Alberta
Agriculture
and Forestry

Capturing Disturbances - Standards and Specifications for Timber Harvesting

Version 3.1
November 2015

Chapter 4 -
Vegetation Inventory Standards and Data Model Documents

1.   Updates

Disturbance Updates – Standards and Specifications for Timber Harvesting was incorporated as Chapter 4 of the Alberta Vegetation Inventory Standards and Data Model Documents in May 2007. Subsequent revisions to the document are summarized below:

Date	Type of Revision	Version No.	Sections Revised
June 2009	Major	2	All
April 2015	Major	3	All
October 2015	Minor	3	Section 4.4.2.3: "… all features greater than **5 m** in width…" changed to "all features greater than **15 m** in width…"
November 2015	Major	3.1	Changed HARV_CODE format from Character (1) to Character (2) to accommodate new attributes MR = Merchantable Residual Retention and NR = Non-merchantable Residual Retention.

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2. Introduction

Well defined standards and specifications are an important component of Alberta Environment and Sustainable Resource Development's (the Department) effort to expedite forest update data exchange between the government and the forest industry. *Capturing Disturbances – Standards and Specifications for Harvesting* describes the Department's standards and specifications related to capturing timber harvesting activities, which are defined as the cutting and removal of trees from a forested area.

The purpose of these standards and specifications is to outline the process that will assure that timber harvesting activities are captured in a consistent and an accurate manner.

This document forms Chapter 4 of Alberta's Vegetation Inventory Standards and Data Model Documents.

2.1 Capturing Harvesting Activity

There are a variety of disturbances that can affect the vegetation on forested lands. The holders of the present vegetation inventories within the province endeavour to maintain and keep them current by capturing and mapping ongoing disturbances. These include wildfires, timber harvesting, clearings for various land use activities (particularly related to the petroleum industry), certain insect and disease damage (chiefly tree defoliation), and weather effects (e.g., windthrow). *Regrowth* of vegetation is generally captured as part of a re-inventory process. Gillis and Leckie[1] (1996) summarized the key decisions to be made when defining inventory update as:

- Required cartographic (mapping) accuracy and acceptable errors (boundary placement and area determination).

- Required detection accuracy (minimum levels of disturbance to be detected and mapped).

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[1] Gillis, M.D. and D.G. Leckie. 1996 Forest Inventory update in Canada. Forestry Chronicle 72(2): 138-156.

- Frequency and timing (how often and when update information is required).

This document deals solely with standards and specifications for capturing harvesting activities. There are several main steps involved:

a) Determining what and where to collect data

Two components are involved. First, defining what disturbances on the landscape are to be collected in this process. Second, locating the disturbances to be captured. The staff involved in this process must know where to look for these disturbances within their sphere of interest.

b) Capturing the timber harvesting activities data

Currently vegetation inventory depletions are captured chiefly by contractors for the Forest Management Agreement (FMA) holders and other non-government agencies. Departmental staff are responsible for capturing cutblocks on non-FMA Forest Management Units (FMU).

The Department has determined that the most accurate method of capturing final cutblock boundaries is with stereo digital imagery in a softcopy environment. This methodology aligns with Alberta Vegetation Inventory standards.

c) Quality control including auditing of the data

Auditing includes the step-by-step quality control processes which may be done by various contractors and/or their clients as well as a process/product audit done by the Department of data submitted directly to it by contractors or by their industrial clients.

d) Integrating the timber harvesting activities data and information into AVI

This document deals solely with the standards and specifications for the capture of data related to timber harvesting activities only. However, it is recommended that cutblock boundaries captured to the standards and specifications defined in this document be used in any inventory update, re-inventory or regeneration survey process.

3. Objectives

The objective of this document is to describe the process for gathering data on recently harvested areas to maintain the integrity of the associated vegetation inventory. In particular, to:

- Identify, define and accurately capture the external boundaries of cutblocks (treed areas harvested, usually in one season, for the purpose of obtaining wood for the production of various wood products such as lumber and pulp).

- Identify, define and accurately capture the internal boundaries of unharvested residual vegetation within cutblocks that constitutes an area(s) of 0.5 ha or larger.

- Establish, for tree harvesting events, a link to the Alberta Regeneration Information System (ARIS).

- Maintain the harvested cutblock boundaries as a permanent record by year of disturbance for each activity.

- Maintain metadata records about the capture process for each harvested area.

It is important to note that the objectives for the capturing harvest disturbances differ slightly from the standards of the associated inventory information. Primarily, AVI involves identifying the boundaries and labelling the contents of different homogeneous vegetation types. The objective of this data capture is to precisely identify the boundaries of any areas affected by timber harvesting *activities* that exceed 0.5 ha in size and 5 m in width.

