorded in the field notes. The presence, extent, height and density of understoreys are also confirmed by collecting the same data as for the overstorey. Tree stems are cored at breast height (bh) and the cores brought back to a location where an accurate age for each tree can be determined. A description of the vegetation seen while travelling to/from each plot is also recorded in the notes. The information collected must be recorded on the back of the photo used for interpretation.

- Before trespassing on any land except Alberta Crown land not under a disposition, interpreters must obtain access permission from landowners, managers or disposition holders. An example of a form that may be used to record plot numbers and legal descriptions, and the names and telephone numbers of the property title or disposition holders, is given in Appendix I. It can be submitted to the contract inspector with the completed work.

  The following procedure should be followed to obtain ownership information:

  - List field plots by plot number (“2000" series number) and legal description to the quarter section level.
  - Contact the appropriate county office and give the clerk the legal description of the plot location. The county clerk can provide the names and addresses of the landowners and disposition holders.
  - Contact the landowners, managers or disposition holders and politely request permission to access their land.
  - If access permission is not granted, that plot location should be omitted and another location selected.

- Increment cores obtained during field data collection should be retained and delivered to the person in charge of the project upon completion of a convenient block of interpretation (usually approximately 4 townships). Individual increment cores are to be delivered in a straw (25 cm x 7 mm), clearly labelled with the tree number, species, plot number, GPS location (accurate to ± 20 m of true ground position), township, range and meridian.

- Field plot locations and plot numbers must be clearly and legibly marked on the project reference maps, the orthophoto base maps, the 1:60 000 or 1:40 000 photos used for stand origin mapping, and the aerial photography used for interpretation.

- Pin holes must be made through the aerial photography used for interpretation at each field plot location at the time of plot measurement, and the plot number recorded on the front and back of the photos. Use "2000" series plot numbers for each township. These numbers are to be inked in black (on the photo), adjacent to a black "x" drawn over each pinhole (plot location). Also record on the back of the photos adjacent to the plot numbers: vegetation species and height by type including species, dbh, height and total age for each measured tree by storey. For example, the information for plot # 2003 would be shown on the back of the photo as:

"2003:	Sw	24.5 cm	28.1 m	146 years (bh$_{age}$)	161 years (total age)
	Sw	20.0 cm	26.2 m	140 years (bh$_{age}$)	155 years (total age)
	Aw	21.1 cm	25.8 m	138 years (bh$_{age}$)	144 years (total age)"

  and the field call might be shown as "mB27Sw9Aw1/86-M". Also record information on non-tree vegetation such as shrub species and heights to assist with the interpretation process. An example of a tally sheet that could be used to record field measurements is shown in Appendix II).

- An easily locatable tie point along the road or other point (e.g., helicopter drop point) from which the interpreter started walking or quading to the field plot must be clearly marked with orange flagging and described in the field notes. The route to the plot must also be flagged. The compass bearing from the tie point to the sample plot is recorded on the top margin of the field tally sheet. The tie point is pin-pricked on the 1:20 000 air photo and this location is labelled on the photo back as "tie-point".

- Each sample tree must also be clearly marked in the field at breast height with orange flagging. The purpose of the flagging and the note taking is to enable someone who needs to check the plot to be able to find it at a later date for the purpose of quality control.

2.1.3 Air Calls

- Air calls, descriptions of vegetation obtained by flying over an area to be interpreted, are also a valuable source of information to interpreters. Descriptions obtained from over-flights should be recorded in each interpreter's notes and later written on both the orthophoto base maps and on the photography used for the actual interpretation (similar to the process used for the interpreter notes) in a manner that doesn't make the photos too cluttered to read.

2.1.4 Other Plot Data

- Data and information from other sources can also provide valuable assistance to interpreters. Generally sources include temporary and permanent sample plots, as well as various surveys such as those done to assess regeneration success. Data and information including tree species, height and density can be obtained from these sources. This information should also be marked on the aerial photos used for interpretation.

2.2 Origin Interpretation Procedures: 1:60 000 or 1:40 000 Aerial Photography

The following procedures are used for the interpretation of origin class in forested stands:

- Clearly, accurately and legibly mark in black ink the Alberta township boundaries on the orthophoto base maps and on the air photos used for interpretation.
- Digital files for all of the recent forest fires that burned at least 12 ha of productive land (and many that burned areas as small as one ha) are listed on the Historical Spatial Wildfire Data from Forest Protection Division's external web site. Use the most current version of that data, small-scale aerial photography and other available data and information to assist in estimating origin class for forested stands. The boundaries of fires that were mapped using a GPS, while not accurate enough to be used for defining AVI stand boundaries, do provide help in determining stand origins.
- Use a minimum polygon size of 60 ha when using 1:60 000-scale photography and of 40 ha with 1:40 000-scale photography.
- Tree ten-year age (called "origin") classes are interpreted on the air photos based on field plots and other available data (e.g., historical spatial fire data, older inventory records, other field plots). The a*ctual year of origin is recorded when known.*
- Interpreted origin classes are marked on the air photos with a # 0 drafting pen containing water-soluble black ink. Polygons are labelled using the 2 centre digits of the origin class (e.g., "94" for 1940) (see Section 3.4.4). Labelling is done entirely on the centre photo of the appropriate stereo triplet.
- All 1:60 000 and 1:40 000 air photos interpreted for origin classes are referenced to existing adjacent origin-class photo interpretations.
- Field plot locations are labelled with a black "x" on the 1:60 000 or 1:40 000 air photos. Each field plot number is labelled on the front of the air photo adjacent to the black "x" using the 2000 series of numbers. Each plot number must be unique to each township within the project.

2.3 Vegetation Interpretation Procedure: 1:20 000 Aerial Photography

The following procedures are used for completing the AVI vegetation interpretation:

- Photo centres must be marked on the aerial photos in red grease pencil using the fiducial marks on the photos as a reference.

- Mark the effective interpretation area on each photo.

- Origin class is determined from the interpreted 1:60 000 or 1:40 000 air photos and collected field data.

- Interpret the photos to Alberta Vegetation Inventory specifications (described in Section 3) with the help of all available data collected prior to commencing the interpretation.

- Check the interpretation work by comparing it to interpretations done on nearby photos and townships. Ensure all polygons are properly labelled and no adjacent polygons with the same attributes are separated.

- Interpretation coverage must extend 1.3 cm (equivalent to about 0.25 km) past township borders or inventory project boundaries.

- Notes made in grease pencil on the photos during fieldwork are to be neat and legible, and are not to be removed from photos.

- If the new AVI replaces an existing AVI coverage the original stand boundary locations should be preserved as much as possible. Only when errors are found or depletions have significantly altered the boundary (or some event or succession has changed the vegetation within a polygon to the point where modifying the boundary is necessary to meet AVI standards) may the original stand boundary be modified.

3 Cover Type Specifications

The primary purpose of a vegetation inventory is to separate the inventory project area into homogeneous components called polygons, the smallest unit areas recognized. Delineated polygons are then assigned a description (attributes) based on the cover type specifications. Other features such as hydrography, access, etc. are also delineated and attributed.

Interpretation should be done in a methodical way to achieve consistent results[1]. The interpreter should begin by looking over the full photograph to obtain a general impression of the features recorded within. Interpretation should then proceed, one type of feature at a time, beginning with the most obvious and easily recognized and working toward the most difficult to classify (i.e., the known to the unknown). Information available from field checks and other sources (including previous inventories, fire maps and records, sample plots, reforestation records) should be consulted.

Once the interpreter has reached the minimum polygon size that can be delineated (see Section 3.1.1), and/or the polygons are homogeneous in appearance (even if fairly large), and/or the maximum level of detail is recognized, other portions of the polygon labels are added. These include moisture regime, tree age or origin, tree height and appearance, stand structure and other modifiers. If polygons are large enough, these variables may result in further subdivisions of existing polygons.

3.1 Land Stratification

The primary stratification in AVI occurs between vegetated and non-vegetated lands (see Figure 3-1) for an overview of the process). The next level of the stratification distinguishes between anthropogenic and natural land areas/features. Polygons with $\geq$ 6% plant cover are considered vegetated, while those with < 6% cover are classified as non-vegetated. The latter are usually not assigned either a timber productivity rating (TPR) nor a moisture regime modifier.

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[1] Spurr, Stephen H. 1960. Photogrammetry and Photo-interpretation With a Section on Applications to Forestry. The Ronald Press Company, New York.472p.

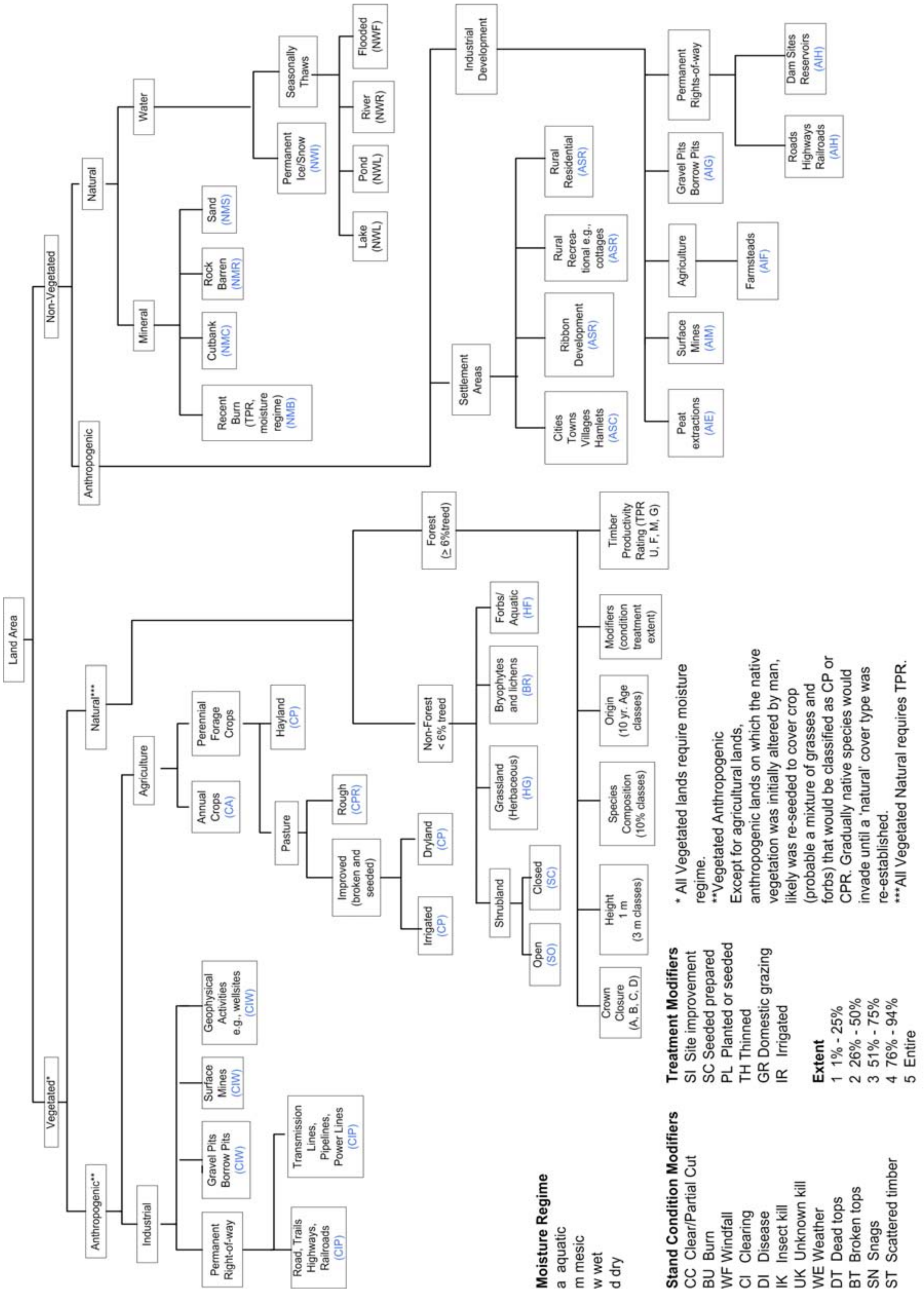


Figure 3-1 Alberta Vegetation Inventory primary classification.

3.1.1 Minimum Polygon Size

The minimum polygon size is affected by the labels used on adjacent polygons. Polygons are delineated to minimum polygon sizes of 1) 2 ha, 2) 10 ha, or 3) 20 ha according to the following criteria:

1) 2 ha minimum if one of the following occurs:

- unproductive forest land, non-forest land or anthropogenic land occurs within productive forest land (see Section 3.4.7)
- productive forest land occurs within unproductive forest land, non-forest land or anthropogenic lands
- coniferous or mixedwood type occurs within a deciduous type
- deciduous or mixedwood type occurs within a coniferous type.

2) (a) If adjacent polygons are not labeled with any of the attributes in 1) above, a 10 ha minimum area can be delineated if the proposed polygon differs from its neighbors according to one of the following criteria:

- the crown closure differs by a minimum of two classes (see Section 3.4.2)
- the tree species composition percentage of a single species within the cover type differs by ≥ 20%
- the origin differs by a minimum of two classes (see Section 3.4.4)
- the height differs by a minimum of two classes (6 metres).

Or, (b) If two or more of the following conditions occur in neighbouring polygons:

- the crown closure differs by one class
- the tree species composition percentage of a single species within the cover type differs by ≥10%
- the origin differs by one class.

3) If none of the adjacent polygons meet any of the conditions listed in 1) or 2) above, a minimum 20 ha size will be used if one of the following conditions in adjacent polygons occur:

- the crown closure differs by one class
- the tree species composition percentage of a single species within the cover type differs by 10%
- the origin differs by one class (≥10 years)
- the height differs by one class (≥ 3 metres).

Examples of minimum polygon sizes are provided in Appendix III.

Numerous other codes and attributes exist in the AVI Standards Manual. These have not been used as criteria for establishing a minimum polygon size. Interpreters are asked to delineate polygons such that significant and observable differences exist between polygons.

3.2 Non-Vegetated Land

Those areas with < 6% plant cover are considered non-vegetated. No moisture regime or TPR rating is required for non-vegetated lands.

3.2.1 Anthropogenic Non-Vegetated Land

Anthropogenic non-vegetated lands are areas that have originated from human activities.

3.2.1.1 Non-linear Features

Anthropogenic, non-vegetated lands include settlement and industrial development areas (see Table 3-1).

Table 3-1. List of anthropogenic, non-vegetated land types and associated codes.

Settlement Areas	Interpretation and Database Code
Cities, towns, villages, hamlets	ASC
Ribbon development, rural recreation (e.g., rural stores and isolated housing sub-divisions, cottages, rural residential, acreage owners, (agriculture is not the primary source of income).	ASR
Industrial Development	
Permanent rights of way; roads, highways, railroads, dam sites, reservoirs	AIH
Peat extractions	AIE
Gravel pits including borrow pits	AIG
Farmsteads (related to agriculture)	AIF
Surface mines	AIM
Industrial (plant sites), sewage lagoons	AII

3.2.1.2 Linear Clearings

Linear clearings for communication, transmission and exploration routes that exceed a certain size are delineated during the interpretation process. The way in which a linear clearing is handled for mapping and area measurement depends upon its width (see Table 3-2).

Table 3-2. Linear clearing interpretation specifications.

Width	Example	Treatment	Classified
< 20 m	seismic lines, roads, pipelines	Not delineated	No reduction of crown closure rating
≥ 20 m	roads, pipelines and major highways	Delineated, edge of clearing forms boundary, splitting polygons in two	Treated as independent “Cleared land” units (e.g., AIH)

3.2.2 Naturally Non-Vegetated

Lands that “naturally” have < 6% plant cover are classified in AVI as naturally non-vegetated . They are divided into cover types that are primarily water and those that are primarily mineral (see Table 3-3). The TPR and moisture regime attributes are not required.

If non-vegetated lands become vegetated, these lands are no longer classified as non-vegetated even if the original dominant feature remains obvious (e.g., a well site or a gravel pit). None of the non-vegetated codes may be used since these lands are now vegetated.

Table 3-3. List of naturally non-vegetated land types and associated codes.

Water	Interpretation and Database Code
Permanent ice, snow	NWI
Seasonally thaws, lakes, ponds	NWL
River	NWR
Flooded (areas periodically inundated with water). Snag modifier (see Section 3.4.6.1) and snag extent (see Section 3.4.6.4) are included if snags are present.	NWF
Mineral	
Recent burn with no recovery of vegetation to date. Include snag modifier and snag density if present. *Moisture regime and TPR are required.*	NMB
Cutbank	NMC
Rock barren	NMR
Sand	NMS

Non-vegetated land attributes may be used in a horizontal structure with vegetated lands as in the example in Figure 3-2. In the example, 70% of the polygon is composed of treed clumps (each less than 2 ha and composed of aspen (Aw) and white spruce (Sw)). Industrial land (gravel pit) accounts for the remaining 30% of the polygon.

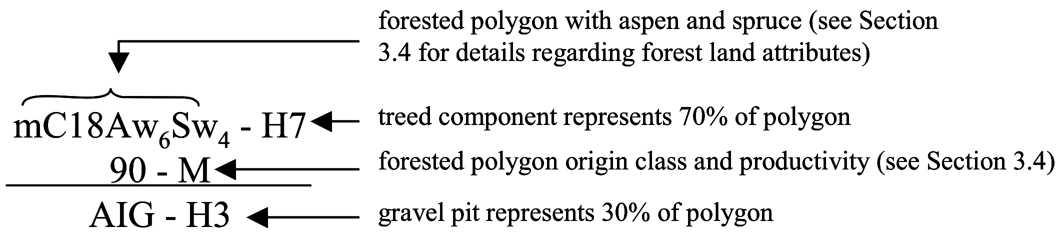


Figure 3-2. Example of non-vegetated land in a horizontal structure.

3.3 Vegetated Land

Vegetated lands include all lands with ≥ 6% vegetation cover.

3.3.1 Moisture Regime Modifiers

The moisture regime modifier is assigned to all vegetated land cover types. Moisture regime signifies the available moisture supply for plant growth, using a descriptive code ranging from dry to aquatic; it is indicated by a lower case prefix added to the polygon attribute (Table 3-4).

Table 3-4. Moisture regime definitions and codes.

Moisture Regime	Definition	Interpretation and Database Code
Dry	rapidly drained substratum	d
Mesic	moderately well drained substratum	m
Wet	poorly drained to flooded where the water table is usually at or near the surface, or the land is covered by shallow water (e.g., sedge fens)	w
Aquatic	permanent deep-water areas where the predominant growth medium is water and the vegetation is characterized by hydrophytic vegetation (emergent) that grows in or at the surface of the water (e.g., pond weeds, water-lily, etc.)	a

The interpreter's assessment of moisture regime is based on plant indicators or environmental factors and soil properties. A general guideline for determining drainage classes can be found in "Ecodistricts of Alberta, Summary of Biophysical Attributes." Alberta Environmental Protection, 1995.

Moisture regime is correlated with the following factors: micro-variations in topoclimate, slope position (macro and meso relief), slope gradient, depth of surface humus layers, soil texture (including the content of coarse fragments), soil depth and the presence of an impermeable layer. In general, the factor that most influences moisture regime is the position of the vegetation on the slope. Refer to Appendix IV for more detailed information on moisture regime.

3.3.2 Anthropogenic Vegetated Land

Anthropogenic vegetated lands are areas where humans have influenced the vegetation, usually by planting cultivated species (i.e., crops in fields). Areas cleared (e.g., for pasture) but not broken and seeded or planted to non-native (cultivated) plant species are included in the natural, non-forest land category (see section 3.3.3.1).

Anthropogenic vegetated land types are described in Table 3-5. No TPR (see section 3.4.7) is required for any of these types, with the exception of CPR. Moisture regime must be described on all polygons. If the code "CPR" is used, the codes "SO" or "SC" must also be present in the label.

Agriculture codes may also be used in horizontal structures in conjunction with other vegetated and non-vegetated lands.

Table 3-5. List of anthropogenic, vegetated land types and associated codes.

