Yukon

Anthropogenic surface disturbance mapping in the Yukon

Standards and guidelines for contractors

Version 4.0.2

WORKING DRAFT

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1 Introduction

1.1 Overview

The Government of Yukon has developed a model for the collection and storage of mapped anthropogenic (human-caused) surface disturbance in the Yukon. The term “surface disturbance” is used to describe any linear or areal feature caused by human activities that is detectable on the ground or visible on satellite or aerial imagery.

Surface disturbance data were originally sought as input to specific wildlife modeling and planning projects, but are now important inputs to many government planning, assessment, and operational activities. Surface disturbance mapping can be initiated and managed by any Government of Yukon program; however, this database is curated by the Fish and Wildlife Branch, Department of Environment.

This document should guide future surface disturbance mapping work to ensure compliance with the Government of Yukon data model, thus facilitating integration into the corporate surface disturbance dataset. Questions regarding this document should be directed to the issuer of the data mapping contract.

1.2 Background

Since 2011, the Government of Yukon has issued contracts to map surface disturbance. Mapping contracts tendered prior to 2014 were issued to different contractors that followed “guidelines” rather than documented standards, granting contractors some latitude in the creation of deliverables. The net result was that each dataset differed in terms of what was collected and how it was described. In September 2014, a surface disturbance data model was created that took into consideration work completed to date, departmental program needs, and mapping approaches. The data collected in previous years was then integrated into a single, centrally-managed geodatabase, compliant with the surface disturbance data model.

In early 2021, the data model was updated to include historical surface disturbance data. This facilitated the characterization of surface disturbance through time in areas that have been mapped at multiple time steps.

1.3 Scope

This document is intended to act as a reference for contractors hired by the Government of Yukon to complete surface disturbance mapping. It provides information on the structure of the surface disturbance data model including the collection and attribution of data.
It describes the way surface disturbance mapping activities are to be performed to facilitate

consistent conformance to technical requirements to support data quality. This document is intended to be read from beginning to end, and to be used as a reference.

1.3.1 Data collection methods

Currently mapped features were primarily captured through heads-up digitization. Select mapping contracts have employed object-based imagery analysis and image classification to help identify and delineate surface features. Different digitization methods may be explored in the future. Ground-based survey data, such as GPS tracks, can be integrated into the data model if properly attributed.

The National Road Network (NRN) and National Railway Network (NRWN) serve as the underlying framework for this database; these features have been copied and integrated into the surface disturbance database.

Review and revision of any new surface disturbance data must be completed by Environment Yukon before it enters the centrally-managed master geodatabase.

2 Surface disturbance data model

The surface disturbance database was designed to use ArcGIS software as the platform. The format of the database is an ESRI file geodatabase; its structure is shown in Figure 1. File geodatabases offer structural, performance, and database management advantages over personal geodatabases and shapefiles. They allow for related datasets to be stored together, and are optimized for easy data migration.

Each feature class within the file geodatabase has metadata associated with it. The metadata includes the summary, description, credits, and ownership of the surface disturbance dataset. All feature classes are stored in NAD 1983 CSRS Yukon Albers projection.

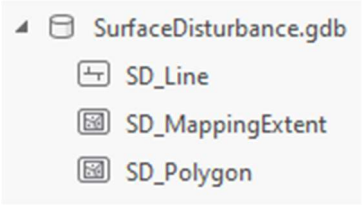

Figure 1: Structure of the surface disturbance database

The surface disturbance features are stored based on their geometry type and are separated into lines and polygons. Point features were previously captured to represent small areal features such as individual buildings. All point features have been retired and re-digitized as polygons to more accurately capture the spatial extent of the surface feature. No new point

data will be collected; moving forward, all surface disturbance data must be stored as either a polygon or line feature.

The polygon feature class entitled “SD_MappingExtent” captures the spatial extent of completed surface disturbance mapping projects. Within these polygons, features were digitized using medium to high resolution satellite imagery and orthophotos; outside of these polygons, disturbance mapping is either incomplete or non-existent.

2.1 Database restructuring

The original database represented a static picture of the best available surface disturbance data across the Yukon. All features were digitized using the most recent and highest resolution imagery available at the time of mapping. Project areas were infrequently remapped to update the database.

In response to the need to track surface disturbance through time, the database was restructured to accommodate the repeat characterization of surface disturbance features through time. The DATABASE field was created to separate features by their data quality and time stamp, as described in Table 1. Each feature must belong to one of these three database sections: Most Recent, Historic, or Retired.

Table 1: A description of each part of the database, as defined in the DATABASE attribute field

DATABASE	Description
Most Recent	The most up to date characterization of surface disturbance on the landscape
Historic	Characterizes surface disturbance observed in the past
Retired	Features that have been removed from the active database

Most Recent features represent the surface disturbance database as it once was: all features represent the best available and most recent characterization of anthropogenic surface disturbance in the Yukon, digitized from imagery with the highest available resolution. There is no feature overlap permitted between Most Recent areal features.

Historic features represent surface disturbance as it was observed in the past; these features are accurate for the associated image date, and are digitized from imagery with the highest available resolution at the time. Historic features may overlap each other and Most Recent features.

Retired features have been deprecated and should be ignored for analysis and mapping purposes. They are not included in the public database. There are a number of reasons why a feature may be retired, including digitization error, location error, and digitization from lower resolution imagery. This will be described in greater detail in Section 5.1.

3 Disturbance data dictionary

The surface disturbance database has two formats:

1. **Complete (internal-use)**
    - All surface disturbance records in one file geo-database
    - Includes attribute fields provided to and received from contractors that facilitate mapping and data integration
    - Example: Who collected the data and when, reasons for modifying features, etc.
2. **Public**
    - A subsection of the complete dataset
    - Includes only attribute fields that convey the essential information regarding surface disturbance features in a streamlined manner
    - Example: disturbance and industry types, linear feature width, representative date, imagery specifications, etc.