4. Standards and Specifications

Standards are the target or the measure of quantity, extent, value or quality that must be attained; they are independent of the measurement equipment, process or technology used. Standards are the required levels of precision/accuracy for defining a given feature type. Specifications define the process, methods or rules for achieving the standards. Specifications describe currently acceptable technology and how it can be used to achieve the desired standards.

This section describes the standards of the disturbance capture process, specifically related to capturing recently harvested cutblocks. It also contains the Interpretation Specifications for describing a disturbance and defining the boundary of a harvested area, and for describing the harvest activity on the landscape.

4.1 Overview

A clear understanding of the purpose of the cutblock capture process is required to understand the specifications. **The current process identifies the location and the area (maximum extent) where harvesting activities have taken place.** The process also assures that a current and accurate portrayal of the extent and condition of the forest resource is made available to forest managers and others seeking information on forest land conditions.

The Department has determined that the most accurate method of capturing final cutblock boundaries is with stereo digital imagery in a softcopy environment. This methodology aligns with Alberta Vegetation Inventory standards. In addition, the photography provides an ongoing, permanent record of the original harvest event.

Historically, cutblock boundaries have been captured multiple times for various purposes. The intent of these standards and specifications is to capture the final boundary once. The final boundary can serve multiple purposes, including incorporation into the next inventory, forest management plan and for meeting Regeneration Standards of Alberta (RSA) requirements.

Depletion updates traditionally follow this four-step process similar to that for AVI:
- planning/preparation;
- imagery acquisition;
- interpretation of imagery;
- data entry, editing, storage and submission of digital boundary and feature attribute data.

4.2 Feature Representation

The level of precision used for mapping harvest blocks is within 5 m of the boundary as identified on the ground with a minimum polygon size of 0.5 ha.

4.3 Aerial Imagery

General aerial imagery specifications are defined by Alberta Environment and Sustainable Resource Development in *General Specifications for Acquiring Aerial Imagery (March 2014.)*[2] The following preferred specifications apply for imagery used for cutblock interpretation:
- uncompressed, original bit-depth (minimum 8 bits per pixel/band) TIFF images.
- 4-Band colour/IR (RGBI)
- Projection - UTM Zone 11, Zone 12
- Resolution - 0.3 m
- Sun angle - >30 degrees
- Imagery must have 60% forward lap and 30% side lap, with minimal or zero cloud cover and no gaps.

The aerial imagery used for cutblock mapping must be acquired within 24 months after the harvesting activity occurs.[3]

4.4 Interpretation of Imagery

The detection and capture of recently harvested cutblock areas is usually based upon the interpretation of aerial imagery in a softcopy environment. The Departmental requirements for the acquisition of cutblock data are mainly concerned with the compliance to standards, independent of the methodology used for its acquisition. The following describes the current image-interpretation specifications applied by the Department.

4.4.1 Minimum Polygon Size

The following table (Table 4-1) summarizes the minimum mapping standards applied to the area of disturbance.

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[2] Alberta Environment and Sustainable Resource Development, 2014. General Specifications for Acquiring Aerial Imagery. Informatics Branch, March 2014.

[3] See Final Cutblock Digital Data Submissions, ESRD, Land and Forestry Policy, 2015 No. 3
http://esrd.alberta.ca/forms-maps-services/directives/forestry-directives.aspx

Table 4-1 List of minimum polygon sizes

Feature	Minimum Size
Disturbed areas (cutblocks) in productive forested land	0.5 ha
Leave Areas (trees left inside a disturbed area; includes merchantable and/or non-merchantable timber)	0.5 ha
Non-treed, non-productive forest land inside a cutblock, includes naturally non-vegetated and anthropogenic disturbances.	0.5 ha

4.4.2 Extent of Feature to Capture

The potential use of the cutblock boundaries for determining areas of reforestation responsibility influences the depletion capture process, making the process somewhat different than that used for other types of depletions e.g., agricultural areas or land use depletions such as road or powerline rights-of-way. The extent captured must reflect the area of the timber that was harvested.

Each cutblock will create one or more depletion polygons. Final cutblock boundaries should be based on appropriate source imagery using planned block boundaries as a reference.

Interpreters should ensure coincidence with existing AVI linework where appropriate. Disturbance features should not be split where they straddle administrative boundaries (township boundaries, etc.). Disturbances split along administrative boundaries must be node-matched (the attributes for the two features must be identical).

Where depletion data spans a UTM zone boundary the data should be referenced to the zone in which the majority of the feature occurs unless the feature extends more than 0.5 km into the other zone. When that occurs the data should be divided into distinct datasets each within its own projection zone.