Industrial	**Interpretation and Database Code**
Pipelines, transmission lines, airstrips, microwave tower sites that have been seeded to perennial grasses. Includes golf courses and cemeteries.	CIP
Geophysical activities including well sites that have been seeded to perennial grasses.	CIW
Agriculture	
Annual crops - Cultivated farmland or farmland planted with annual crop species.	CA
Perennial forage crops – Reclaimed lands, farmlands planted with cultivated grasses and/or legumes. These lands are used primarily for grazing livestock and/or may have cultivated species harvested at least once a year. These lands contain < 10% crown closure of woody cover (shrubs). These lands also include pastures that have been irrigated or otherwise treated to improve their productivity.	CP
Rough pasture - Similar to improved pasture with > 10% woody cover. Normally, this pasture has not been irrigated, fertilized or cultivated to improve productivity. **An open or closed shrub notation must be added to indicate the height, extent and type of shrub cover**. In this instance the annotation will be written in reverse in order to facilitate the standardized coding form used for data input. The TPR is included because of the shrub notation (e.g., w2SC$_5$-F-CPR indicates that 50% (5) of the polygon is covered by 2 m high shrubs having a closed canopy, wet moisture regime and a fair site).	CPR

3.3.3 Naturally Vegetated Land

Cover types that have not been created by man or which do not have any cultivated plant species are considered naturally vegetated. There are two main categories of naturally vegetated lands: non-forest (described below) and forested (section 3.4). A moisture regime and timber productivity rating class (G, M, F, or U) is assigned to all naturally vegetated cover types (see section 3.4.7).

3.3.3.1 Non-Forest Vegetated Land

Non-forest, naturally vegetated lands includes vegetated areas with ≥ 6% plant cover but < 6% tree cover. These cover types can be used alone or in overstorey/understorey situations with, or without any differences in height class between the two storeys. Additional rules for the non-forest land codes usage are included in Appendix V.

Shrubs Types

Shrubs types are areas where multiple-stemmed woody plants (e.g., alder, willow, bog birch) cover a minimum of 10% of the polygon area and tree cover is <6%. Non-forest areas with shrub vegetation are described using codes for height and crown closure (Table 3-6). For example the label ‘m2SC$_9$ – F’ denotes 90% closed shrub with an average 2 m canopy height, growing on mesic moisture regime with fair productivity (TPR).

Table 3-6. List of shrub descriptors, modifiers and associated codes (naturally vegetated, non-forest land).

Shrubs		Interpretation and Database Code
Height descriptors of 1 m to 6 m will only apply to shrub cover		1 - 6
Crown descriptor	Closed shrub (crowns of most shrubs interlocking)	SC
	Open shrub (crowns of most shrubs not touching each other)	SO
Shrub cover subscript indicating the percentage (to the nearest 10%) of polygon area occupied by the closed or open shrub.		1 - 10

Non-woody Types

Non-woody vegetation includes grasses, forbs and bryophytes (shrub cover must account for < 10% of the polygon area). Non-forest areas with non-woody vegetation are identified using codes described in Table 3-7.

Table 3-7. List and description of non-woody vegetation types and associated codes.

Non-woody Vegetation	Interpretation and Database Code
Herbaceous - Grassland - Natural meadow, grassland and/or sedge lands, graminoids dominant	HG
Herbaceous - Forbs - Natural herbaceous plant cover dominated by forbs (not graminoids). Forbs include aquatic plants e.g., a HF can describe pond weeds, water-lilies, etc. living in shallow water (aquatic).	HF
Bryophyte - Bryophytes (mosses, liverworts) and/or lichen dominate.	BR

3.3.3.2 Peatlands

Peatlands are areas with an accumulation of organic material resulting from excess moisture, with peat depths generally greater than 40 cm. Dominant peat materials may consist of mosses, sedges, grasses and woody material forming distinct wetland vegetation cover types.

Peatlands are not specifically interpreted or identified during AVI photo interpretation. Peatlands may be interpreted at a later date based on moisture regime and vegetation cover type.

Vegetation cover types that will be identified (in conjunction with the wet moisture regime modifier) as potential peatlands are described in Appendix VI.

3.4 Forest Land

Land is considered forested if it supports tree growth (including seedlings and saplings) with a crown closure of ≥ 6% (see Appendix VII for a guide to crown closure).

A basic six-part forest polygon code (moisture regime, crown closure, height, species composition, stand origin and timber productivity rating) is assigned to every forested polygon or forest stand (Figure 3-3). If other attributes such as understorey, disturbances, conditions, stand structure, etc., are observed, they are also indicated in the stand description.

3.4.1 Species Composition

The common, naturally occurring Alberta forest tree species, along with their AVI codes are listed in Table 3-8. Tree species present in a stand (polygon) are listed in the label (to a maximum of 5) in decreasing order of occurrence based on percent crown closure for each layer. Estimated composition to the nearest 10% by species is assigned as a subscript, e.g., Sw_8Aw_2 signifies 80% Sw, 20% Aw. The subscripts for each layer must add up to 10 (100%).

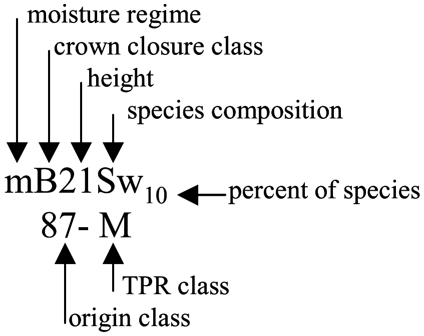


Figure 3-3. Example of a basic six-part AVI polygon label.

When more than five tree species occur in a stand, the percentage of the canopy represented by each of the additional coniferous or deciduous species is added to one of the first five species as appropriate. Appropriate combinations include:

- Aw, Pb, Bw
- Sw, Fb, Fa, Se, Fd
- Sb, Lt, Lw
- Pl, Pj, Pa, Pf.

For example, a stand composed of 24% Sw, 20% Pl, 16% Sb, 14% Pb, 10% Bw, 9% Aw, 7% Fb would be labeled $Sw_3P_2Pb_2Sb_2Bw_1$.

The photo interpreter will decide the sequence in which the tree species are listed in stands where two or more species have similar crown closure subscripts based on which species he estimates has the greater crown closure. For example, the label Sw_5Aw_5 indicates that the crown closure of white spruce is slightly higher (by <5%) than the crown closure of aspen in the layer even though both species were given the same subscript (50%).

Table 3-8. List of tree species names and associated codes.

Tree Species		Interpretation and Database Code	
		Confirmed Species[1]	**Generalized Code**
White spruce	*Picea glauca*	Sw	Sw
Engelmann spruce	*Picea engelmannii*	Se	Sw
Black spruce	*Picea mariana*	Sb	Sb
Lodgepole pine	*Pinus contorta*	Pl	P
Jack pine	*Pinus banksiana*	Pj	P
White-bark pine	*Pinus albicaulis*	Pa	P
Limber pine	*Pinus flexilis*	Pf	P
Balsam fir	*Abies balsamea*	Fb	Fb
Alpine fir	*Abies lasiocarpa*	Fa	Fb
Douglas fir	*Pseudotsuga menziesii*	Fd	Fd
Alpine larch	*Larix lyallii*	La	Lt
Tamarack	*Larix laricina*	Lt	Lt
Western larch	*Larix occidentalis*	Lw	Lt
Trembling aspen	*Populus tremuloides*	Aw	A[2]
Balsam poplar	*Populus balsamifera*	Pb	A
Paper (white) birch	*Betula papyrifera*	Bw	Bw

1) Where a stand has been field checked or where the species present are known based on another information source, complete species differentiation (up to five species) of both coniferous and deciduous trees will be listed (e.g., mB20Pl$_5$Pj$_5$ or mC19Fa$_7$Se$_3$).

2) The “A” symbol cannot be used in conjunction with any other differentiated species of the *Populus* genus. For example, mC18Aw$_5$A$_5$ or mB16Pb$_5$A$_5$ cannot occur. However, the A may be used in conjunction with species of the *Betula* genus (e.g., mC18A$_5$Bw$_5$).

3.4.2 Crown Closure Class

Crown closure refers to the ground area (expressed as a percentage of the total polygon area) covered by a vertical projection of tree crowns onto the ground for each identified storey. Table 3-9 lists the classes used to describe crown closure.

Table 3-9. Crown closure classes.

Crown Closure (%)	Interpretation and Database Code
6 – 30	A
31 – 50	B
51 – 70	C
71 – 100	D

3.4.3 Height

Stand height is interpreted or determined through field measurements and recorded to the nearest metre. Stand height is the average height of the dominant and codominant trees of the leading species. Adjacent stands differentiated on the basis of height alone must have a difference of 3 metres or greater.

3.4.4 Origin

Tree ages are generally taken at breast height. An age adjustment factor to account for the growth of the tree to reach breast height must then be added to breast height age. The adjustment varies with species (Table 3-10).

Table 3-10. Age adjustment factors (bh_{age} to total age) by tree species.

Species	Adjustment
Fir, Larch, White Spruce	15 years
Pine	10 years
Black spruce	20 years
Deciduous	6 years

Since tree ages change each year, AVI inventory uses 10-year origin classes. The origin class of a stand is its average "year of origin" with the first and last numbers dropped (e.g., a stand of 1877 origin is labeled 87, but coded in the database as 1877) (see Table 3-11).

Table 3-11. Origin classes and codes.

Year of Origin	Interpretation Code	Database Code
2000-09	00	2000
1990-99	99	1990
1980-89	98	1980
1970-79	97	1970
etc.	etc.	etc.

Actual year of origin (when known) can be accommodated (e.g., 1928).

3.4.5 Stand Structure

Single and two-storeyed stands were recognized in previous Alberta timber inventories and are included in the AVI specifications. AVI also accommodates horizontal and complex stand structures to better portray stand conditions.

3.4.5.1 Single-storeyed Stand Structure

Interpretation and Database Codes

Single-storey stand structures are inferred by default, therefore no code is included in the label or in the database.

Definition

Single-storey stands are generally of even height (dominants and codominants crown classes, mostly within a 3 m range) with only one canopy layer. Figure 3-4 provides an example of a label for a single-storey stand.

wB14Sb_7Lt_3
82 - F

Figure 3-4. Example of an AVI label for a single-storey stand.

3.4.5.2 Two-storeyed Structure

Interpretation and Database Codes

Two-storey stand structures are inferred, therefore no code is placed on a polygon (i.e., no interpreter code). The database code (M) is used to denote multi-layered stand structures. This attribute is placed only with the upper vegetation layer on the AVI coding sheet.

Definition

Two-storeyed stands have two distinct layers or canopies that are visible and fairly evenly distributed throughout the stand area. In polygons where tree species are present in the overstorey and understorey, AVI requires the average height of the top layer to differ from the average height of the lower layer by at least 3 m.

Understoreys are identified if they are clearly observable on air photographs or if they have been confirmed through ground observations.

Each storey of a two-storeyed stand is given an independent description. Multi-storey stands with three or more distinct layers are rare and are not considered valid stand structures. These stands are generally classed as complex structures or two-storey stands.

In the absence of one of the tree species (listed in Table 3-8) in the understorey, a non-forest understorey may be recognized that has a height difference from the overstorey of less than 3 m. If a non-forest understorey is identified, the TPR of the understorey must be the same as the overstorey. Natural non-vegetated land codes can be used in two-storey stand situations if none of the tree species listed in Table 3-8 is present (see Appendix V). Rough pasture, settlement areas and farmstead descriptions can be listed as understoreys of forested lands. The TPRs must be the same in both strata and be based on the overstorey trees. In two-storeyed stands, the tallest vegetation layer is indicated as the upper layer except when the stand structure is ‘Horizontal’ and one layer contains tree species. In that case the forested stratum is listed in the upper layer regardless of its height. The same moisture regime is assigned to both layers of a two-storeyed stand. If the leading species are the same for both layers of a multi-storey stand, the same TPR is assigned to both layers; otherwise ratings may differ. Examples of labels used for two-storeyed structures are shown in Figure 3-5.

mB25Sw$_6$Aw$_4$	wA13Pb$_{10}$	m3SO$_4$
87 - M	91 - F	- U
mB21Sw$_7$Aw$_3$	w2SO$_5$	mHg
87 - M	- F	- U

Figure 3-5. Examples of labels showing a two-storeyed structure.

3.4.5.3 Horizontal Structures

Stand Label and Database Codes

Horizontal stands are labeled and coded in the database as ‘H’, plus a numeric code between 1 and 9, which indicates the percentage of stand area associated with each horizontal component (e.g., H9).

Definition

Stands with this structure are composed of numerous small homogeneous stands within other distinctly different homogeneous stands, each of which are too small to be separately delineated at a 1:20 000 mapping scale. For example, a 30 ha pine stand may have many aspen clones less than 2 ha in area scattered throughout which account for 20% of the entire polygon. The pine would therefore be one portion of the horizontal structure with the aspen as the other (see Figure 3-6, first example).

mC20P$_{10}$ - H8	mC13Sb$_{10}$ - H5	mC15Sw$_{8}$Bw$_{2}$ - H8	w2SO$_{3}$ - CPR - H7
88 - M	86 - M	93 - M	- F
mC18Aw$_{10}$ - H2	wB10Lt$_{5}$Sb$_{5}$ - H5	AIF - H2	wHg - H3
91 - M	86 - U		- M

Figure 3-6. Examples of labels showing horizontal structure.

The interpretation code for a horizontal stand indicates a horizontal relationship between the sub-stands instead of a two-storey or complex structure. The percentage of stand area in 10% increments, attributed by each structure to the entire polygon, is also listed following the "H" code. The sum of individual percentages must equal 10, or 100% of the stand area (e.g., H8 + H2 in the first example in Figure 3-6). A 3 m height difference is not required between the structures. Moisture regime and TPR can differ between horizontal structures. The tallest vegetation structure (when both layers are forested or non-forested) is listed in the upper part of the label. If only one component of the polygon is forested, the forested component of a horizontal structure must be coded in the upper portion of the label. Non-forest land and naturally non-vegetated anthropogenic lands are also described in the stand label if they occur as a component of a horizontal stand.

Minimum polygon size guidelines should be used to help reduce the occurrence of horizontal stand descriptions (section 3.1.1). Horizontal structures can describe vegetation accurately but they do not inform the AVI user of where the structures occur spatially within a polygon.

Horizontal structures are described using diagrams in Figure 3-7, Figure 3-8 and Figure 3-9.

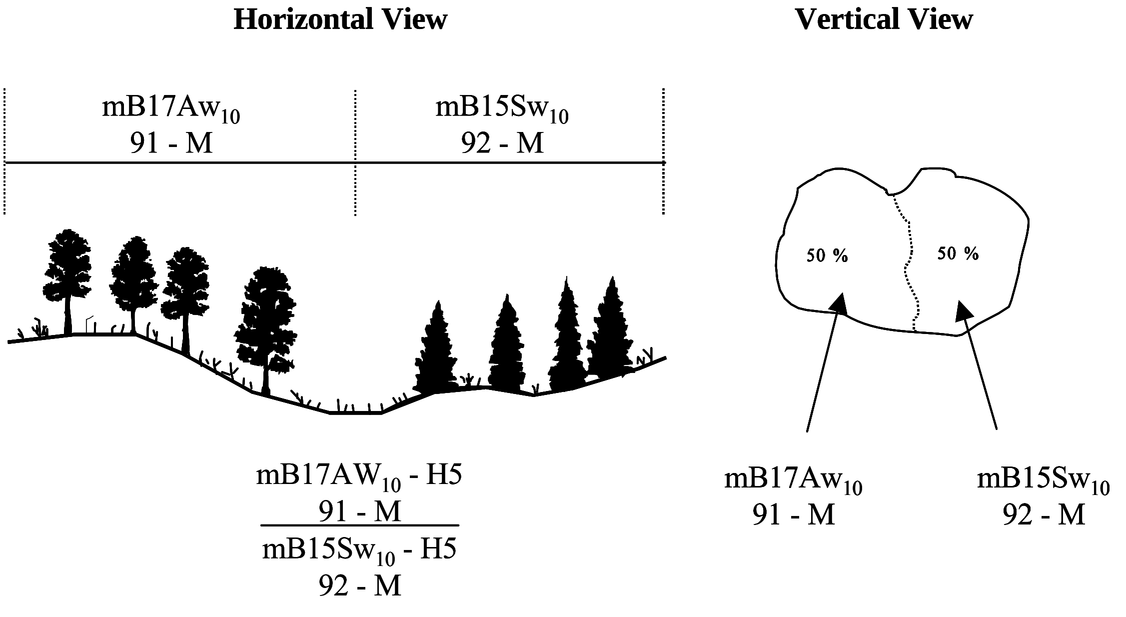


Figure 3-7. Diagrammatic representation of a horizontal stand (example 1).

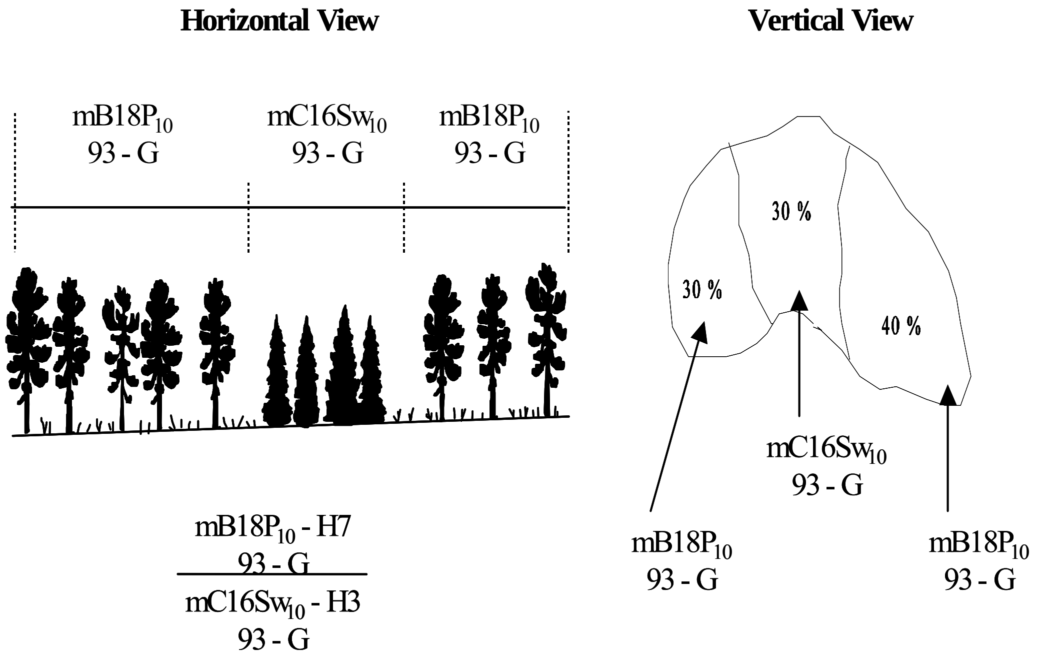


Figure 3-8. Diagrammatic representation of a horizontal stand structure (example 2).

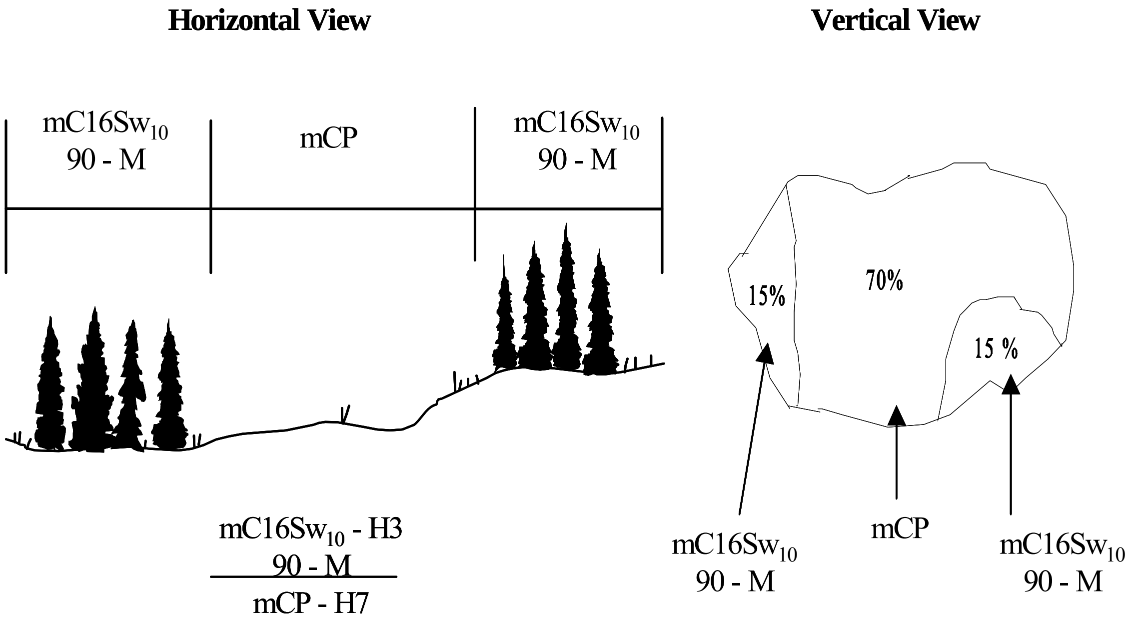


Figure 3-9. Diagrammatic representation of a horizontal stand structure (example 3).

3.4.5.4 Complex Structures

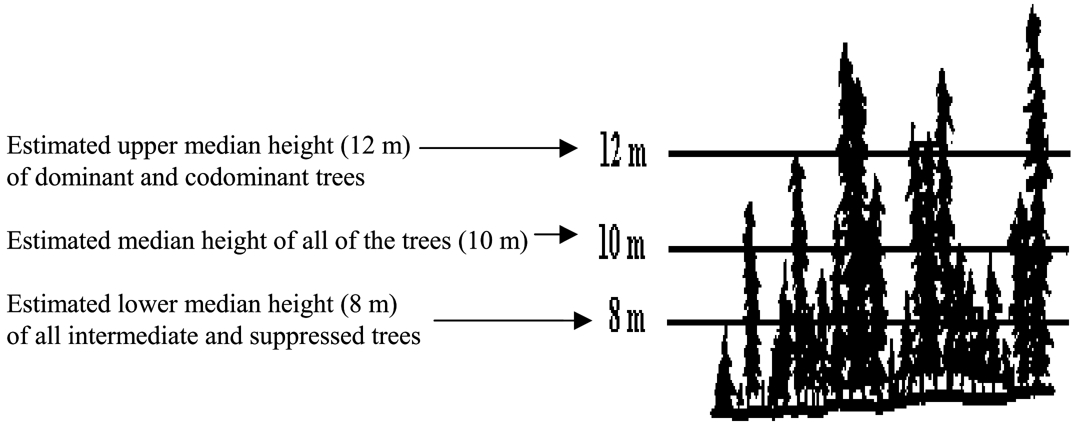
Stand Label and Database Codes

Complex-structured stands are labeled and coded in the database as “C” plus a numeric code between 4 and 9 which indicates the range of median tree heights within the stand (e.g., C6).

Definition

Complex-structured stands are those where multiple layers form a pattern or mosaic that can not be clearly described using the criteria for two-storeyed or horizontally structured stands. These stands are often a mixture of trees of different heights and sometimes species that are intermixed throughout the stand (e.g., black spruce stands growing on a muskeg site). Figure 3-10 provides an example of one of these stands. The height assigned to such stands is the median tree height of all the trees in the stand. The median range of tree heights is also listed immediately following the “C” code (C4 indicates a complex structure with a 4 m height range in the example). Figure 3-10 also describes how the height range is determined. TPR is determined using the origin ‘87’ and the upper median height of ‘12’ (10 m + ½*4 m) for black spruce.

Complex structures can only be used for treed polygons in which a minimum of 80% of the leading tree species (by crown closure) are Sb and/or Lt, Fb or Sw that show: a) a variation in height of >3 m, and b) no evidence of recent fires nor anthropogenic disturbance.



wC10Sb_9Lt_1 - C4
87 - M

Figure 3-10. Complex stand structure, 10 m height with 4 m median height range.

3.4.6 Modifiers to Land Classification

Changes affecting the current vegetation are represented by modifier codes identified in parenthesis at the end of a stand label. Two types of modifiers are used to provide additional information: stand condition and silviculture treatment. A maximum of two conditions and/or treatments may be used. In addition, a numeric extent code is used to describe the extent of the condition or treatment. In some cases, year may also need to be recorded. Modifiers may be used only for vegetated lands.

3.4.6.1 Stand Condition

Stand condition modifiers present additional information about the origin or condition of the vegetation. Stand conditions and their associated codes are listed in Table 3-12.

If the vegetation developed following timber harvesting (either clear or selective cutting), it is represented by a "CC" and an extent code (section 3.4.6.3). The year of harvesting must be recorded. For example, a 1951 harvest of a forest stand of medium TPR that now contains tall, dense shrub cover is coded as: w6SC_7 – (CC5)-1951/-M. Similarly, a wet site burned in 1978 with a "U" timber productivity rating that now supports a low open shrub cover would be shown as: w1SO_4 – (BU5) – 1978/-U.

Burn areas that are a) clearly depicted on the photography (fire boundaries are clearly identified), and b) delineated on fire origin maps, must have a "BU" modifier and the corresponding year of occurrence if a modifier field and modifier year field are available in the label descriptors.

Three types of extent codes are used, based on one of the following:

a) percent loss of crown closure
b) percent land area affected (used only with scattered timber)
c) snag density (used only for snags).

Table 3-12. List of stand condition modifiers and associated codes.

Condition	Interpretation and Database Code
Clearcut/partial cut	CC
Burn/partial burn	BU
Windfall	WF
Clearing (extent not required)	CL
Disease	DI
Insect kill	IK
Unknown kill	UK
Weather (e.g., red belt)	WE
Discoloured/dead tops	DT
Broken tops	BT
Snags[1]	SN
Scattered timber[2]	ST

1) Snags are standing dead trees ≥ 6.0 m tall, normally lacking leaves. Snag modifiers and snag density are used only when snags are clearly observable on air photos or were identified on the ground).

2) Scattered timber is used for anthropogenic vegetated land and non-forest land only (used with areal extent code).

3.4.6.2 Treatment

Treatment modifiers indicate that silvicultural treatments have been applied to a stand. Table 3-13 lists treatments and their associated codes. Treatment codes are also used with an extent modifier (section 3.4.6.3.

Table 3-13. List of treatment modifiers and associated codes.

Treatment	Interpretation and Database Code
Site improved (e.g., fertilization, drainage, weed control)	SI
Seedbed prepared (e.g., scarification)	SC
Planted and/or seeded (regardless of success)	PL
Thinned	TH
Developed for grazing domestic livestock	GR
Irrigated	IR

3.4.6.3 Condition and/or Treatment Extent and Year

Condition and treatment modifiers are used in combination with a severity (i.e., extent) code and year of disturbance, if known (e.g., (WF1) 1949). Table 3-14 defines the extent classes and provides their associated codes.

If two conditions and/or treatments occur in a polygon, they are listed in order of occurrence with the most recent appearing last, e.g., mB24Aw$_{10}$ – CC2 – PL4 (1988)/ M. This example indicates that the stand was harvested and then planted in 1988. If a stand has been cut (“CC”) and new activities occur after the cut, the modifier CC will be retained regardless of the other activities (e.g., stand harvested in 1987 (CC5), then scarified in 1988 (SC4) then planted in 1989 (PL4), will have the following modifiers: (CC5)-1987 (PL4)-1989).

3.4.6.4 Snag Density

Extent codes for the snag modifier are based on density (Table 3-14). A two-part code incorporating the snag symbol and the snag density modifier code is used, along with year of disturbance, if known (e.g., (SN1) 1949). If a condition/treatment occurs in conjunction with snags in a polygon, they are listed in order of occurrence with the most recent appearing last (e.g., mB24Aw$_{10}$ – SN2 – PL4 (1988)/M). This example indicates that there are moderate numbers of snags present that existed prior to the polygon being planted in 1988.

Table 3-14. List and description of snag modifiers and associated codes.

Extent	Snag Density (Per ha)	Interpretation and Database Code
Nil	<5	
Light – 1% - 25% loss of crown closure or land area affected	5 – 99	1
Moderate – 26% - 50 % loss of crown closure or land area affected	100 – 299	2
Heavy – 51% - 75% loss of crown closure or land area affected	300 – 499	3
Severe – 76% - 94% loss of crown closure or land area affected	500 – 700	4
Entire – entire crown or land area is affected	>700	5

3.4.7 Timber Productivity Rating (TPR)

A timber productivity rating (TPR) is assigned when any of the tree species listed in Table 3-8 are or have been present on a site. TPR reflects tree growth response to environmental factors including soil, topography, climate, elevation and moisture. It indicates the potential timber productivity of a stand based on the height and bh_{age} of the dominant and codominant trees of the leading species (first tree species listed in the polygon label). Timber productivity is determined using the TPR for one of the five major tree species. Four TPR classes are recognized (Table 3-15). If the stand TPR is “G”, “M”, or “F” the stand is considered productive. Formulas for calculating site index and deriving TPR for the five main Alberta tree species groups are listed in Appendix VIII.

Table 3-15. List of timber productivity classes and codes.

Timber Productivity	Interpretation and Database Code
Good	G
Medium	M
Fair	F
Unproductive	U

TPR is assigned to polygons labels if:

a) The polygon is classed as vegetated:
   - Forested or Non-forested

  - Anthropogenic Agricultural – code “CPR” (rough pasture) only.

b) The polygon is classed as non-vegetated:

  - Naturally Non-Vegetated Mineral – code “NMB” (recent burns that haven’t re-vegetated) only. TPR is assigned based on the productivity estimated to exist before the burn.

TPR is not assigned to anthropogenic vegetated polygons within the industrial or agricultural categories except for rough pasture as noted above.

In forested areas, TPRs are calculated using the height and age of the leading tree species. In non-forested lands, TPRs are assigned based on the interpreter’s assessment of the productivity of these lands.

For stands in which the stand structure is described as “complex structure”, the TPR is calculated based on the leading species, the assigned origin, the assigned height (indicated after the crown closure code), and ½ of the tree height range (see Figure 3-10).

TPR must be interpreted for forest stands less than 20 years old and for suppressed trees (e.g., those released due to the removal of an overstorey) from site conditions and/or nearby stands or historical data (pre-harvest conditions). The data source code “I” is used to signify an interpreted TPR (e.g., 1980-M-I) (section 3.5).

Two-storeyed Stands

1. If trees are present in both storeys and the leading species (Species1) in the overstorey = Species1 in the understorey, then the TPR is obtained from the overstorey tree Species1 and the same TPR assigned to both strata.

2. When leading tree species are different in the two storeys, the TPR class is determined separately based on Species1 in each storey.

3. If the overstorey is forested and the understorey is not forested, the same TPR is assigned to both strata based on Species1 in the overstorey.

4. If both layers are classified as non-forested, the same TPR is assigned to the overstorey and understorey.

5. If the overstorey is non-forested and the understorey is forested, then the same TPR is assigned to both strata based on Species 1 in the understorey. Figure 3-11 is an example of a shrub overstorey ‘m6SO$_4$’ (with the assigned TPR code ‘M’) that has the same TPR code as the forested understorey ‘mB1Sw$_{10}$’ The data source code “F” (field checked), or any other evidence of the presence of tree species, must be recorded, as well as the year when the data source was verified.

$$\begin{array}{c} \text{m6SO}_4\text{ - F (1999)} \\ \text{- M} \\ \hline \text{mB1Sw}_{10}\text{ - F (1999)} \\ \text{99 - M} \end{array}$$

Figure 3-11. Example of a polygon label for a two-storey stand with trees only in the understorey.

Horizontal Stands

TPRs can differ in different strata of a horizontal structures.

Non-forested Land

When a polygon has a tree crown closure of <6% (i.e., non-forested land), TPR is determined from residual trees, adjacent stocked forest land (if on the same ecosite) or other available information (e.g., soils maps, air photos acquired prior to tree removal). Reference trees from allocation outside of the polygon being classified are used only if they appear to be growing on land with apparently equal productivity.

3.5 Existing Stand Data and Confirmation of Attributes

When AVI attributes have been confirmed from other information sources or existing stand data are available to confirm attributes, codes are used to describe the data source. The reference year for the data sources is also coded if known (e.g., F– 1991 interpreter plot measured in 1991). When more than one data source attribute exists, the hierarchy indicated by order of listing in Table 3-16 applies.

Table 3-16. Codes for indicating data sources.

Data Source	Interpretation and Database Code
Interpreter plot	F[1]
Air call	A
Interpreted TPR	I
Supplementary Photography	S
PSP	P
Cruise Plot	C
Volume plot	V
Large-scale photography	L

1) Interpreter plot data are recorded on a Cruise Tally Sheet or equivalent (see Appendix II). Section 2.1.2 describes the interpreter field plot procedures.

Additional rules regarding data source and data source date code uses are described in Appendix IX.

4 Orthophoto Base Map

Interpreted information is transferred onto an orthophoto base map to create a spatially correct vegetation map suitable for digitizing. Orthophoto bases are produced from scanned aerial photos that have been corrected for the displacement that results from aircraft tip and tilt at the time of photo exposure, and from variations in ground relief and aircraft flying height, using control data. They are usually portrayed at the selected inventory scale (e.g., 1:20 000 for AVI). The interpreted information is stereoscopically transferred onto the orthophotos, thereby spatially correcting it. The interpreter's work can then be digitized directly from the orthophoto. The AVI linework from the interpreted photography is tied to the hydrography (lakes and rivers) and the access (roads, power lines, pipelines and seismic lines) information (derived from the Provincial base features database) previously plotted on the orthophoto. An example of a completed orthophoto base map is shown in Figure 4-1.

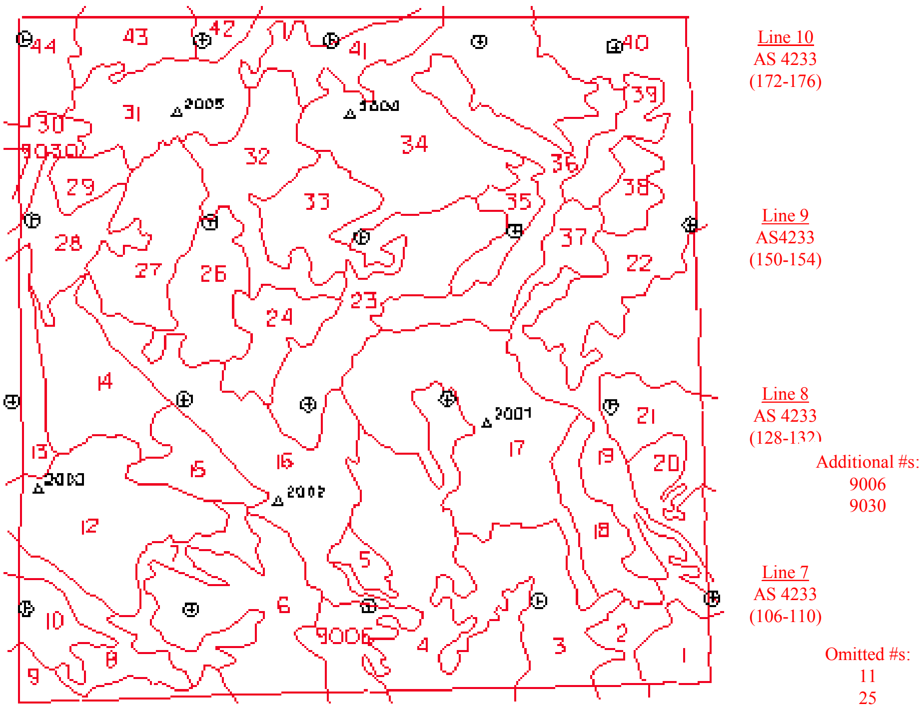
4.1 Transfer of Photo Detail to Orthophoto Base Map

Before transfer of the interpreted information begins, the exact township boundaries are linked into the base in black, water-soluble ink with a # 0 drafting pen.

Information to be transferred from the interpreted 1:20 000 air photographs to the orthophoto base map include:

- polygon boundaries and polygons #s - red ink
- field plot centre - black ink
- field plot numbers (2 000 series) - black ink
- photo flight line number, photo roll number, photo number range (e.g., 182 - 187). All 1:20 000 air photo information is labeled on the orthophoto base even if the photo centre of the photography lies between the township boundary and the white margin of the orthophoto base map - red ink.
- photo centre - black ink
- number of field plots established- red ink

- name of the forestry consultant creating the AVI- red ink
- name of the agency/ company funding the AVI- red ink
- date of interpretation - red ink
- interpreter's name and AVI certification #- red ink
- Level 3 Interpretation stamp of the interpreter responsible for the work
- omitted and additional polygon numbers (9 000 series)- red ink
- photo scale and photo date - red ink
- AVI version # - red ink.



**Twp. 48 - Rg. 7 - W5M
1:20 000**

1:20 000 Photo date: Aug. 22, 1985
AVI Version 2.1
Company name: ABC Consulting
Agency funding the work

Interpretation date: February 1989
Interpreter name: John Doe
AVI certification #: 000

Number field plots: 5
Number of air calls: 8
Number of PSP plots: 3

Note: ⊕ indicates photo centres, Δ shows field plot locations and plot numbers, polygon numbers indicated by numeric labels 1-44

Figure 4-1. Example of a completed orthophoto base map.

All information labelled on the orthophoto base map and the detail transferred from the 1:20 000 air photos are recorded with a # 0 pen.

Polygon lines must extend 1.3 cm beyond the township boundaries to facilitate tieing the interpretation to that in adjacent areas.

4.2 Numbering of Polygons on the Orthophoto Map

Each individual polygon on the orthophoto map is given a unique, consecutive polygon number. Polygon numbers are written onto the orthophoto map in the centre of each of the interpreted polygons whenever possible.

Number “1” is assigned to the polygon in the lower right hand corner of each orthophoto base map. Each polygon thereafter is assigned the next number in sequence, with the highest number being assigned to the polygon in the upper right corner of each orthophoto base map. The numbering sequence is shown in Figure 4-2. Numbers must be assigned beginning in the southeast corner of each township such that they lead into the next section once each section is complete (legal sections 1 to 12 are marked in Figure 4-2). Polygon numbering will follow this pattern until the northeast corner of the township is reached. Thus the stand numbering sequence on the orthophoto base map follows the order in which the sections are numbered.

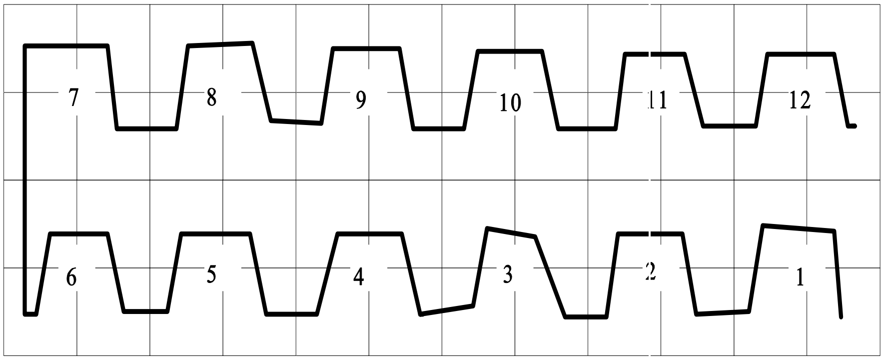
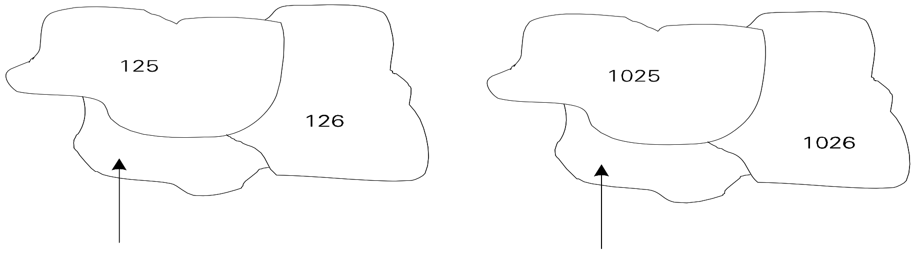


Figure 4-2. Polygon numbering pattern in a portion of a township map

The boundaries of all privately owned and Crown land within the inventory area will be mapped and drafted onto the inventory base maps. Excluded areas are assigned a 9000 number.

4.2.1 Omissions and Errors in Numbering

If a polygon is missed during the initial numbering, and the closest numbered polygon is less than or equal to 999, a 9000 number will be assigned to that polygon (Figure 4-3). The 9000 numbers are determined by taking the number of the polygon closest to the omitted polygon and adding 9000 to it. If the closest numbered polygon is greater than or equal to 1000, an 8000 number is assigned to that polygon. The 8000 number series is assigned by taking the number of the closest polygon, deleting the first digit then adding 8000 to it. All 9000 and 8000 numbers shall be listed in the right hand margin of the orthophoto base under the label “Additional Numbers”.



Assign number 9125 or 9126

Assign number 8025 or 8026

Figure 4-3. Examples of assigned 9000 and 8000 series polygon numbers.