The current ARIS requirement is that the net harvested hectares, the final block boundary and area, must be reported within two years of the skid clearance date. Cutblocks generally range from 2 - 200 ha; therefore, most block boundaries will be readily visible on 30 cm digital imagery in a softcopy process. Figure 4-1 illustrates a range of cutblock sizes.

If a cutblock is represented as multiple disjoint polygons, then the cutblock should be captured as a multipart polygon resulting in a single cutblock feature.

Figure 4-1: Range of cutblock sizes

4.4.2.1 External Boundaries - Clearly Visible

In some cases, cutblock boundaries are quite distinct and easy to identify. For example, first-pass clearcuts in single-species cover types without understoreys are easily identified and are usually associated with very distinct boundaries. The depletion polygon is simply delineated so that the entire harvested area is included. Any non-vegetated areas or portions of a treed polygon that were not harvested (0.5 ha and greater) that occur adjacent to or extend into the depletion are excluded from the depletion polygon.

4.4.2.2 External Boundaries - Unclear

In some cases, harvest blocks and their associated boundaries may be difficult to identify. Primarily these situations are associated with partial harvests (e.g., selective or shelterwood tree harvest) or where harvest activities occur adjacent to a low-density stand, a natural opening (e.g., meadow, muskeg or wet area) or to recently cleared or partially cleared areas that have not been captured as a depletion prior to harvesting the new cutblock being interpreted.

Any non-vegetated, non-harvested areas or areas previously harvested that are located adjacent to the cutblock (i.e., they were not harvested or they were harvested at a different time) must be excluded from the depletion polygon (see Figure 4-2).

Transition areas

To meet certain forest management objectives (e.g., minimize windthrow or visual impact) or in an attempt to harvest all of the trees of merchantable size, the boundary between harvested areas and adjacent unharvested areas may not be obvious because the percentage of trees harvested along the boundary reduces gradually. This technique is often called 'feathering' and results in a progression from a clearcut in the central area of the depletion polygon to a selectively cut area to the unharvested adjacent stands. The feathering seldom extends more than the distance a feller buncher can reach (10 - 12 m) beyond the boundary of the clearcut area.

In these cases, the cutblock boundary must extend to the outermost limit of the harvested area (i.e., follow the stump line rather than stopping at some transitional boundary where, for example, more stems were left standing than were harvested).

Partial Harvests

Partial or selective harvesting or thinning is done to meet a wide variety of forest management objectives and can, therefore, vary in terms of harvest intensity, pattern, etc. The intensity and pattern of harvest, the availability of ancillary data, and the characteristics of the timber being cut all influence an interpreter's ability to accurately identify and define the extent of harvesting using aerial imagery. Partial harvesting in mixedwood forest cover types (e.g., removal of the conifer component) can be very difficult to identify. Mixedwood cover types can vary significantly in density and species composition, and an interpreter will experience difficulty properly identifying and describing harvesting-caused changes in species composition, stand density, etc.

Ancillary information must be used to help identify the extent and the type of harvesting activity that has occurred. These include:

- Forest harvest plans or other detailed cutblock maps available from the Department field staff or companies that show the extent of actual or planned harvest activities[4].

- Any imagery, if available, taken prior to the initiation of harvest activities (e.g., the imagery used for the original AVI interpretation, previous depletion imagery) which can help identify changes in vegetation that are associated with harvesting.

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[4] Final harvest boundary must be based on an appropriate source image. Planned block boundaries should be used as a reference to assure mapping consistency.

As in the case of feathered cutblock boundaries, the depletion boundary identified on the digital imagery must extend to include the outermost trees harvested (rather than to some transitional boundary where, for example, more stems were left standing than were harvested).

Figure 4-2: Cutblocks with unclear external boundaries
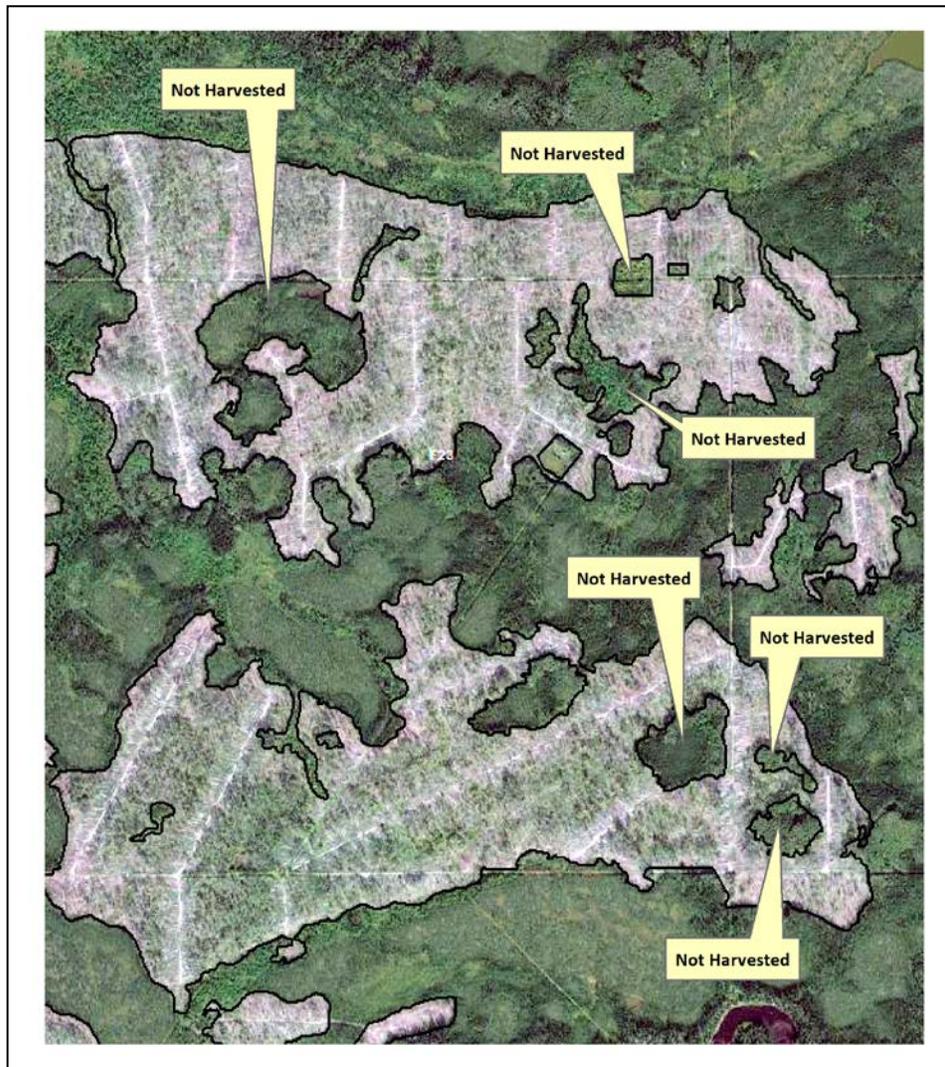
Progressive Harvesting

In some cases, harvesting may proceed in a progressive manner with the original cutblock being enlarged over a period of two or more years of harvesting. If update imagery was not obtained after each year of harvesting, there will be no image record of the cutblock extent for the individual years.

In such cases, annual operating plans, satellite imagery or other detailed cutblock maps available from Departmental field staff or from companies that show the extent of actual harvest activities must be used to establish the cutblock boundaries by harvest year.

Adjacency to Other Disturbances

Occasionally, a harvested area may lie adjacent to an area which has been disturbed or otherwise cleared (e.g., previously harvested block, wellsite, pipeline or other industrial activity), making the task of establishing the boundary between the harvest block and the adjacent disturbance difficult (see Figure 4-3). In all cases, the intent is to differentiate disturbed areas by the cause and date of depletion. Older aerial images or other ancillary sources of information must be consulted to achieve this purpose.