Another common error that occurs during polygon numbering is the assigning of two different numbers to the same polygon. This usually happens to long, wandering polygons which are difficult to follow. If this type of error is discovered after the entire map has been numbered and the error cannot be corrected, all but one of the polygon numbers must be deleted. Any deleted or omitted numbers are to be listed in the centre of the right hand margin between the photo line numbers and labelled in red ink under the label “Omitted Numbers”.

4.2.2 Numbering Previously Completed Orthophoto Base Maps

AVI maps completed during a previous inventory project may already partially cover some townships. The numbering of polygons for the additional AVI on the orthophoto bases will commence with the next highest number after the largest existing AVI polygon number, and the new numbers will start in (or closest to) the lower right portion on the base map.

5 Digital Attribute Loading

Table 5-1 identifies the Alberta Vegetation Inventory (AVI) coding parameters.

Prior to the creation of the digital attribute database, all polygon attributes from interpreted photos are listed on a coding sheet (Table 5-2).

Data base files on diskettes or CDs are to be named as the example in Figure 5-1 indicates (e.g., file name for Township 9, Range 4, W 5 Meridian).

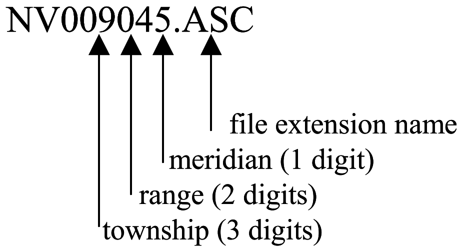


Figure 5-1. Example of the database file numbering system.

ASCII files are to be consistent with the parameters identified in Table 5-1.

Two additional documents, “AVI Data Model, Version 2.1” and “Digital Mapping Standards and Specifications” (Chapter 8, Section 1 and Chapter 2 respectively, in Alberta’s “Vegetation Inventory Standards and Data Model Documents”) contain additional information regarding AVI digital data requirements.

Table 5-1. Alberta Vegetation Inventory (Version 2.1.1) coding parameters.

Parameter		Field[1]			Allowable Codes
		Width	Type[2]	Position	
Meridian		1	N	1	4 - 6
Range		2	N	2 –3	1 – 30
Township		3	N	4 – 6	1 – 126
Polygon number		4	N	7 – 10	1 – 9999
Moisture regime		1	C	11	d, m, w, a
Crown closure		1	C	12	A, B, C, D
Height		2	N	13 –14	0 – 40 (suggested)
Species 1 -	Species	2	C	15 – 16	Sw, Se, Sb, P, Pl, Pj, Pa, Pf, Fb, Fa, Fd, Lt, La, Lw, A, Aw, Pb, Bw
	Percent	2	N	17 - 18	2 - 10
Species 2 -	Species	2	C	19 – 20	Sw, Se, Sb, P, Pl, Pj, Pa, Pf, Fb, Fa, Fd, Lt, La, Lw, A, Aw, Pb, Bw
	Percent	1	N	21	1 - 5
Species 3 -	Species	2	C	22 – 23	Sw, Se, Sb, P, Pl, Pj, Pa, Pf, Fb, Fa, Fd, Lt, La, Lw, A, Aw, Pb, Bw
	Percent	1	N	24	1 - 3
Species 4 -	Species	2	C	25 – 26	Sw, Se, Sb, P, Pl, Pj, Pa, Pf, Fb, Fa, Fd, Lt, La, Lw, A, Aw, Pb, Bw
	Percent	1	N	27	1 - 2
Species 5 -	Species	2	C	28 – 29	Sw, Se, Sb, P, Pl, Pj, Pa, Pf, Fb, Fa, Fd, Lt, La, Lw, A, Aw, Pb, Bw
	Percent	1	N	30	1 - 2
Stand structure	Type	1	C	31	Blank, M, C, H
	Percent/range	1	N	32	0 – 9
Origin		4	N	33 – 36	1400 – current year
Timber productivity rating (TPR)		1	C	37	G, M, F, U

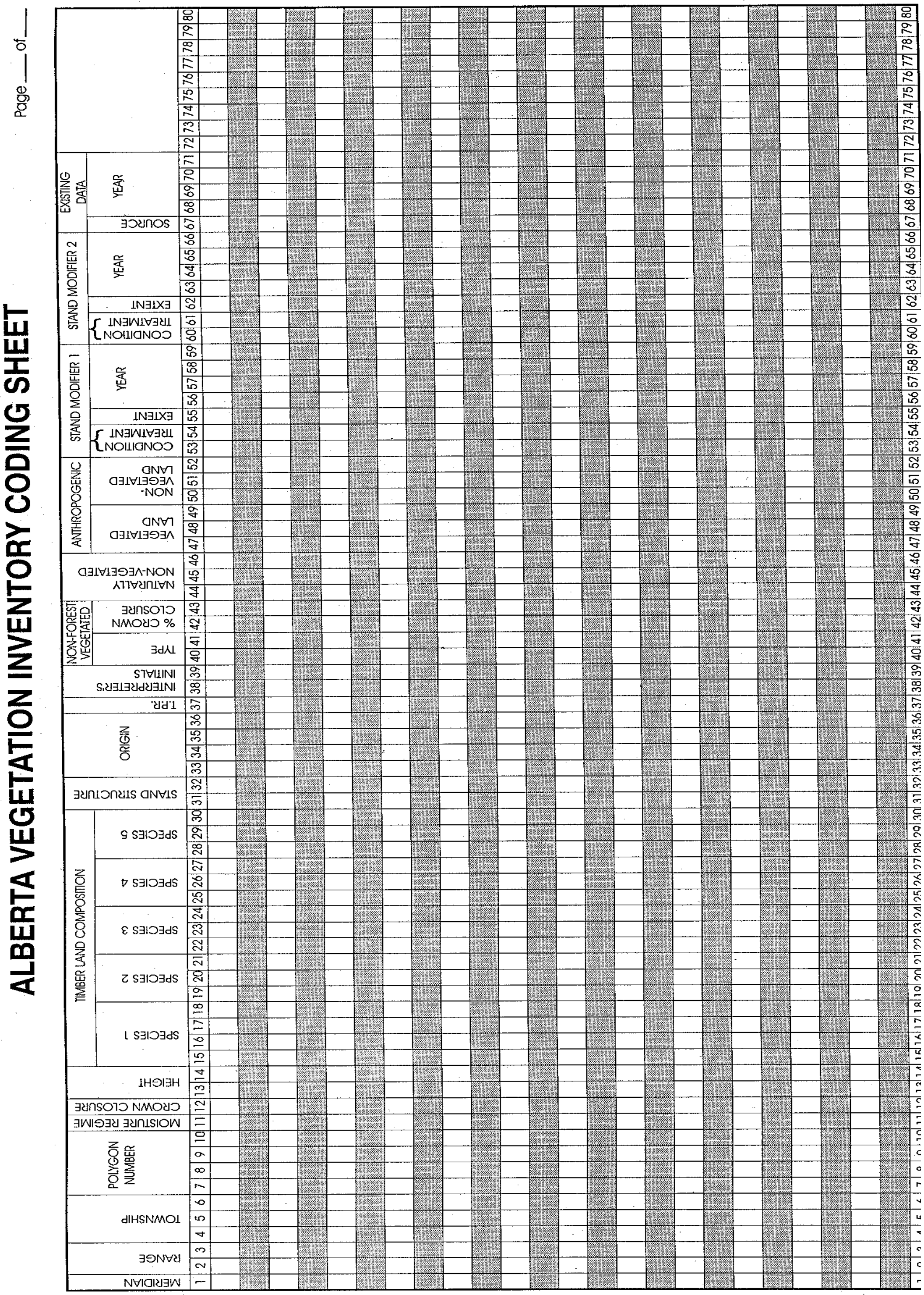
Table 5-1. continued.

Parameter		Field			Allowable Codes
		Width	Type	Position	
Interpreters initials		2	C	38 – 39	AA – ZZ
Non-forest vegetated	Type	2	C	40 – 41	SC, SO, HG, HF, BR
	Shrub closure	2	N	42 – 43	0 – 10
Naturally non vegetated		3	C	44 – 46	NWI, NWL, NWR, NWF, NMB, NMC, NMR, NMS
Anthropogenic vegetated		3	C	47 - 49	CA, CP, CPR, CIP, CIW,
Anthropogenic non-vegetated		3	C	50 – 52	ASC, ASR, AIH, AIE, AIG, AIF, AIM, AII
Stand Modifier 1	Condition/treatment	2	C	53 – 54	CC, BU, WF, CL, DI, IK, UK, WE, DT, BT, SN, ST, SI, SC, PL, TH, GR, IR
	Extent	1	N	55	0 – 5
	Year	4	N	56 – 59	1900 – current year
Stand Modifier 2	Condition/treatment	2	C	60 – 61	CC, BU, WF, CL, DI, IK, UK, WE, DT, BT, SN, ST, SI, SC, PL, TH, GR, IR
	Extent	1	N	62	0 – 5
	Year	4	N	63 – 66	1900 – current year
Data Source	Year	1	C	67	F, A, I, S, P, C, V, L
	Data reference	4	N	68 - 71	1940 – current year

1) Field width and position as per coding sheet (Table 5-2).

2) N = Numeric, C = Character.

Table 5-2. Alberta Vegetation Inventory coding sheet (Version 2.1.1).



ALBERTA VEGETATION INVENTORY CODING SHEET

Page____ of____

MERIDIAN		1
RANGE		2 3
TOWNSHIP		4 5 6
POLYGON NUMBER		7 8 9 10
MOISTURE REGIME		11
CROWN CLOSURE		12
HEIGHT		13 14
TIMBER LAND COMPOSITION	SPECIES 1	15 16 17 18
	SPECIES 2	19 20 21
	SPECIES 3	22 23 24
	SPECIES 4	25 26 27
	SPECIES 5	28 29 30
STAND STRUCTURE		31 32
ORIGIN		33 34 35 36
T.P.R.		37
INTERPRETER'S INITIALS		38 39
NON-FOREST VEGETATED	TYPE	40 41
	% CROWN CLOSURE	42 43
NATURALLY NON-VEGETATED		44 45 46
ANTHROPOGENIC	VEGETATED LAND	47 48 49
	NON-VEGETATED LAND	50 51 52
STAND MODIFIER 1	CONDITION TREATMENT	53 54
	EXTENT	55
	YEAR	56 57 58 59
STAND MODIFIER 2	CONDITION TREATMENT	60 61
	EXTENT	62
	YEAR	63 64 65 66
EXISTING DATA	SOURCE	67
	YEAR	68 69 70 71
		72 73 74 75 76 77 78 79 80

6 AVI Edits

AVI quality control criteria are described in Appendix X. All original AVI materials are to be corrected if changes occur due to Departmental edit verification functions (e.g., air photo polygon attributes, line work, etc).

7 Process Summary

A summary of the activities involved in completely interpreting and mapping of a township or area are depicted in the flowchart (Figure 7-1).

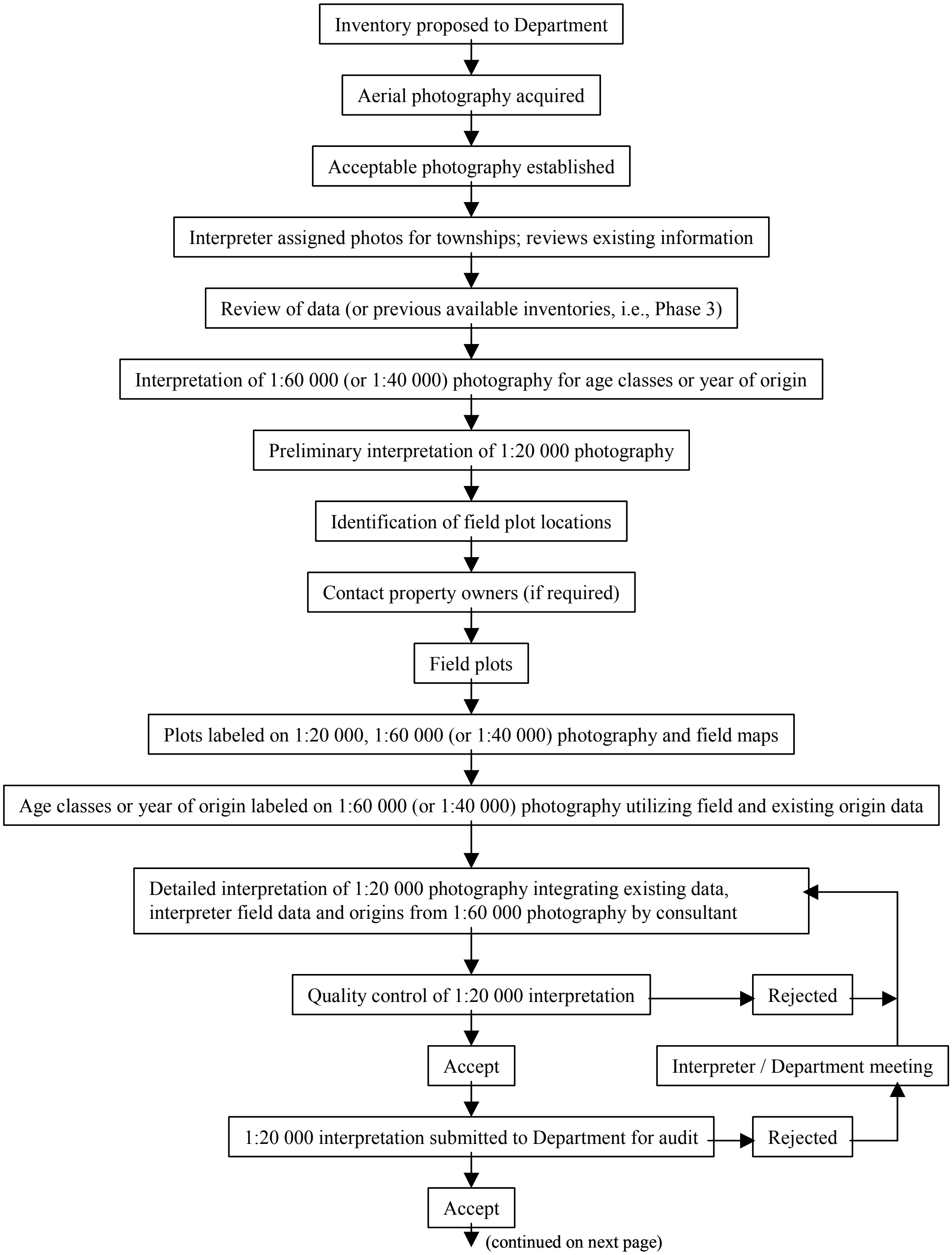


Figure 7-1. Flowchart showing the sequence of photo interpretation activities.

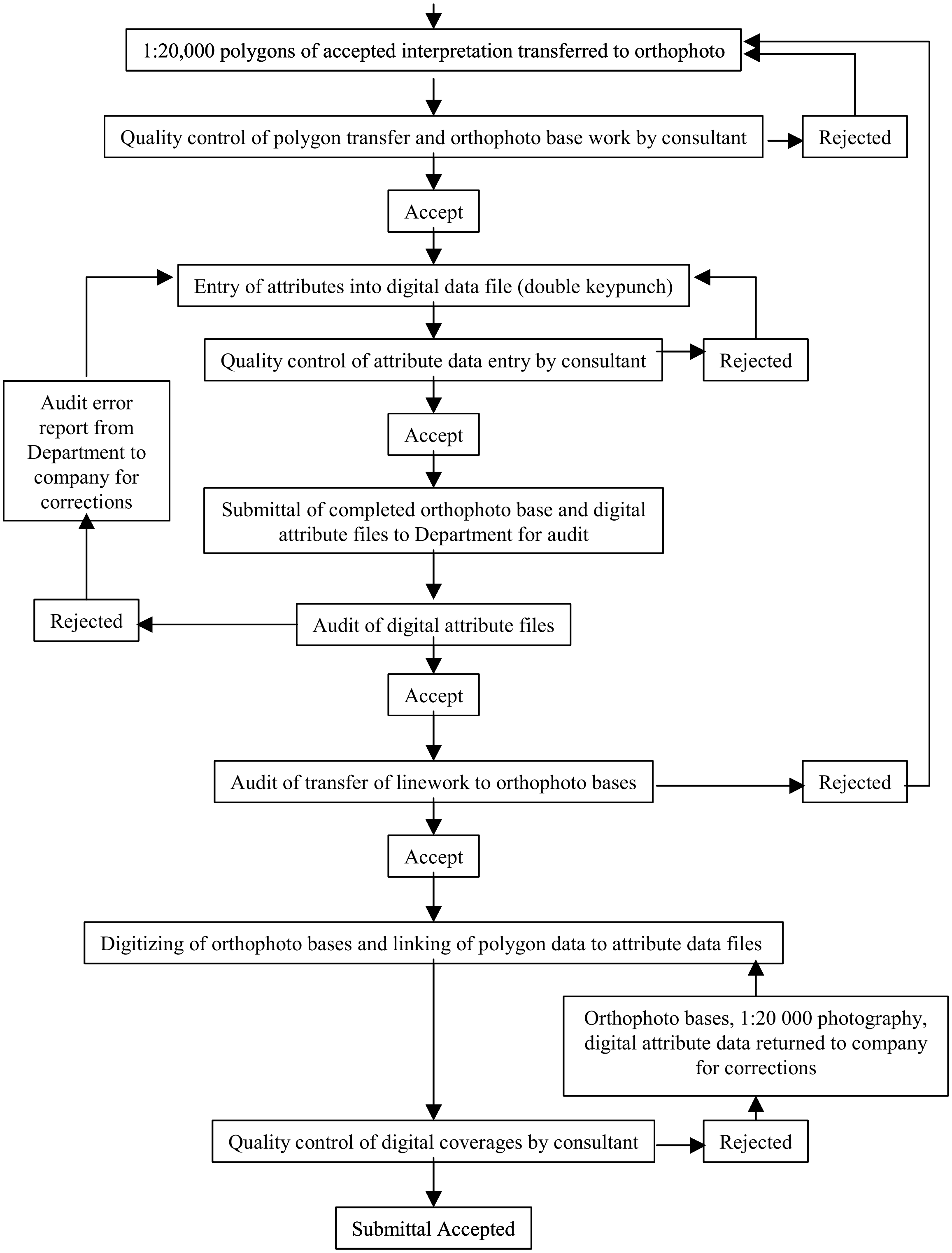


Figure 7-1. (continued).

Appendix I Records of field access permission from landowners

Twp.________ Rge._____ W___M

Date:_________________________

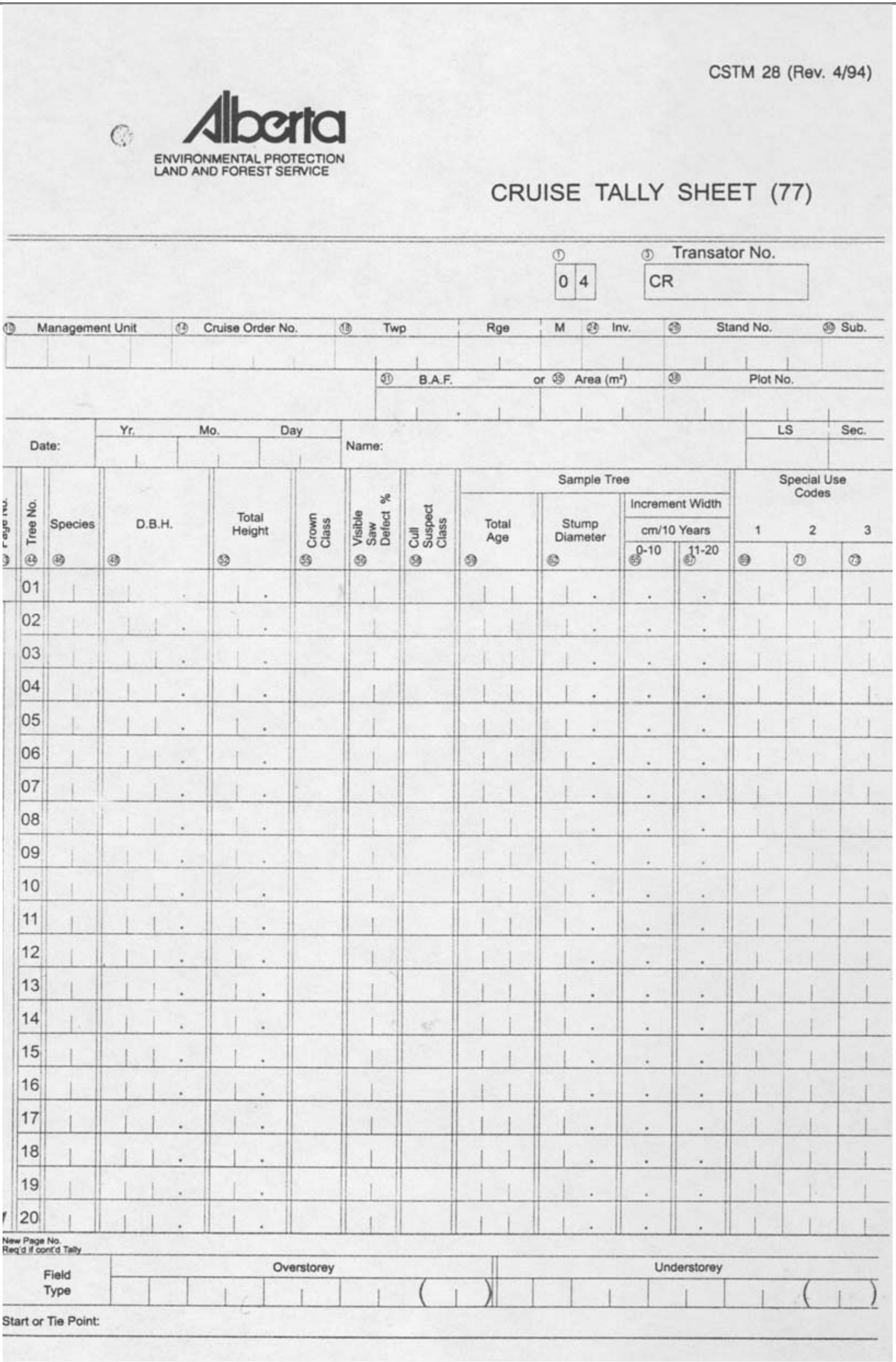
Contractor ___________________

Interpreter ___________________

Plot #	¼ Sec.	Landowner's Name	Phone #	Access Granted (Yes or No)	Comments/ Signature of Landowner

Figure A-I-1 Record of field plot access permission from landowners.