Figure 4-3: Timber harvesting adjacent to other disturbances
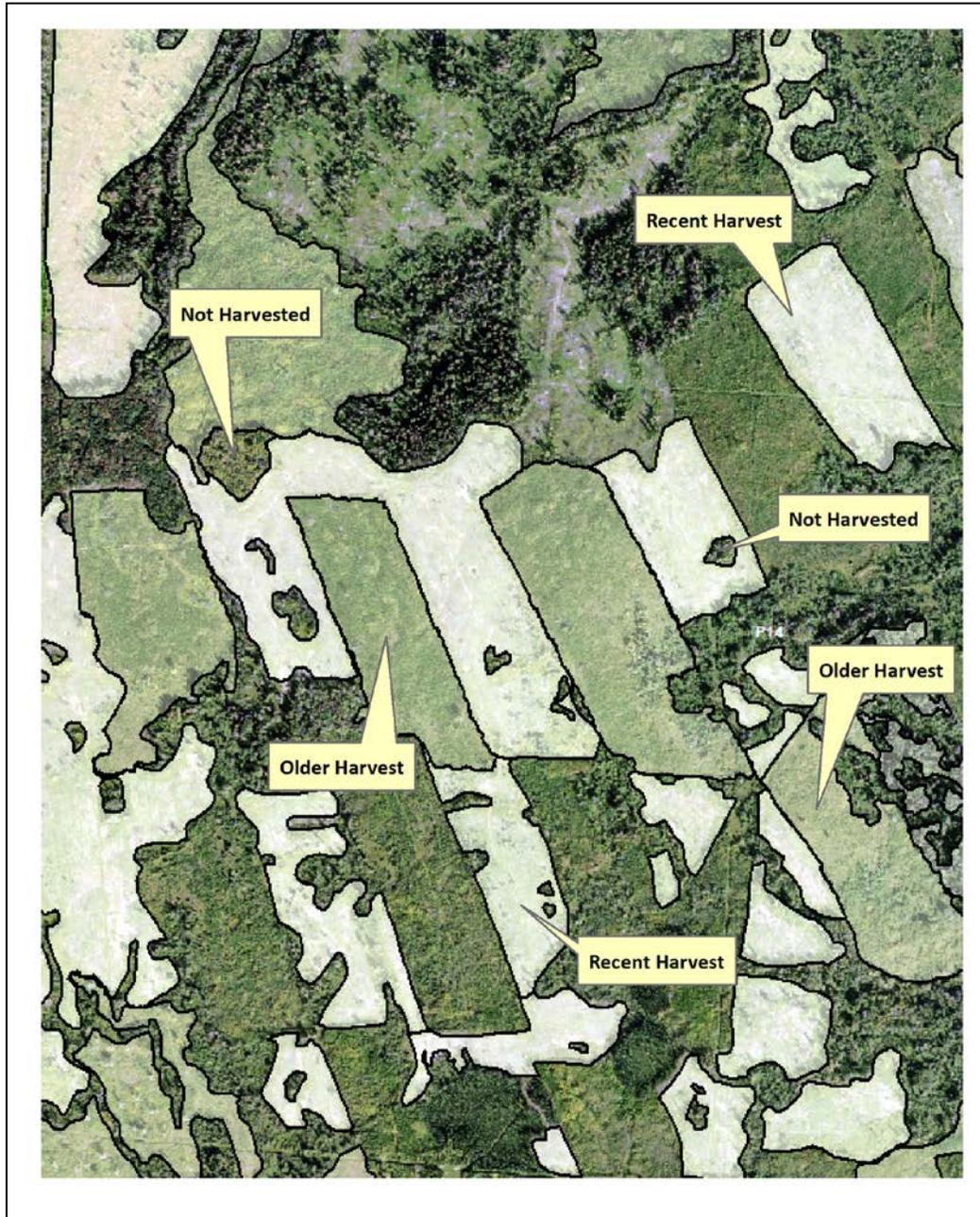
4.4.2.3 Internal Boundaries

Generally, a single depletion polygon is sufficient to characterize a harvest block. If any of the following conditions are met, however, more than one depletion polygon is required:

- A significant forested leave patch (> 0.5 ha) or non-forested area occurs within a cutblock boundary (see explanations below).

- Post-harvest vegetation conditions vary significantly within the block (e.g., due to understorey protection, partial harvest intensity, etc.) and each condition covers a minimum area of 0.5 hectare of the disturbed productive forest landbase.

Leave Patches (Residuals or Retention)

It is important that all areas 0.5 ha or greater in size with residual trees (trees remaining after any type of harvest) that remain unharvested within the extent of the harvest cutblock be identified as a separate polygon because of the potential uses of the information (e.g., determining areas for reforestation responsibility, biodiversity assessment, etc.). This includes any unharvested, non-merchantable treed areas that constitute a minimum polygon size of 0.5 hectare that were not identified in the original AVI because of the 2 ha minimum polygon size standard (see Figure 4-4).

Figure 4-4: Cutblock with residual timber

Naturally Non-vegetated Areas

Any naturally non-vegetated polygons 0.5 ha in size within the boundaries of or adjacent to the cutblock polygon are excluded from the depletion polygon.