Appendix II Cruise tally sheet



CSTM 28 (Rev. 4/94)

Alberta
ENVIRONMENTAL PROTECTION
LAND AND FOREST SERVICE

CRUISE TALLY SHEET (77)

① 0 4

③ Transator No. CR

⑩ Management Unit	⑭ Cruise Order No.	⑱ Twp	Rge	M	㉔ Inv.	㉖ Stand No.	(30) Sub.

㉛ B.A.F. or ㉟ Area (m²) | ㊳ Plot No.

Date: Yr. Mo. Day | Name: | LS | Sec.

Page No.	Tree No. ㊹	Species ㊻	D.B.H. ㊽	Total Height (52)	Crown Class (55)	Visible Saw Defect % (56)	Cull Suspect Class (58)	Sample Tree Total Age (59)	Sample Tree Stump Diameter (62)	Sample Tree Increment Width cm/10 Years 0-10 (65)	Sample Tree Increment Width cm/10 Years 11-20 (67)	Special Use Codes 1 (69)	Special Use Codes 2 (71)	Special Use Codes 3 (73)
	01													
	02													
	03													
	04													
	05													
	06													
	07													
	08													
	09													
	10													
	11													
	12													
	13													
	14													
	15													
	16													
	17													
	18													
	19													
	20													

New Page No.
Req'd if cont'd Tally

Field Type	Overstorey	Understorey
	( )	( )

Start or Tie Point:

Figure A-II-1 Cruise tally sheet (77) – CSTM 28 (Rev. 4/94).

Appendix III Examples of polygon size

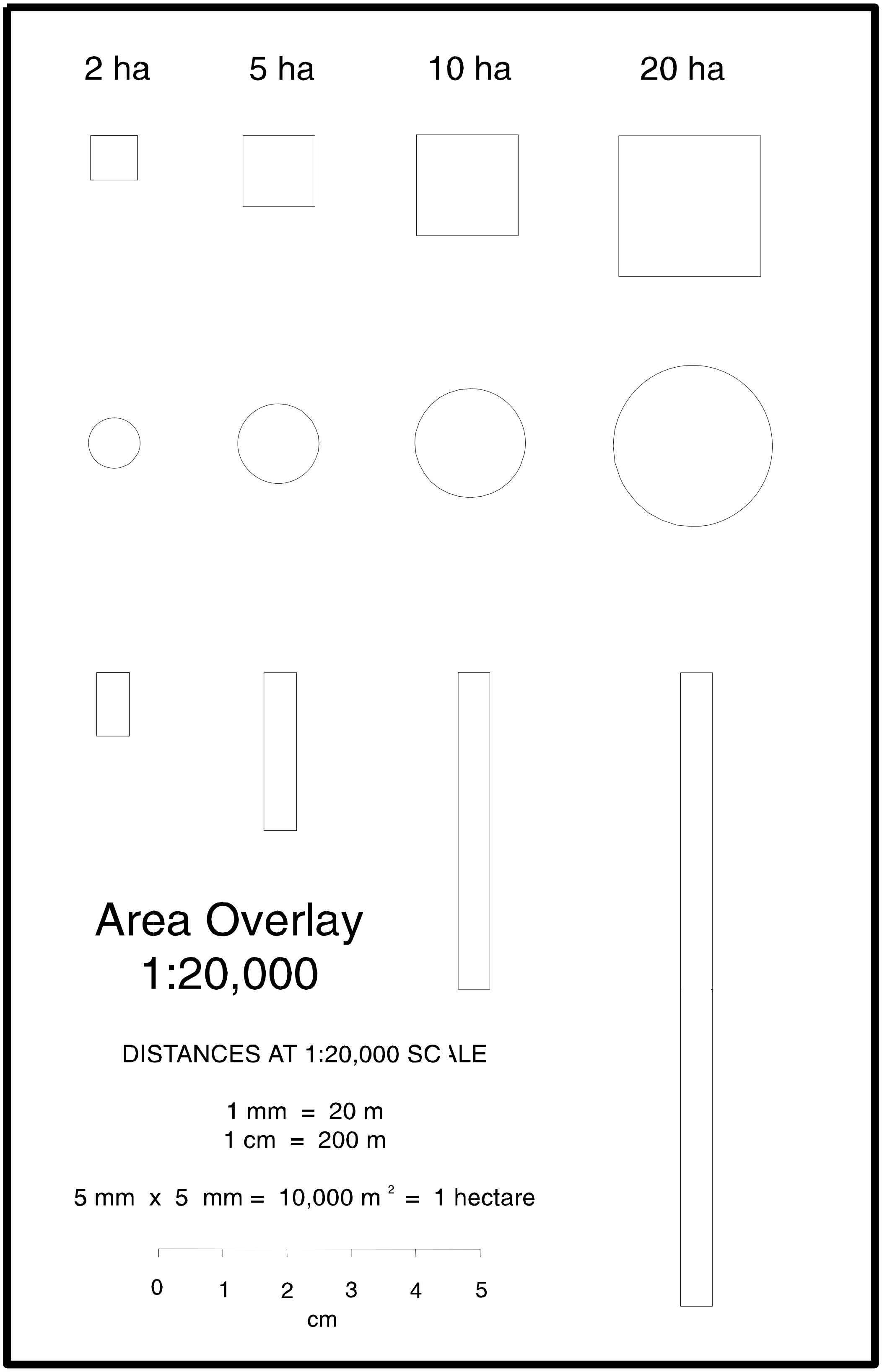


Figure A-III-1 Examples of different areas at a scale of 1:20 000.

Appendix IV Ecological moisture regime

Ecological Moisture Regime (Adapted from Klinka, 1977 and Utzig et al. 1978)

Ecological moisture regime (hygrotype), relative to the specific macroclimatic conditions representing a biogeoclimatic subzone or any other biogeoclimatic unit, signifies the available moisture supply for plant growth. At present, there has been little quantitative investigation of the classes described here. Assuming that, within a given subzone, climatic variables such as temperature and precipitation are essentially constant (or vary within narrow ranges), the subzone variation of available moisture results from the redistribution of precipitation by edaphic factors. Sites that have a specific amount of available moisture that reflects the given climate, and have average conditions of slope, moisture translocation and texture, have a mesic moisture regime; those with less than normal available moisture grade to xeric (i.e., dry) and those with more than normal available moisture grade to hydric (wet) (see Table A-IV-1).

The ecological moisture regime is a relative ranking of sites based on their available moisture supply (available moisture is that held between 1/3 bar and 15 bars matrix potential). The moisture regime is assessed regardless of osmotic potential (i.e., salt content is not considered). Because available moisture is a dynamic property that varies throughout the year, the intent of the assessment is to evaluate available moisture on the basis of the growing season as a whole, not at any particular time.

The ecological moisture regime integrates many interrelated environmental and biotic parameters that, when combined, determine the actual amount of available moisture. The field assessment is ideally completed by evaluating a combination of environmental factors, soil properties and indicator plants. However, the assessment can be made on the basis of plant indicators or environmental factors and soil properties alone. A schematic illustration of the influence of these factors is given in Figure A-IV-I.

Ecological moisture regime is correlated with the following factors: micro-variations in topoclimate, slope positions (macro- and meso-relief), slope gradient, soil drainage, depth of surface humus layers, soil texture (including the content of coarse fragments), soil depth and the presence of an impermeable layer. Factors related to internal soil properties can be evaluated in a soil pit, on road cuts or in disturbed spots. In general, the most influential factor is the position on the slope. On ridges and upper slopes, precipitation is the main source of water since moisture passes quickly downslope and little, if any, moisture is retained. Middle slopes receive, in addition to precipitation, some seepage from up-slope which is usually discontinued during the summer. The lower slopes, flats and depressions are usually enriched by a temporary or permanent seepage waterflow. The other factors can be considered as compensating this general pattern, i.e., affecting to a varying degree the ultimate ecological moisture regime.

The amount of available moisture often increases with decreasing slope gradient, decreasing soil particle size (i.e., from coarse to fine-textured soils), decreasing content of coarse fragments, increasing soil depth, and increasing thickness of humus layers (in particular with the thickness of colloidal and humified H-layer.

Table A-IV-1. Ecological moisture regime class.

		Defining Characteristics		Field Characteristics						
				Soil Properties						
AVI Moisture Regime Code	Moisture Regime	Description	Primary Water Source	Slope Position	Texture	Drainage	Depth to Permeable Layer	Surface Humus Depth	Available Water Storage Cap	Slope Gradient
d	Very Xeric	Water removed extremely rapidly in relation to supply. Soil is moist for a negligible time after ppt.	precipitation	ridge crests shedding	very coarse (gravely) abundant coarse fragments	very rapid	very shallow (<0,.5 m)	very shallow	extremely low	very steep (especially on south aspects)
d	Xeric	Water removed very rapidly in relation to supply. Soil is moist for brief periods following ppt.	precipitation							
d	Subxeric	Water removed rapidly in relation to supply. Soil is moist for short periods following ppt.	precipitation	upper crests shedding	coarse to mod. coarse (LS-SL) mod. coarse fragments	rapid	shallow (< 1m)	shallow	very low	steep
m	Submesic	Water removed readily in relation to supply; water available for moderately short periods following ppt.	precipitation			rapid to well			low	
m	Mesic	Water removed somewhat slowly in relation to supply. Soil may remain moist for a significant, but sometimes short period of the year. Available soil moisture reflects climatic inputs.	precipitation in moderately to fine - textured soils & limited seepage in coarse-textured	mid-slope normal rolling to flat	moderate to fine (L-SiL) few coarse fragments	well to moderately well	moderately deep (1-2 m)	moderately deep	moderate	moderate
m	Subhygric	Water removed slowly enough to keep the soil wet for a significant part of the growing season. Some temporary seepage and possibly mottling below 20 cm.	precipitation and seepage	lower slopes receiving	variable depending on seepage	moderately well to imperfect	deep (>2 m)	deep	high	slight
w	Hygric	Water removed slowly enough to keep the soil wet for most of the growing season; permanent seepage and mottling present. Possibly weak gleying.	seepage			imperfect to poor	variable depending on seepage		variable depending on seepage	
w	Subhydric	Water removed slowly enough to keep the water table at or near the surface for most of the year. Gleying mineral or organic soils. Permanent seepage less than 30 cm below the surface.	seepage			poor to very poor		very deep		
a	Hydric	Water removed so slowly that the water table is at or above the soil surface all year. Gleying mineral or organic soils.	permanent water table	depressions receiving	variable depending on seepage	very poor	variable depending on seepage		variable depending on seepage	flat

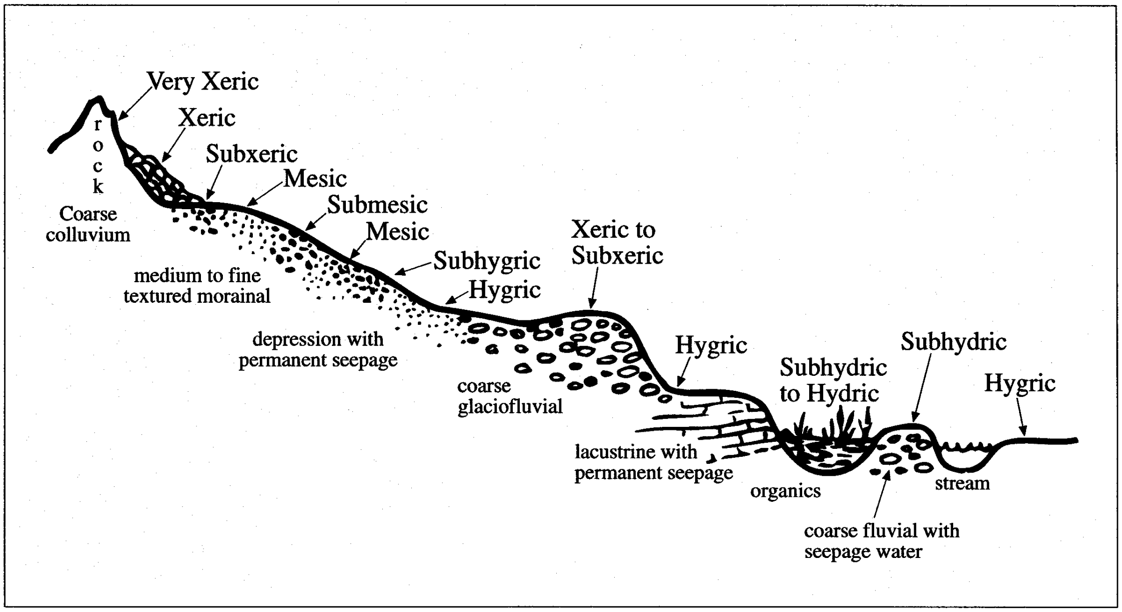


Figure A-IV-1. Ecological moisture regime in relation to landscape position and geologic material.

The presence of an impermeable layer (e.g., bedrock, compacted till, cemented layer) may inhibit soil water storage, or create conditions for temporary or permanent seepage if subsurface water flow seepage is present. This can also result in an increase of available moisture.

The use of plant indicators for assessing ecological moisture regimes requires an existing vegetation classification scheme for the subzone under consideration or a reconnaissance of the areas sufficient to establish relationships between vegetation indicators and the range of edaphic conditions. When assessing sites near subzone boundaries, care must be taken to differentiate between seepage inputs and increases in precipitation or decreases in evapotranspiration demands. For example, plants normally found on mesic sites in one subzone can occur on subhygric sites in an adjacent subzone with lower precipitation or higher temperatures. Care must also be taken to assess the plant community as a whole. Some species may have a limited rooting depth and may not reflect the presence of deeper seepage waters, while others may reflect changes in nutrient availability rather than available moisture. Even when extensive vegetation information is available, it is always best to consider the environmental factors as well.

Appendix V Non-forest land over natural non-vegetated land rules

Non-Forest Land over Natural Non-Vegetated Land Rules

The following table summarizes the possible structures resulting from the natural non-vegetated understoreys that are assigned to non-forest vegetated overstoreys.

Table A-V-I. Natural non-vegetated understoreys assigned to non-forest vegetated overstoreys.

Non-Forest Vegetated Overstorey		
SO or SC	**HG or BR**	**HF**
Allowable Understories		
NMR	NMR +’F or A’	NMR +’F or A’
NMS + ‘F or A’	NMS +’F or A’	NMS +’F or A’
NMC	NMC +’F or A’	NMC +’F or A’
		‘a’+ NWF
		‘a’+ NWL
Understories Not Allowed		
NWI	NWI	NWI
NWR	NWR	NWR
NWF	NWF	
NWL	NWL	

F = field checked; A = air call; a = aquatic moisture regime

Examples of allowed combinations:

aHF	aHF	HF F 1999
NWL	NWF	NMR F 1999

Examples of combinations **not allowed**:

HG	SO	HF
NWF	NWR	NMR

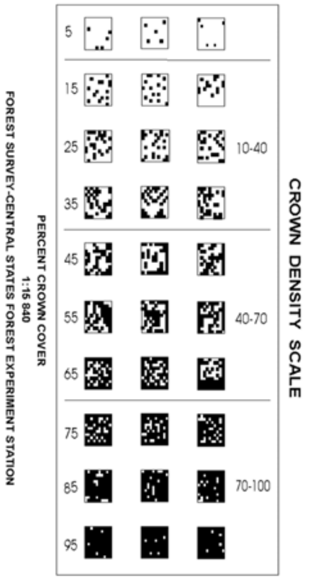
Appendix VI Potential peatland vegetation cover types

Table A-VI-1. List of potential peatland vegetation cover types.

Cover type	Vegetation component
Forested	black spruce, tamarack, western larch
Non-Forested	bryophytes (mosses), grassland (herbaceous), shrub land (open and closed)
Agriculture	annual crops, perennial forage crops
Pasture	rough, pasture and highland (includes cultivated and recent clearing)

Appendix VII Crown closure guide

CROWN CLOSURE GUIDE



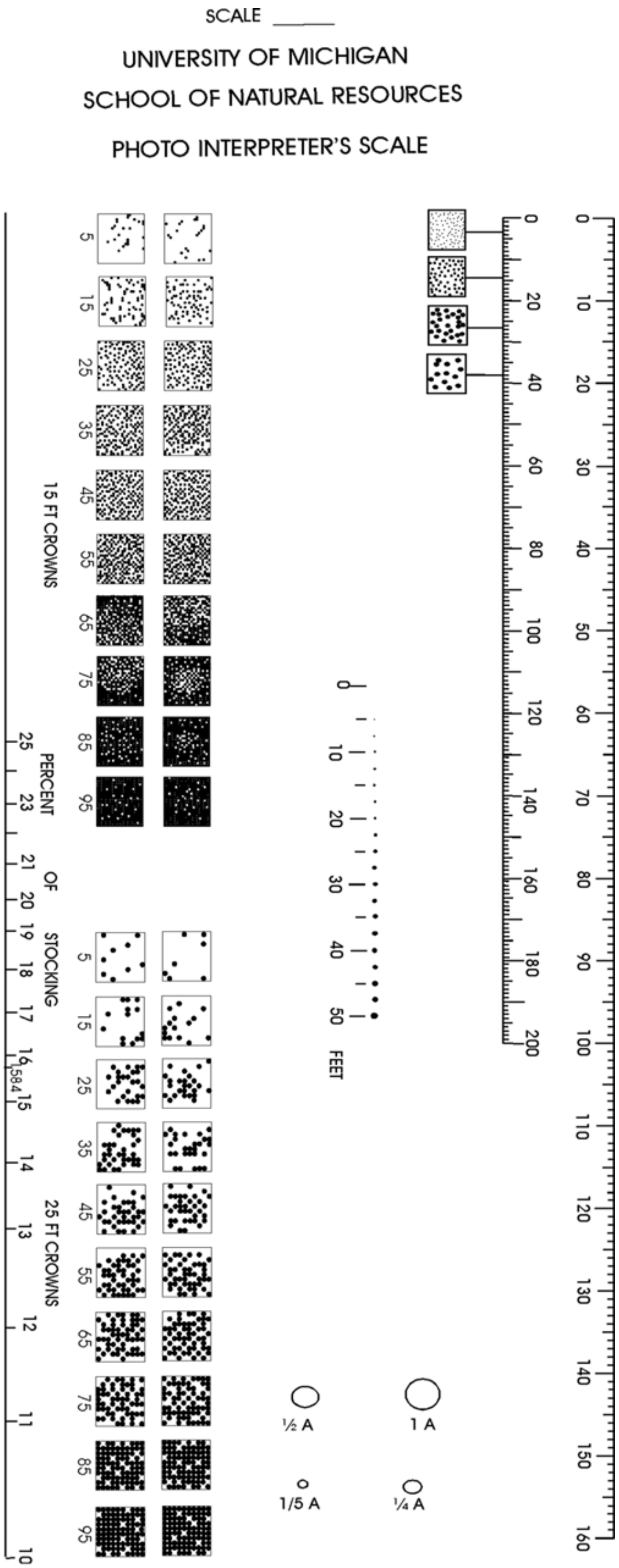


Figure A-VII-1. Crown closure guide.