Figure 4-5: Cutblock differentiated from naturally non-vegetated areas
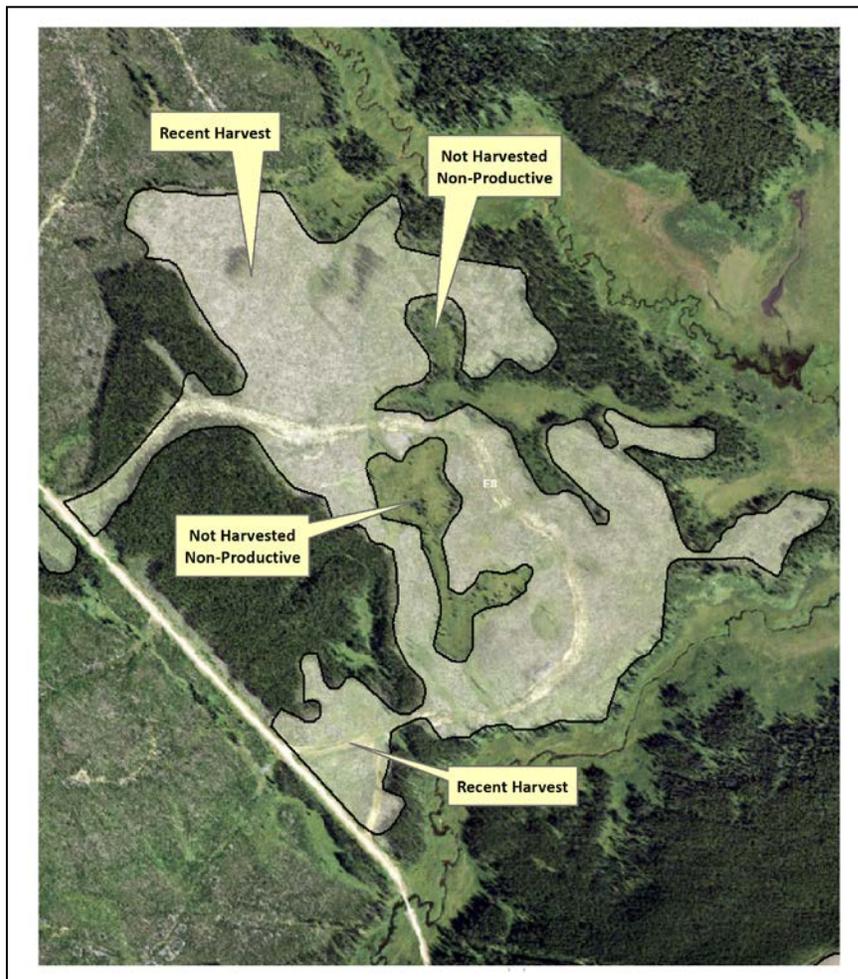
## *Anthropogenic Non-vegetated Areas*

Any anthropogenic disturbed areas that were not identified in the original AVI (which would therefore not be considered cutblocks) must be identified as a separate polygon, providing they are a minimum of 0.5 hectare in size. Wellsites, dugouts, borrow pits and industrial clearings (e.g. campsites) are the most common instance where this occurs (see Figure 4-6).

Figure 4-6: Cutblocks with permanent features excluded, including pipelines, plant site, roads, borrow pits, wellsites and previously harvested cutblocks

In the case of permanent anthropogenic features like pipelines, transmission lines and major roads, all features greater than 15 m in width must be excluded from the depletion polygon. Seismic lines that form a boundary for a cutblock must be excluded from the depletion polygon; however, existing seismic lines within the outer boundary must be included in the harvested area. Provincial regulations require these areas to be reforested (see Figure 4-7).

Figure 4-7: Cutblocks and seismic lines
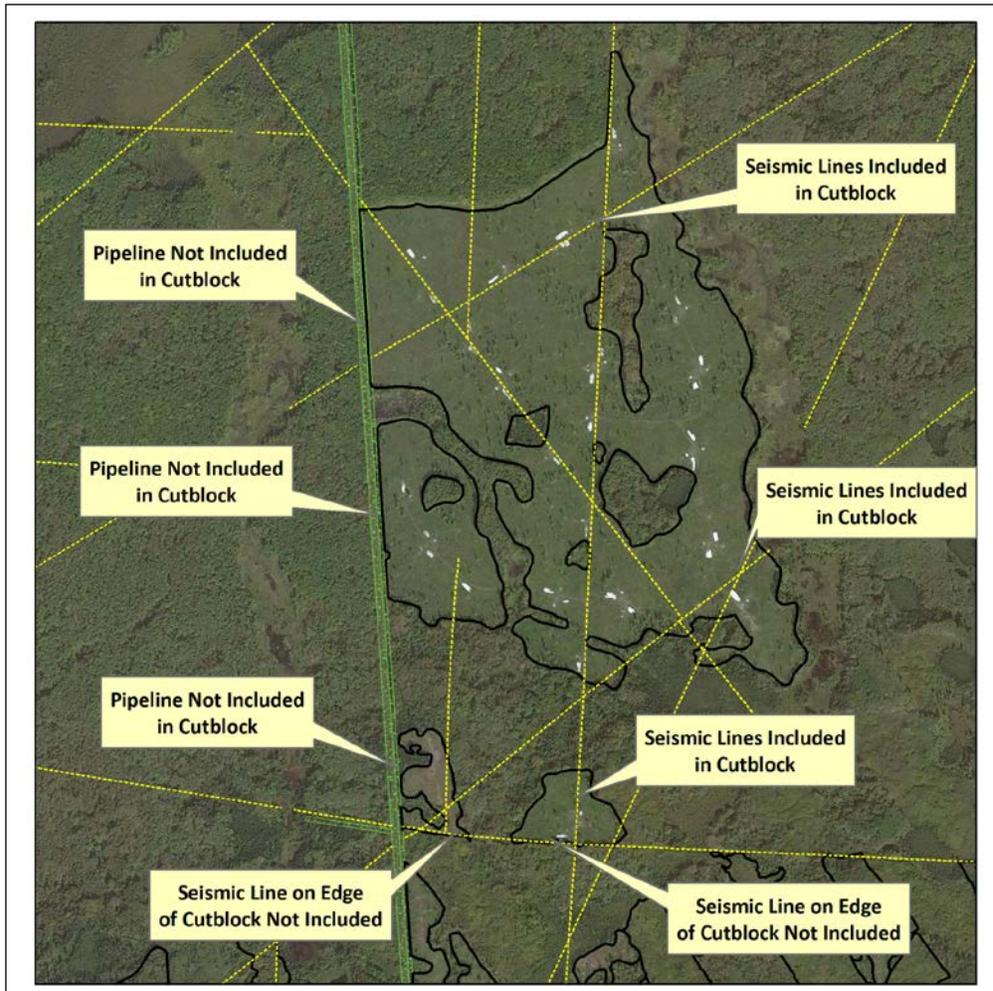
4.4.3 Field Verification

The cutblock capture process does not require field verification, but, in instances where the interpreter cannot differentiate between the disturbed and undisturbed boundaries, field confirmation may be required.

4.5 Feature Attributes[5]

If a polygon is classified as harvested, all attributes must be populated. If the polygon is not classified as harvested, only the Object-id and Harvest Code need be populated.

Feature attributes identify the company/agency to which reforestation responsibility is attached, as well as identifying retention and providing a link to the Alberta Reforestation Information System (ARIS).

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[5] These are ESRD standards. Disposition holders should refer to ESRD, Land and Forestry Policy, 2015 No. 3: Final Cutblock Digital Data Submissions http://esrd.alberta.ca/forms-maps-services/directives/forestry-directives.aspx for direction on digital data submission standards.

In *all* cases, the following attributes must be included with the data:
- Object-id
- Disposition holder
- Authority to harvest
- ARIS opening number
- Harvest code
- Skid clearance date

4.5.1 OBJECT-ID

Unique polygon number, generated by the software.

4.5.2 Disposition Holder (DISP_HOLDER)

This identifies the company or agency with reforestation responsibility for the block. The ARIS stakeholder code designation (see Appendix D – ARIS Industry Operations Manual[6]) must be used.

4.5.3 Disposition Number (DISP_NUM)

The disposition number (e.g. FMA, CTL, DTL) under which the disposition holder has the authority to harvest and to which reforestation responsibility is attached.

4.5.4 ARIS Opening Number (OPENING_NUMBER)

Recording the (ARIS) opening number enables the Department to track the extent and spatial location of any cutblock, as well as allowing the Department to extract information from ARIS about the cutblock in the future. Information from ARIS must be recorded for all cutblocks, in the format Meridian, Range, Township, Section, Grid number, based on the centroid of the cutblock polygon.[7]

4.5.5 Harvest Code (HARV_CODE)

All interpreted polygons must be classified as either harvested, merchantable residual retention, non-merchantable residual retention, anthropogenic disturbance or naturally non-vegetated.

It is important to accurately identify the harvested area. All residuals (retention), areas under a disposition or areas classed as naturally non-vegetated/non-productive that are inside the outer boundary of the harvested area and are greater than 0.5 ha in size must be differentiated from the harvested area.

4.5.6 Skid Clearance Date (SKID_CLEARANCE_DATE)

The year of harvest is an important attribute that must be accurately captured. This is equivalent to the Alberta Reforestation Information System (ARIS) "skid clearance date".[8]

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[6] https://srdsp.alberta.ca/ifm/ARIS/ARIS%20Manual/Forms/AllItems.aspx Appendix D
[7] https://srdsp.alberta.ca/ifm/ARIS/ARIS%20Manual/Forms/AllItems.aspx Appendix A
[8] https://srdsp.alberta.ca/ifm/ARIS/ARIS%20Manual/Forms/AllItems.aspx Appendix A

4.6 Linkage to ARIS

The Alberta Regeneration Information System (ARIS) contains data and information on cutblocks. The ARIS opening number (OPENING_NUMBER) must be used to provide a link between ARIS and the update polygon.