Appendix VIII Site index equations and curves

FORMULAS FOR CALCULATING TPR FOR THE FIVE MAIN SPECIES GROUPS

1. Aw, Bw, Pb, A

SI_{50} = 1.3 + 17.0100096 + 0.878406 *(THEIGHT – 1.3)
+ 1.836354 * LOG (BR_HEI_AGE)
- 1.401817 * (LOG (BR_HEI_AGE))**2
+ 0.437430 * LOG (THEIGHT- 1.3) /BR_HEI_AGE

Table A-VIII-1. Site class guide for hardwood species.

TPR	SI Age	Range
U	50	5.00 – 10.05
F	50	>10.05 – 14.05
M	50	>14.05 – 18.05
G	50	>18.05 – 30.00

2. Sw, Fd, Fb, Fa

SI_{50} = 1.3 + 10.398053 + 0.324415 * (THEIGHT – 1.3)
+ 0.00599608 * LOG (BR_HEI_AGE) * BR_HEI_AGE
- 0.838036 * (LOG (BR_HEI_AGE)) ** 2
+ 27.487397 * (THEIGHT – 1.3) /BR_HEI_AGE
+ 1.191405 * LOG (THEIGHT – 1.3)

Table A-VIII-2. Site class guide for white spruce, Douglas fir, and the true firs.

TPR	SI Age	Range
U	50	3.00 – 6.05
F	50	> 6.05 – 10.05
M	50	> 10.55 – 15.55
G	50	> 15.55 – 25.00

3. Pine

SI_{50} = 1.3 + 10.940796 + 1.675298 * (THEIGHT – 1.3)
- 0.932222 * (LOG (BR_HEI_AGE)) ** 2
+ 0.005439671 * LOG (BR_HEI_AGE) * BR_HEI_AGE
+ 8.228059 * (THEIGHT – 1.3) / BR_HEI_AGE
- 0.256865 * (THEIGHT – 1.3) * LOG(THEIGHT – 1.3)

Table A-VIII-3. Site class guide for the pines.

TPR	SI Age	Range
U	50	3.00 – 7.05
F	50	> 7.05 – 12.05
M	50	> 12.05 – 16.05
G	50	> 16.05 – 25.00

4. Sb

$$\begin{aligned}SI_{50} = {} & 1.3 + 4.903774 + 0.811817 *(THEIGHT - 1.3)\\ & - 0.363756 * (LOG(BR\_HEI\_AGE)) **2\\ & + 24.030758 * (THEIGHT - 1.3) / BR\_HEI\_AGE\\ & - 0.102076 * (THEIGHT - 1.3) * LOG(THEIGHT - 1.3)\end{aligned}$$

Table A-VIII-4. Site class guide for black spruce.

TPR	SI Age	Range
U	50	1.00 – 6.05
F	50	> 6.05 – 7.05
M	50	> 7.05 – 10.05
G	50	> 10.05 – 20.00

5. Lt

$$\begin{aligned}SI_{50} = {} & 1.3 + 4.903774 + 0.811817 *(THEIGHT - 1.3)\\ & - 0.363756 * (LOG(BR\_HEI\_AGE)) **2\\ & + 24.030758 * (THEIGHT - 1.3) / BR\_HEI\_AGE\\ & - 0.102076 * (THEIGHT - 1.3) * LOG(THEIGHT - 1.3)\end{aligned}$$

Table A-VIII-5. Site class guide for the larches.

TPR	SI Age	Range
U	50	1.00 – 6.05
F	50	> 6.05 – 7.05
M	50	> 7.05 – 10.05
G	50	> 10.05 – 20.00

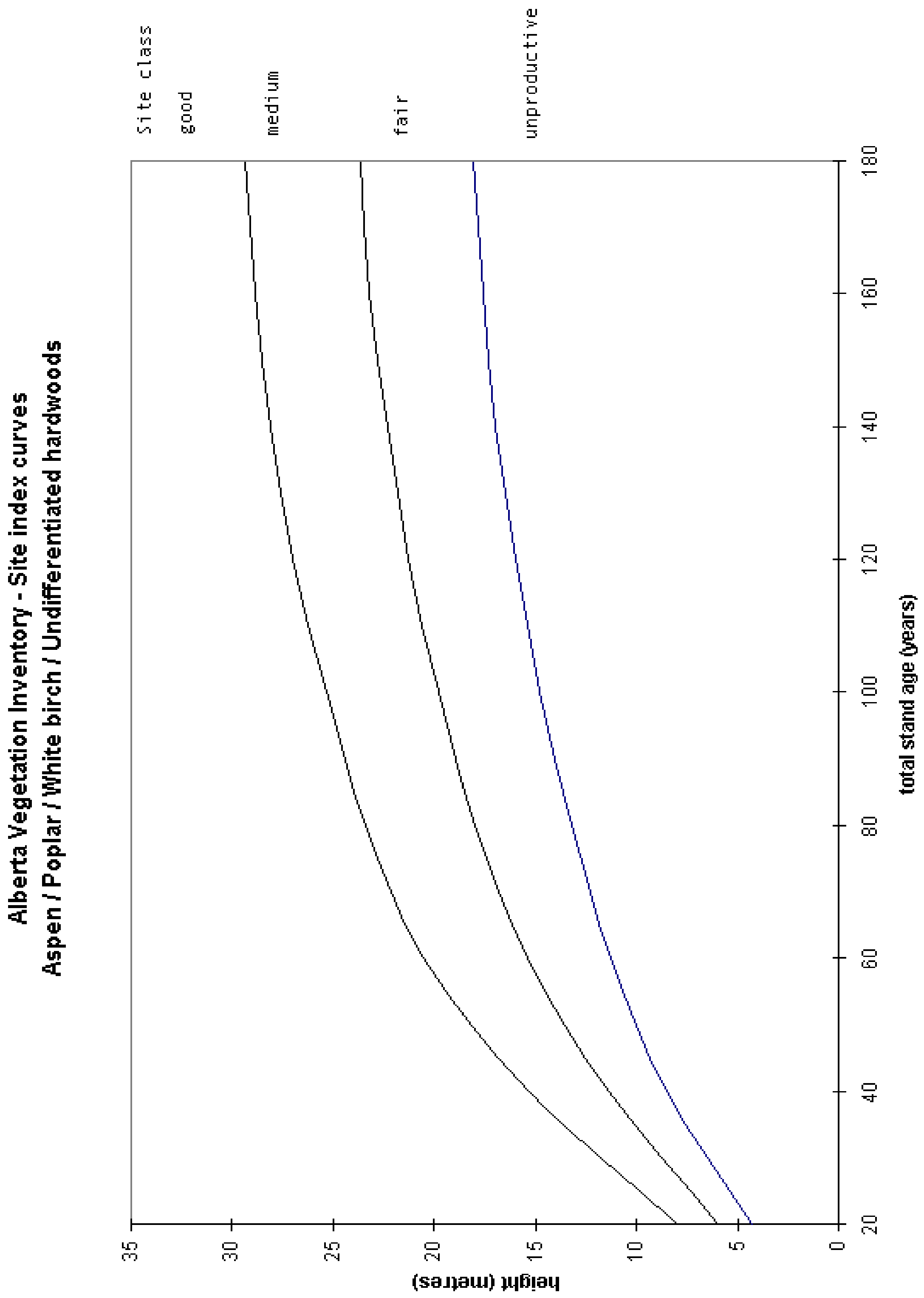


Figure A-VIII-1. Graph showing the provincial hardwood site classes.

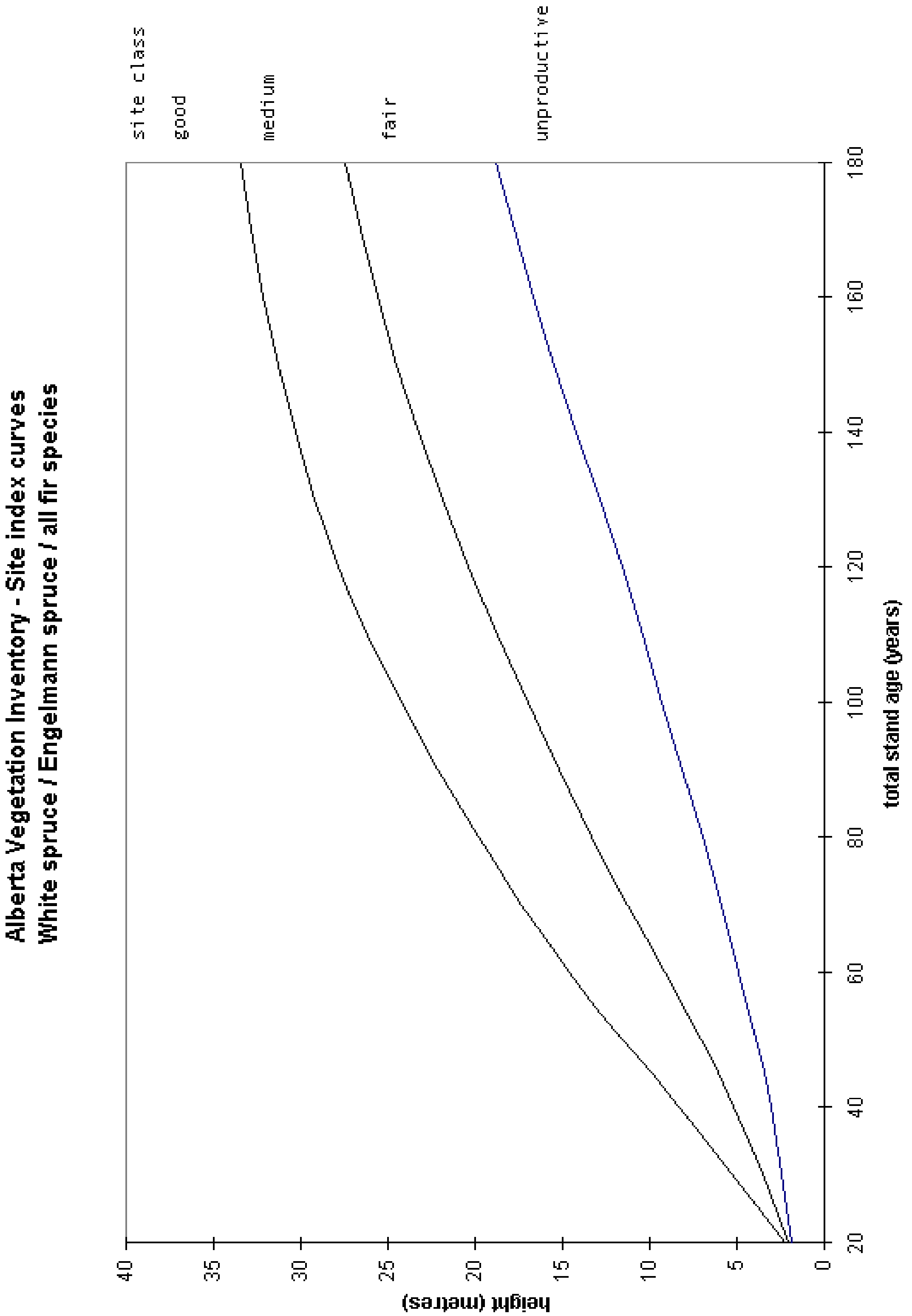


Figure A-VIII-2. Graph showing the provincial site classes for white and Engelmann spruce and the fir species.

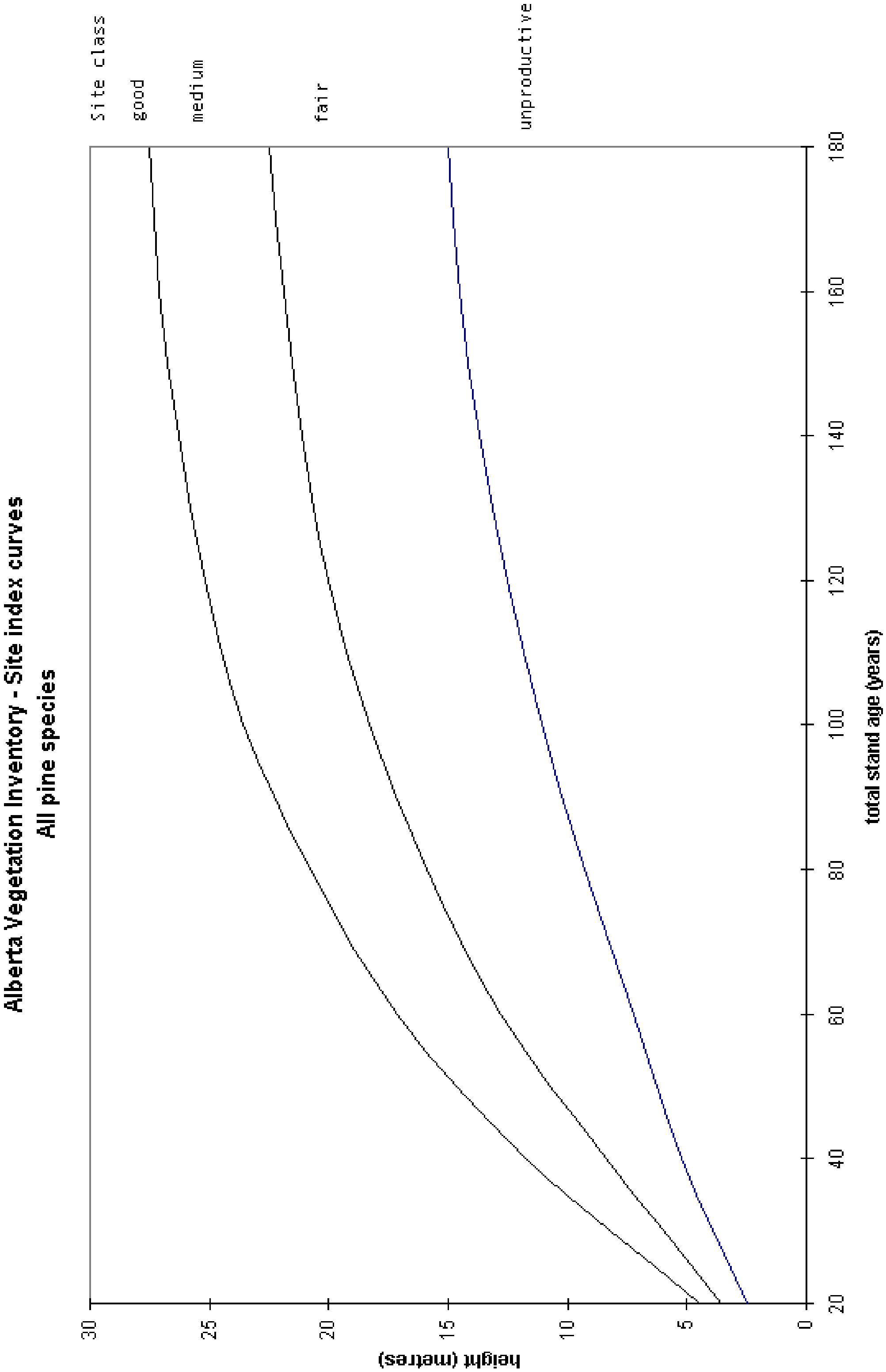


Figure A-VIII-3. Graph showing the provincial pine site classes.

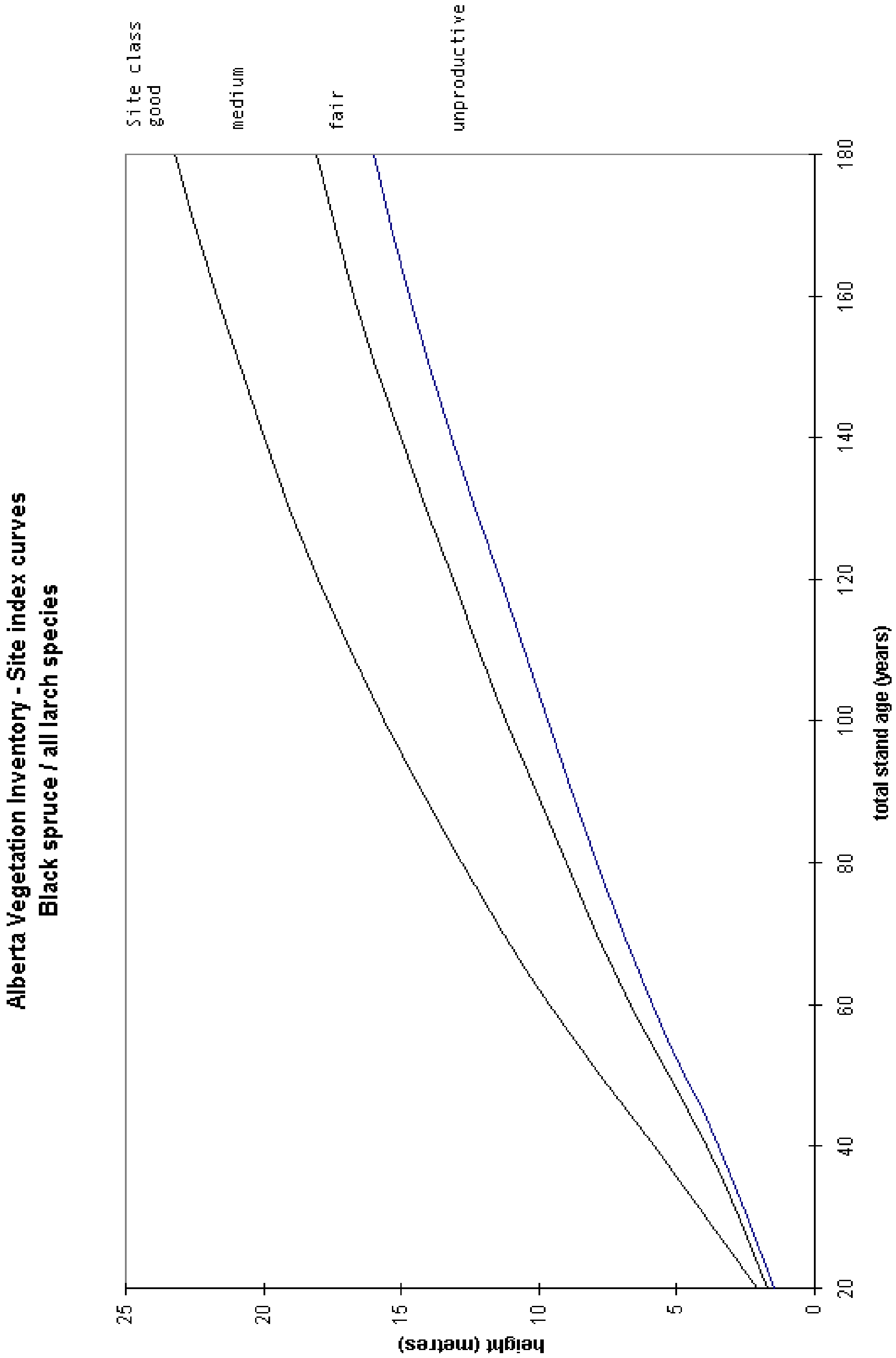


Figure A-VIII-4. Graph showing the provincial site classes for black spruce and the larches.

Appendix IX Data source and data source year rules

Data Source and Data Source Year Rules

The following describes the values for the data source codes:

- Data year: 1940 – present year
- Data Source 'I' (interpreted TPR): Only field that can not have a data year attached
- 'I' can not be used with Anthropogenic Vegetated
- 'I' can not be used with Anthropogenic Non-Vegetated
- 'I' can not be used with Natural Non-Vegetated

The following structures are allowed:

If overstorey is 'F' (field checked) or 'F + year':

$\frac{\text{F}}{\text{F}}$ $\frac{\text{F(year)}}{\text{F(year)}}$ $\frac{\text{F}}{\text{S}}$ $\frac{\text{F}}{\text{S(year)}}$ $\frac{\text{F(year)}}{\text{S}}$ $\frac{\text{F(year)}}{\text{S(year)}}$ Structures not allowed: $\frac{\text{F}}{\text{I}}$ $\frac{\text{F(year)}}{\text{I}}$ $\frac{\text{F}}{\text{A}}$ $\frac{\text{F(year)}}{\text{A}}$

If overstorey is 'A' (air call) or 'A + year' (code 'S' = supplementary photography):

$\frac{\text{A}}{\text{A}}$ $\frac{\text{A(year)}}{\text{A(year)}}$ $\frac{\text{A}}{\text{S}}$ $\frac{\text{A}}{\text{S(year)}}$ $\frac{\text{A}}{\text{F}}$ $\frac{\text{A}}{\text{I}}$ $\frac{\text{A}}{\text{F(year)}}$ $\frac{\text{A(year)}}{\text{S}}$ $\frac{\text{A(year)}}{\text{S(year)}}$ $\frac{\text{A(year)}}{\text{F}}$ $\frac{\text{A(year)}}{\text{I}}$

If understorey is 'A' or 'A + year':

$\frac{\text{A}}{\text{A}}$ $\frac{\text{A(year)}}{\text{A(year)}}$ $\frac{\text{I}}{\text{A}}$ $\frac{\text{I}}{\text{A(year)}}$ Structures not allowed: $\frac{\text{A}}{\text{A(year)}}$ $\frac{\text{Field empty}}{\text{A}}$

If understorey is 'F' or 'F + year':

$\frac{\text{F}}{\text{F}}$ $\frac{\text{F(year)}}{\text{F(year)}}$ $\frac{\text{S}}{\text{F}}$ $\frac{\text{S(year)}}{\text{F}}$ $\frac{\text{A}}{\text{F}}$ $\frac{\text{A(year)}}{\text{F}}$ $\frac{\text{S}}{\text{F(year)}}$ $\frac{\text{S(year)}}{\text{F(year)}}$ $\frac{\text{A}}{\text{F(year)}}$ $\frac{\text{A(year)}}{\text{F(year)}}$

In all cases:

If Data source in overstorey = Data source in understorey, then Year in overstorey must = Year in understorey.

Appendix X Quality control criteria

Quality Control Criteria

The following aspects, prior to the quality control procedures, are to be considered in the quality assessment of the AVI work

Neatness - Delineation

Air photo polygon lines must be consistent in width and smooth flowing. Do not leave gaps and repair smudges, blots, etc. Type lines should accurately describe the type boundary, but not to the extent of causing excessively jagged lines.

Neatness - Lettering

Must be clearly legible and large enough for normal reading. Avoid confusion created from similar characters (i.e., “5" confused with “S” or open “8”).

Type symbols are printed as though on a horizontal line parallel to the bottom of the aerial photo (usually south side).

Avoid placing symbols over dark areas. When polygons on air photos are excessively dark, white ink is used for labelling attributes.

00 size drafting pen containing water-soluble black ink is used.

Awkward Types

When small, narrow, or awkward polygons are encountered, the symbol can be placed outside the polygon (Figure A-X-1). An arrow will point from the symbol to the polygon.

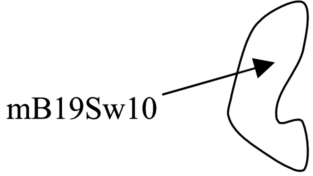


Figure A-X-1. Method for labelling small, narrow or awkward polygons.

River and Stream Delineation

A river or creek should be regarded as a double-line river or creek, and delineated with type lines if it is >20 m in width. When a double-line river forms the inventory boundary, the entire river is interpreted to include up to both sides of high water marks, including entire islands and sandbars.

Orthophoto bases will be provided which will identify double-line rivers or creeks and their spatial location. These double line rivers and creeks are considered to be of greater accuracy than those being interpreted and are to be copied unless there has been a shift of 20 m or more in the high water mark. Any changes needed require prior approval by the Department.

Sandbars are also classified by the photo interpreter and should conform to minimum polygon size specifications. The boundary between the sandbar and the river may need to be enhanced if it is not clear.

Other Water Bodies

Orthophoto bases will be used to identify the perimeter of water bodies such as lakes, flooded lands, ponds, reservoirs, etc. and their spatial location. These boundaries (where available) are considered to be of greater accuracy than those interpreters can provide. They are to be copied unless there has been a shift of 20 m or more in the high water mark or if the water body no longer exists. Information on any boundary changes must be forwarded to Resource Information Management Branch, Sustainable Resource Development.

Linear Features

Linear features are delineated if their width is > 20 m. Mapping of linear features of variable size that exceed 20 m at some point in their length is at the discretion of the interpreter.

Effective Area

Interpretation should be done only within the effective area (of stereo coverage) of the photography. Photo acquisition contracts normally require 60% forward overlap and 30% lateral overlap. When these percentages are not achieved, a minimum extension of the effective area should be made to cover the effective area normally interpreted.

Tie-In

Ensure that polygon-type lines are "tied-in" to those on all adjacent photos, particularly photos on adjacent lines (this should be a 1 cm or more type line overlap).

When large polygons extend onto adjacent photos, the polygon symbol should be indicated at least once on each photo. Large wandering polygons on the same photo should also be labeled more than once to assist drafting personnel who must transfer the interpreted information onto base maps.

If applicable, audits are completed on the following phases. Acceptable accuracy standards for each phase are also listed.

1. Photo Interpretation Audit - acceptance accuracy ≥80%.
2. Fieldwork audit – the standards commonly applied to volume sampling plots applies.
3. Orthophoto base transfer audit - acceptance accuracy ≥ 90%.
4. Attribute Coding audit - acceptance accuracy ≥ 95%.
5. Digital attribute database audit - acceptance accuracy ≥99%.

1. Photo Interpretation Audit

The Department has established quality measures (tolerance limits) for the inventory cover typing process in order to assure that a minimum quality standard for interpretation is attained (Table A-X-1). Known ground data are used as much as possible as the basis for the interpretation audit.

Table A-X-1. Categories and weights used for assessing interpretation quality.

Categories for assessing interpretation		Weight
Crown Closure	overstorey correct at all times	1.5
	understorey correct at all times	1.5
Species Composition - Overstorey		1.5
	species correctly identified in order of occurrence	
	correct to ± 10% per individual species in the label	
	labels with two species - exact composition	
Species Composition - Understorey		1.5
	species correctly identified in order of occurrence	
	correct to ± 10% for individual species in the label	
	labels containing two species - exact composition	
Height - tallest vegetation layer	correct to ± 1.5 m	1.5
Height - lowest vegetation layer	correct to ± 1.5 m	1.5
Origin (age) class		1.5
	coniferous and deciduous in all layers	
	correct to ± 5 years	
Non-Forest Land Class	correct at all times	1.5
Anthropogenic Vegetated Land Class	correct at all times	1.5
Modifiers	correct at all times	1.0
Moisture Regime	correct at all times	1.0
Stand Structure	correct at all times	1.0
Stand Structure Percentage (Horizontal)	correct to ± 10%	1.0
TPR	correct at all times	2.0
Natural Non-Vegetated	correct at all times	1.0
Anthropogenic Non-Vegetated	correct at all times	1.0
Polygon Size	correct at all times	3.0
Legibility	correct at all times (to non-AVI user)	3.0
Labelling	correct polygon label at all times	3.0

1.1 Other Tolerances Pertaining to Vegetation Interpretation Submission

The following items are located on the lower portion of the interpretation audit form.

Depletions

- Evidence of the incorporation of existing inventory information (such as previous timber harvesting cuts) must be included in the vegetation interpretation submission.

Field plot access permission from landowners sheet

- Must be included with each Departmental interpretation submission (if private land).

Increment Cores

- Must be included with each Departmental interpretation submission for all interpreter field plots.
- Increment core containers must be labeled correctly.

Correct Age Count of Increment Cores

- All increment cores must be counted correctly (to within +5 years of actual age). Damaged cores or cores with rot affecting a clear age determination are not acceptable. An alternative tree must be cored in these cases.

Tally Sheets

- All interpreter field tally sheets for field plots established within submission the area must be included in any Departmental interpretation submission.

Map of Submittal Area

- Submittal area map is a 1:250 000 flight index for the 1:20 000 air photos, colour coded to indicate submittal area.

Legibility

- All contents of the interpretation submittal must be neat, clear and legibly written. Legibility is assessed by having a non-AVI user transcribe questionable writing. If any writing is transcribed incorrectly, the submittal is illegible and unacceptable.

Field Plots

- Field plot data and plot procedures must be consistent with the standards described in Section 2.1.2.
- Plot locations must be pin-pricked onto the 1:20 000 air photos to within 10 m of the actual ground location.
- Pin-pricked tie points must be within 10 m of the actual ground location.
- Interpreter field plot heights must be measured to within ± 3% of the quality control check measured height.

- Dbh (measured at 1.3 m above average ground level) must be within ± 2% of the quality control check measurement.

1.2 Interpretation Audit Process

A two-part audit is conducted. Normally AVI mapping is done by contractors, whether done for the Department or for some other client. The Department requires contractors to conduct a self audit. The Department conducts its own, independent audit as well using similar procedures.

Departmental Audit Process

- Obtain 1:250 000 flight index of submission area.
- Assign a sequential number on the flight index (using red ink) to all photos that fall within each individual township being audited as indicated in Figure A-X-2. .
- Randomly select six (numbered) photos per township for audit.
- On each selected photo, randomly choose the northern or southern half of the interpreted area (except for Line 4 or Line 7 where the northern half or the southern half within the township are considered respectively) then number all the polygons on these areas with a # 0 drafting pen containing water soluble blue ink. Numbering applies to any selected closed or open (incomplete boundaries) polygon. At least 30 polygons are required for auditing each township. New photos must be randomly chosen for townships in which the selection resulted in less than 30 polygons. Partial townships with less than 30 interpreted polygons are merged with the adjacent township for sampling purposes.
- If a photo-centre falls on a township boundary (e.g., print # 75 on Line 6 in Figure A-X-2), only the portion inside the township being audited will be considered for the polygon selection.
- Check the accuracy of each attribute for each numbered polygon on the interpreted photos being audited (visually on the photos or by field checking). Attributes and codes that are assessed for accuracy are identified on the AVI audit form.
- Complete the header data on the AVI Photo Interpretation Audit Form on Table A-X-2and provide a detailed assessment of the interpretation accuracy for each township.
- Only one “error” per polygon can be “noted and counted” and assigned an “x” on the form. An “error” is an interpreter assigned code which is outside of the AVI Photo Interpretation Quality Control Standards. Once an ‘x’ has been assigned to a particular attribute of a polygon being audited, additional errors detected on this polygon are assigned a “0” for the respective polygon attribute.
- If a minor error is identified in any attribute, a “0” (indicating the error is noted but not counted) can be marked on the audit form.
- Complete audit information for Table A-X-3.
- Submitted increment cores for townships being audited are checked for the accuracy of the correct age count.
- Submitted tally sheets are checked for completeness and to ensure plot data agrees with interpretation.
- Results are tabled when the audit process is completed. The summary audit form (Table A-X-3) is used to present the final results of the vegetation audit interpretation submission.

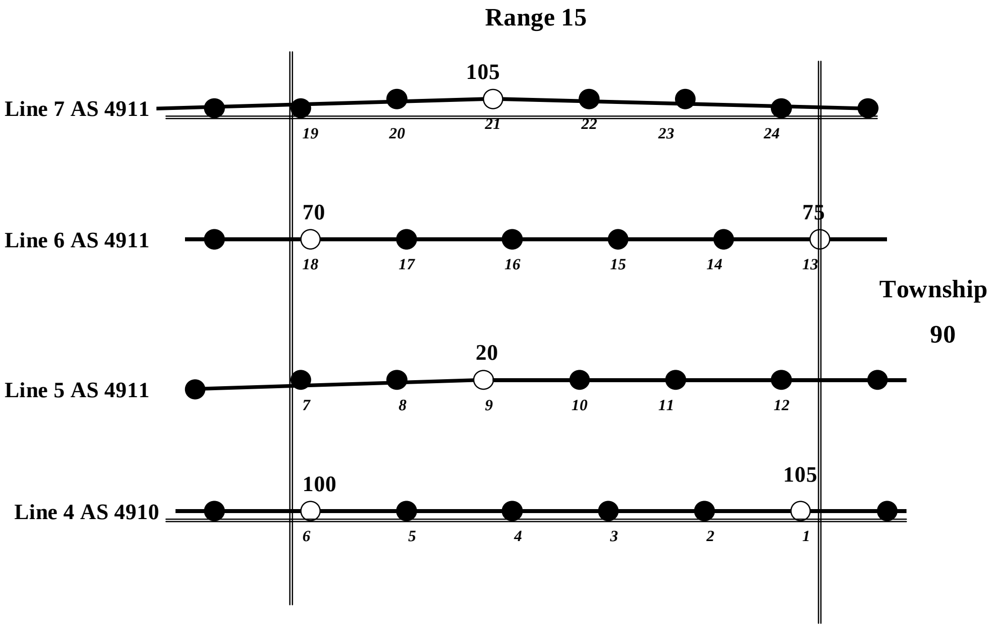


Figure A-X-2. Example of a portion of a flight index showing numbered photos per township for AVI audit.

1.3 Quality Control Interpretation Acceptance Limit

- Interpretation work is accepted if the interpretation audit accuracy is 80% or greater for each township in the submission.
- Submitted increment cores are checked for correct age count.
- Submitted tally sheets are checked for completeness and to ensure plot data agrees with interpretation.
- The summary audit form (Table A-X-3) is used to present the final results of the audit. Results for the interpretation accuracy of each township (Table A-X-2) within the submission are included.
- All submissions of interpretation must include a quality control audit form that is signed by a certified AVI (level 3) Photo Interpreter.

1.4 Quality Control Audit for Origin class Interpretation

- Origin classes interpreted on the 1:60 000 (or 1:40 000) air photos must accurately reflect interpreter field plot and other existing origin class data.
- Age polygon interpretation must follow procedures indicated in Origin Interpretation Procedures (see section 2.2 of these Standards).

2. Fieldwork Audit

Fieldwork documentation completed by the contractor according to Section 2.1.2 is reviewed for accuracy and completeness. Increment core measurements are checked and results communicated to the contractor for correction if applicable. In cases of unsolved discrepancies found in the vegetation interpretation audit, a field verification is conducted to address these discrepancies.

3. Orthophoto Base Transfer Audit

Transfer of polygon boundaries will conform to the following standards:

- Fifteen (15) percent of the polygons within each township are randomly selected for quality control of line work transfer.
- The features listed below will be transferred correctly at all times provided that these polygons are delineated on the air photographs.

Hydrography

- Including rivers, lakes, flooded areas, sandbars, creeks (>20 m width).

Access

- Includes but is not limited to paved highways, main and secondary roads, railroad rights of way, airstrips, trails (>20 m width).

Man-Made Features

- Includes but is not limited to battery sites, well-site clearings, pipeline clearings, power line clearings, transmission line clearings, dam sites, reservoirs.

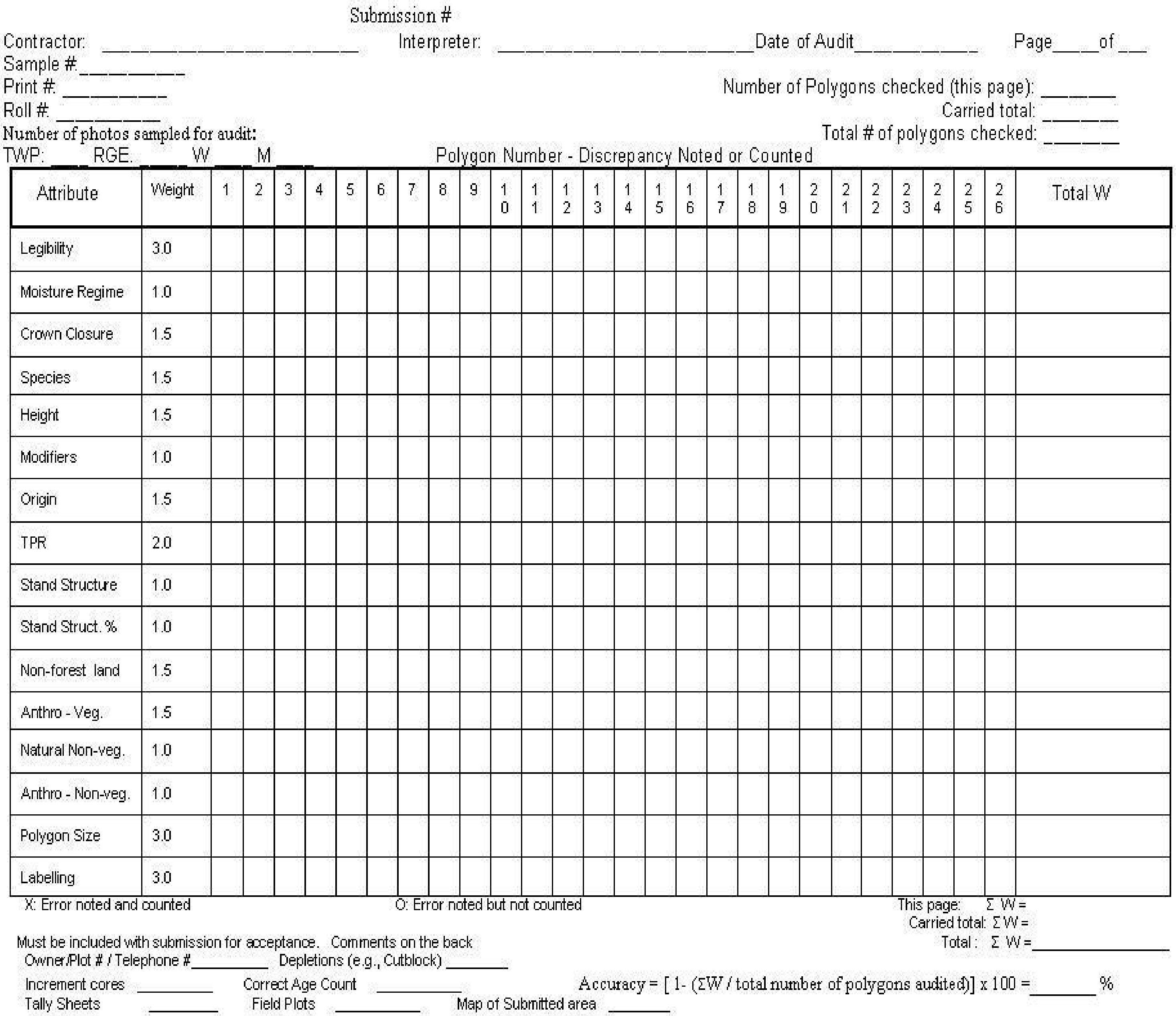
Settlement Areas

- Including cities, towns, villages, hamlets, ribbon developments (rural recreation, cottages).

All polygons selected for quality control of transfer will be re-transferred onto the bases if displacements occur with a # 0 pen containing water-soluble blue ink. Previous line work in red ink will not be removed.

All other polygon boundaries should not have a displacement greater than 1 mm (20 m ground distance), measured perpendicularly to polygon line and the extent of the displaced line should not exceed 1/3 of the length of the polygon line. A polygon line is defined as the portion of the polygon between two adjacent line connections (see Figure A-X-3).

Table A-X-2. AVI Photo Interpretation Audit form.