Approval of, amendment, and changes to the Net Harvested Hectares recorded in ARIS must involve a designated forest industry representative and ESRD staff (a forest officer and/or ARIS staff). ARIS has a mandatory, Timber Year after the Timber Year of Harvest requirement for reporting of Net Harvested Hectares. The opening area captured through the process described in this document must be the same as the Net Harvested Hectares declared in ARIS.

4.7 Spatial Digital Data Submissions

4.7.1 Spatial Data Formats

Spatial data must be submitted as an ESRI® polygon, line or point feature class contained in a shapefile or file geodatabase (FGDB). A zip file that can be unzipped into FGDB format is also acceptable.

4.7.1.1 Shape Files

A minimum of 5 files are required for shape file submissions, including:
1. <filename>.shp
2. <filename>.shx
3. <filename>.dbf
4. <filename>.prj
5. <filename>.xml

4.7.1.2 File Geodatabase

Data can be stored as independent feature classes, or as feature classes in a feature dataset.

4.7.1.3 Projection and Datum

NAD83 Canadian National Transformation version 2 (NTv2) is the only acceptable datum. Acceptable projections include:
- UTM Zone 11N (WKID 26911) and
- UTM Zone 12N (WKID 26912).

4.7.2 General Documentation Requirements

Every submission needs to include appropriate metadata (see Appendix I) that defines:
- Dates
- Operational area
- Source organization
- Contact for data issues
- Imagery specifications including:

- Camera
- Resolution (pixel size)
- Bands
- Leaf-on/leaf-off
- Date(s)

A data dictionary (see Appendix II) must be included with each data set submitted. Each data dictionary must include:

- The file name/feature class name
- The name and version of the software used to create the file
- Attribute table(s) structure(s), as defined by the following:
  - Field name
  - Field type
  - Field width
  - Number of decimal places (where applicable)
  - Valid codes
  - A description/definition for each valid code.

4.7.3 Media

A secure FTP site can be used to upload data. Details about the site will be provided upon request. Otherwise, delivery media (e.g. CD, DVD or USB device (hard drive or memory stick)) must be labeled. A complete label includes submission date, stakeholder name and a listing of media contents. Upon specific request, the USB device shall be returned to the owner following data download.

5. Quality Control

The quality control process will involve the following aspects of the update data:

- Interpretation
- Attribute coding
- Positioning and completeness of the data
- Validation of the digital data
- Metadata

5.1 Interpretation

A sample constituting up to 10% of the updates will be selected in a random fashion for verification of the interpretation calls. An AVI Level 2 interpreter will verify the calls on the blocks.

5.2 Attribute Coding

The validity of the codes and the combinations of codes will be verified as per the standards noted in Section 4.2. For each record that contains a disturbance code of 'H', all attributes must be populated. If the polygon is not classified as harvested, only the Object-id and Harvest Code need be populated.

5.3 Positioning and Completeness

The most recent satellite imagery available to the Department will be used to verify the 'completeness' of the update information. The imagery will also be used to verify the relative positioning of the disturbance boundaries.

5.4 Digital Verification

Verification/validation procedures will be applied to the attributes and the digital data (i.e., are the attribute codes valid, do all polygons have a label, do all labels have a polygon, etc.).

5.5 Metadata

The metadata will be audited for completeness.

APPENDIX I – Metadata Example

Submission Date		
Contact	Name Email Phone	
Company Name		
Operational Area	FMU Regional office	
Imagery	Camera Resolution (pixel size) Bands Leaf-on/leaf-off Date(s)	
Additional Information		

APPENDIX II Data Dictionary for Cutblock Data (ESRD Standards)

Field Name	Field Type	Description
FILE_NAME/FEATURE CLASS	Character (20)	Name of the file
SOFTWARE	Character (20)	Name and version of software used to create the data
OBJECT-ID	Numeric (10)	Unique polygon number
DISP_HOLDER	Character (4)	ARIS stakeholder code
DISP_NUM	Character (10)	Disposition number
OPENING_NUMBER	Character (11)	ARIS Opening Number –unique identifier (MRRTTTSSGGA)
HARV_CODE	Character (2)	Harvest code H = Harvested MR = Merchantable Residual Retention NR = Non- merchantable Residual Retention A = Anthropogenic disturbance (area under disposition) N = Naturally non-forested
SKID_CLEARANCE_DATE	Date	Skid clearance date