Submission #

Contractor: ________________________ Interpreter: ________________________ Date of Audit___________ Page_____of ___

Sample #:__________

Print #: __________ Number of Polygons checked (this page): ________

Roll #: __________ Carried total: ________

Number of photos sampled for audit: Total # of polygons checked: ________

TWP: ____ RGE. _____ W ____ M ____

Polygon Number - Discrepancy Noted or Counted

Attribute	Weight	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Total W
Legibility	3.0																											
Moisture Regime	1.0																											
Crown Closure	1.5																											
Species	1.5																											
Height	1.5																											
Modifiers	1.0																											
Origin	1.5																											
TPR	2.0																											
Stand Structure	1.0																											
Stand Struct. %	1.0																											
Non-forest land	1.5																											
Anthro - Veg.	1.5																											
Natural Non-veg.	1.0																											
Anthro - Non-veg.	1.0																											
Polygon Size	3.0																											
Labelling	3.0																											

X: Error noted and counted O: Error noted but not counted

This page: Σ W =

Carried total: Σ W =

Total : Σ W =________________

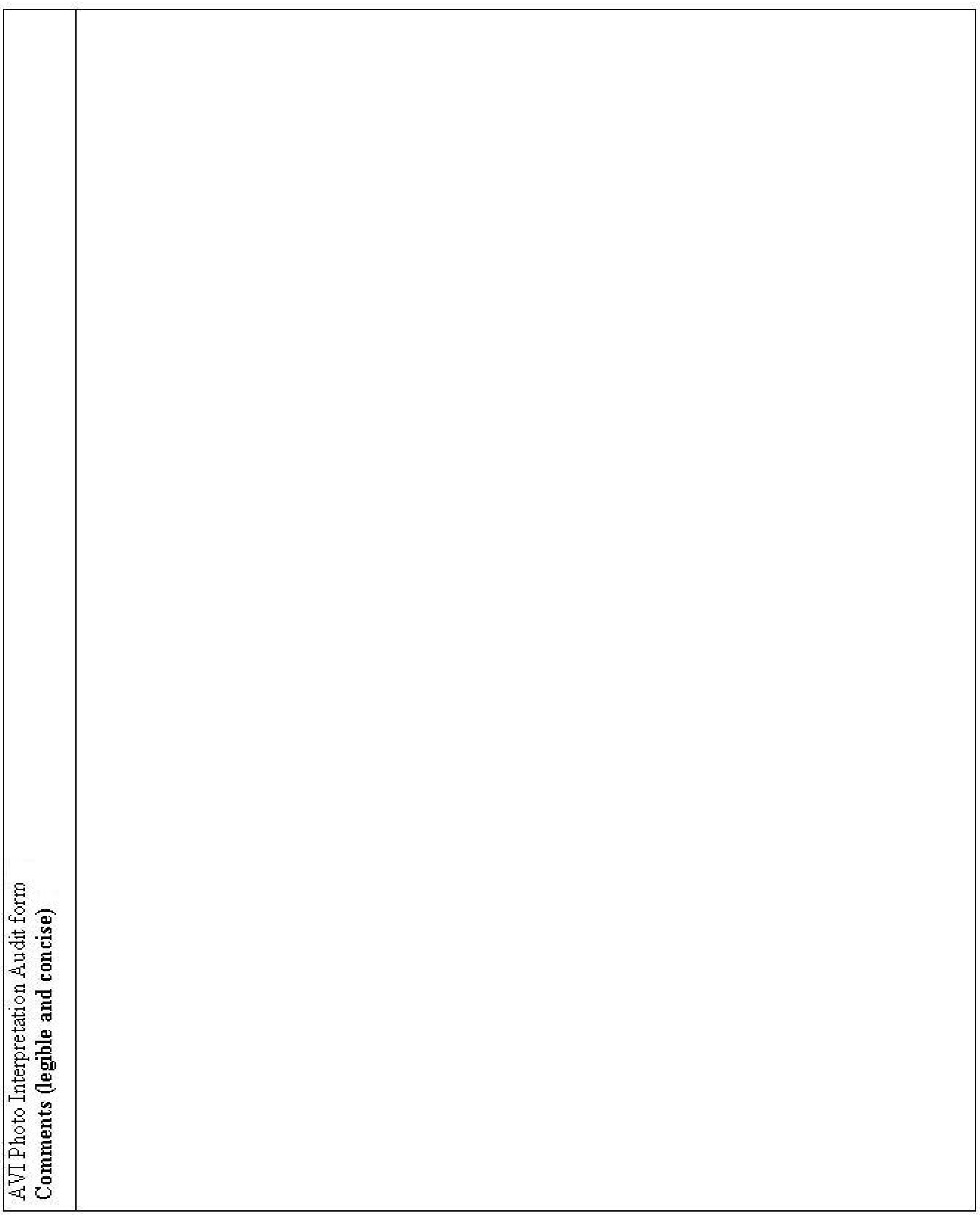
Must be included with submission for acceptance. Comments on the back

Owner/Plot # / Telephone #__________ Depletions (e.g., Cutblock) ________

Increment cores __________ Correct Age Count ___________ Accuracy = [1- (ΣW / total number of polygons audited)] x 100 =________ %

Tally Sheets _________ Field Plots ___________ Map of Submitted area ________

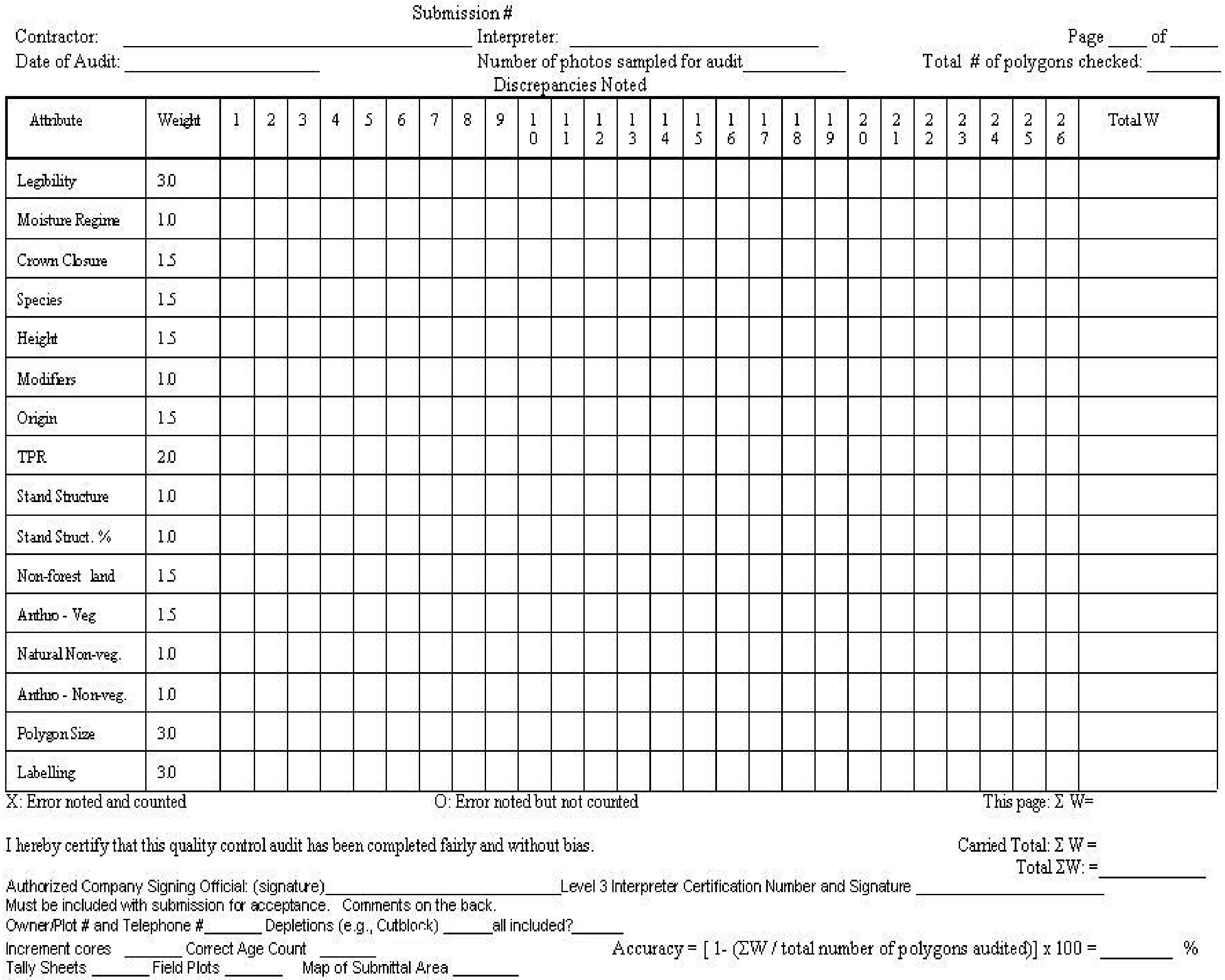
Table A-X-2. AVI Photo Interpretation Audit form (continued).



AVI Photo Interpretation Audit form

Comments (legible and concise)

Table A-X-3. AVI Photo Interpretation Self Audit – Summary form.



Submission #

Contractor: ________________ Interpreter: ________________ Page ____ of _____

Date of Audit: ________________ Number of photos sampled for audit__________ Total # of polygons checked: ________

Discrepancies Noted

Attribute	Weight	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Total W
Legibility	3.0																											
Moisture Regime	1.0																											
Crown Closure	1.5																											
Species	1.5																											
Height	1.5																											
Modifiers	1.0																											
Origin	1.5																											
TPR	2.0																											
Stand Structure	1.0																											
Stand Struct. %	1.0																											
Non-forest land	1.5																											
Anthro - Veg	1.5																											
Natural Non-veg.	1.0																											
Anthro - Non-veg.	1.0																											
Polygon Size	3.0																											
Labelling	3.0																											

X: Error noted and counted O: Error noted but not counted This page: Σ W=

I hereby certify that this quality control audit has been completed fairly and without bias. Carried Total: Σ W =

Total ΣW: =__________

Authorized Company Signing Official: (signature)________________________Level 3 Interpreter Certification Number and Signature ____________________

Must be included with submission for acceptance. Comments on the back.

Owner/Plot # and Telephone #_______ Depletions (e.g., Cutblock) ______all included?______

Increment cores _______ Correct Age Count _______ Accuracy = [1- (ΣW / total number of polygons audited)] x 100 = ________ %

Tally Sheets _______ Field Plots _______ Map of Submittal Area ________

Table A-X-3. – AVI Photo Interpretation Self Audit – Summary form (continued).

AVI Photo Interpretation Self Audit – Summary form **Comments (legible and concise)**	

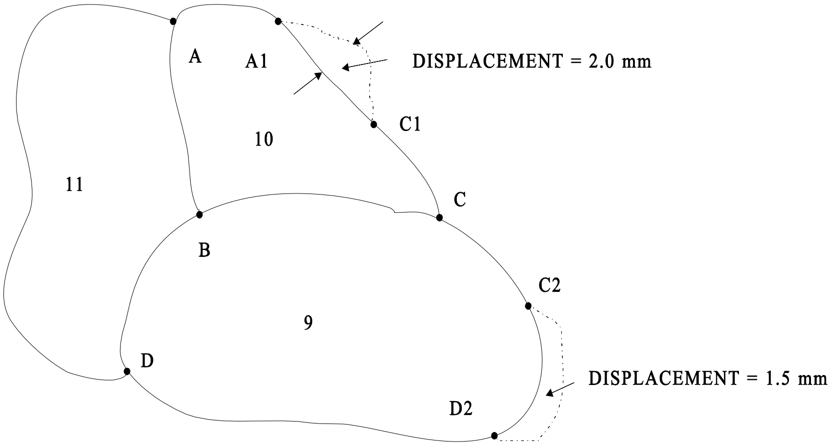


Figure A-X-3. Measuring polygon boundary line displacements in transferred polygons
(9, 10, 11 = polygon numbers; A, B, C, D = polygon line connections; A - C = polygon line for polygon # 10 - clockwise from A; A_1 - C_1 = displaced line for polygon # 10; C - D = polygon line for polygon # 9 - clockwise from C; C_2 - D_2 = displaced line for polygon # 9).

As shown in A-X-3, polygon # 10 is not acceptable for polygon boundary transfer because the displacement is >1 mm and the extent of the displaced line (A_1 - C_1) is > 1/3 of the length of polygon line A - C. Polygon # 9 has a displacement of 1.5 mm but the extent of the displaced line (C_2-D_2) is < 1/3 of the polygon line C – D therefore, this polygon is acceptable for polygon boundary transfer.

Polygon boundaries are also checked for tie-in with adjacent polygons in contiguous townships. A polygon is not acceptable for polygon boundary transfer if tie-in lines with adjacent townships are displaced by > 1 mm.

Field plot centres, photo centres, and annotations concerning photo lines (roll #, flight line #, print #) must be correct at all times.

Polygon numbering must be done according to the procedures described in section 4.2 of AVI standards manual.

Polygon numbering is unacceptable if a polygon:

- contains two or more different polygon numbers
- contains a polygon number previously assigned to another polygon
- does not have a polygon number
- contains a 9000 series number, but is not listed on the ”additional numbers” annotation list
- was not numbered sequentially (e.g., assigned # 7 instead of # 6) and the omitted number is not listed on the “omitted numbers” annotation list
- assigned number is illegible.

Polygon boundaries, field plot centres and photo centres should be stereoscopically transferred from the photography to the orthophoto base. All this information is drawn in red ink. A township boundary (based on corner marks) is drawn in black ink.

All submissions of completed orthophoto bases will include a quality control audit form that is signed by the certified AVI (level III) Photo Interpreter. An example of the form to be used in the audit is shown on Table A-X-4.

The audit process consists of an examination of 15% of the polygons on each township according to the following steps:

- 15% of the polygons are randomly selected on each township in the submission.
- Each selected polygon is examined for the following types of discrepancies: polygon boundary, polygon number and field plot centre, photo centre and tie-in with adjacent photo base when applicable.
- A polygon considered unacceptable will be assigned a “1” on the appropriate row/column on the audit form.
- A polygon with a noted discrepancy will be assigned a “0” on the appropriate row/column on the audit form.
- A weight is assigned to each class of discrepancy.
- The percent polygon line transfer accuracy for each township is calculated as:
  Accuracy = [1 - {total weighted discrepancies / total # of checked polygons}] X 100.

Information contained in the following orthophoto base labelling annotations is also considered when assessing township interpretation accuracy, and must be correct at all times:

- Photo roll number, photo line number, photo print numbers, omitted/additional polygon numbers, number of field plots, number of volume sampling plots, number of permanent sampling plots, interpreter’s name, company name, interpretation date. Township boundaries (in black ink) are also included.

Townships with a photo detail transfer accuracy below 90% will be returned to the contractor to be corrected. Approval of the submissions for photo detail transfer depends on approval of each individual township in the submission being checked. Orthophoto base labelling accuracy must be 100% to be acceptable.

4. Attribute Coding Audit

Quality checking of transfer of the photo interpreted attributes to the attribute databases is done by comparing 15% of the attributes written on the interpreted photos to the attributes contained in the attribute database. The attributes selected for this quality check are from the same polygons chosen for the quality control of the orthophoto base transfer audit.

The accuracy must be $\geq$ 95%. 100% of the coded attributes must checked for townships with an error rate higher than 5%.

An error in attribute coding means that one or more codes in a polygon label were coded incorrectly.

Copies of all quality control reports prepared by the contractor are to be supplied to the Department.

5. Digital Attribute Database Audit

Quality assessment of the digital attribute data files is done by re-entering (double entering) 100% of the polygon attributes for each township. The polygon attributes, which are double entered, are the attributes which are read directly off the coding forms. Double data entry software can output a comparison report that identifies data entry accuracy.

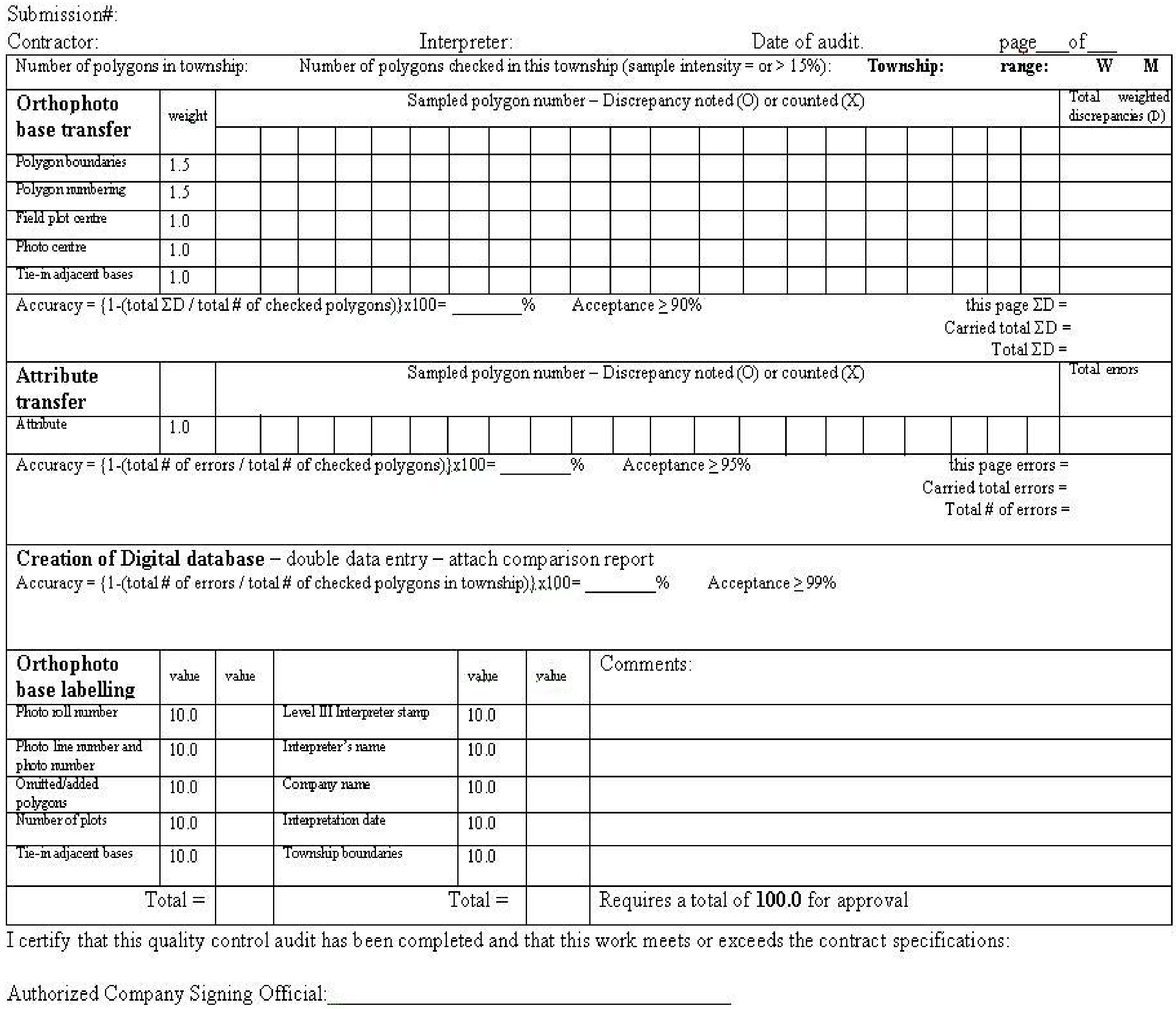
The accuracy tolerance for the entry of attributes into the digital attribute database is 1% error.

The attributes for townships with data entry error higher than 1% must be entirely entered again. An error in the entry of attributes is considered to be one or more codes in an attribute entered incorrectly.

All comparison quality control reports for double-entered data for each township are to be supplied to the Department by the contractor.

Final polygon attributes written on the photos should match the attributes coded in the attribute database for each township within the contract project area.

Table A-X-4. AVI Orthophoto Base and Attribute Database Work Audit



Submission#:

Contractor: Interpreter: Date of audit. page___of___

Number of polygons in township:	Number of polygons checked in this township (sample intensity = or > 15%):	**Township:**	**range:**	**W**	**M**

Orthophoto base transfer	weight	Sampled polygon number – Discrepancy noted (O) or counted (X)																					Total weighted discrepancies (D)
Polygon boundaries	1.5																					
Polygon numbering	1.5																					
Field plot centre	1.0																					
Photo centre	1.0																					
Tie-in adjacent bases	1.0																					

Accuracy = {1-(total ΣD / total # of checked polygons)}x100= ________% Acceptance ≥ 90%

this page ΣD =
Carried total ΣD =
Total ΣD =

Attribute transfer		Sampled polygon number – Discrepancy noted (O) or counted (X)																					Total errors
Attribute	1.0																					

Accuracy = {1-(total # of errors / total # of checked polygons)}x100= ________% Acceptance ≥ 95%

this page errors =
Carried total errors =
Total # of errors =

Creation of Digital database – double data entry – attach comparison report
Accuracy = {1-(total # of errors / total # of checked polygons in township)}x100= ________% Acceptance ≥ 99%

Orthophoto base labelling	value	value		value	value	Comments:
Photo roll number	10.0		Level III Interpreter stamp	10.0		
Photo line number and photo number	10.0		Interpreter's name	10.0		
Omitted/added polygons	10.0		Company name	10.0		
Number of plots	10.0		Interpretation date	10.0		
Tie-in adjacent bases	10.0		Township boundaries	10.0		
Total =			Total =			Requires a total of **100.0** for approval

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

Authorized Company Signing Official:________________________________

Table A-X-4. AVI Orthophoto Base and Attribute Database Work Audit (continued).

AVI Orthophoto Base and Attribute Database Work Audit (continued)

Comments (legible and concise).

For additional information, please contact:
Resource Information Management Branch.
Alberta Sustainable Resource Development
Edmonton, AB

http://www.srd.gov.ab.ca/index.html