The following sections outline the attributes and domains used to characterize surface disturbance within the current data model.

3.1 Interpretation dictionary for public attributes and domains

Both line and polygon feature classes have essentially the same data model, except for a few fields that are unique to the line feature class. Coded domains ensure consistency in feature naming and attribution, and help increase the efficiency of data collection. The following sections identify the domains used for linear and areal disturbance types and all other shared domains, including descriptions for each.

3.1.1 Industry and disturbance types

In the surface disturbance database, industry and disturbance types are represented in the attribute fields TYPE_INDUSTRY and TYPE_DISTURBANCE respectively. The disturbance type is intended to describe the feature on the ground (cutline, clearing) regardless of its cause, whereas the industry type further qualifies the disturbance and references who/what is responsible for creating the disturbance. The industry type is often interpreted, or derived from area knowledge or other ancillary data.

The disturbance type is not necessarily defined by the industry type. Disturbance type classifications can be associated with multiple industry type classifications. For example, the disturbance type “Gravel Pit / Quarry” may be associated with both the “Mining” and “Transportation” industry type classes.

The TYPE_INDUSTRY and TYPE_DISTURBANCE fields use coded domains to ensure consistency in naming and attribution. These domains, or pick list options, vary depending on the feature geometry.

The coded domain values for industry type are described in Table 2. It is important to note that this list is not exhaustive for surface disturbances in the Yukon. Classifications can be added as needed, as long as they are consistent, and clearly explained by the contractor in their final report.

Table 2: Industry type coded values

Field: TYPE_INDUSTRY	Description
Mining	Mining includes mineral exploration for quartz or placer: mine aggregates, pits, remote fuel caches, exploration roads, etc.
Oil and Gas	Seismic, well and pad, camps, pipelines, etc.
Rural	Disturbance typically caused by land ownership in rural areas
Transportation	Road and trails that are not obviously for resource access or extraction. Gravel pit for road maintenance would also have this industry type.
Unknown	Unknown industry type
Urban	Urban Disturbance, residential, commercial, towns, etc.
Utility	Power lines and telephone corridors
Agriculture (Polygon only)	Farms, ranches, fields, etc.
Forestry (Polygon only)	Cut blocks, resource roads, etc.

3.1.2 Polygon/areal surface disturbance features

The polygon feature class is best used to represent areal disturbances or clearings resulting from various industries or activities, such as agricultural fields, forestry cut blocks, oil and gas well pads, mining sites, industrial areas, etc.

3.1.2.1 Data dictionary and attributes for polygon/areal surface disturbance features

The data dictionary of attributes used to describe areal features in the public database is shown in Table 3.

Table 3: Areal surface disturbance attributes, domains, and descriptions (public).

Attribute	Data Type	Domains	Description
REF_ID	Text (100)		Unique feature reference ID
DATABASE	Text (12)	Historic, Most Recent, Retired	Sub-database to which the feature belongs
TYPE_INDUSTRY	Text (20)	Table 5	Major classification of disturbance feature by industry
TYPE_DISTURBANCE	Text (30)	Table 5	Sub classification of disturbance feature

Table 4 continued: Areal surface disturbance attributes, domains, and descriptions (public).

Attribute	Data Type	Domains	Description
SCALE_CAPTURED	Long		Scale at which the feature was digitized
DATA_SOURCE	Text (10)	Imagery, GPS, Other	Data source: digitized from imagery, captured by GPS, or obtained by other means
IMAGE_NAME	Text (100)		Filename of source imagery
IMAGE_DATE	Date		Date that imagery was captured
IMAGE_RESOLUTION	Double		Resolution of source imagery in metres
IMAGE_SENSOR	Text (35)		Name of sensor that captured source imagery

3.1.2.2 Coded domains for industry and disturbance type attribute fields (polygon features)

Table 5 shows the different coded domains that currently exist under TYPE_INDUSTRY and TYPE_DISTURBANCE for areal features.

Table 5: Areal industry and disturbance type classifications

TYPE_INDUSTRY	TYPE_DISTURBANCE	DESCRIPTION
Agriculture	Agriculture	Farms, ranches, or other agricultural areas
Forestry	Forestry	Cut blocks or other forestry related activities
Mining	Building	A building footprint or the building and the surrounding land related to mining activities.
	Drill Pad	Drill pad features related to mineral exploration activities
	Fuel Cache	Remote caches of fuel allowing for mineral exploration activities (will often have fuel tanks and barrels)
	Gravel Pit / Quarry	Pit or quarry for mining gravel or aggregate
	Laydown area	Areas used to store materials and equipment for mining operations
	Mining	Miscellaneous or unknown mining activities
	Placer Mining - Minor	Placer mining area with little disturbance
	Placer Mining - Significant	Placer mining area with greater disturbance
	Quartz Mining - Minor	Quartz mining area with little disturbance
	Quartz Mining - Significant	Quartz mining area with greater disturbance
	Tailing Pond	Tailing pond associated with mining activity
	Camp	Mining camp
Oil and Gas	Well Pad	Cleared area surrounding oil or gas well

Table 5 continued: Areal industry and disturbance type classifications

TYPE_INDUSTRY	TYPE_DISTURBANCE	DESCRIPTION
Rural	Camp	Any camp outside of mining areas, including fishing/hunting camps, ENV conservation officer cabins/camps, outfitters, etc.
	Homestead	Rural dwelling and associated land
Transportation	Airstrip	Airport or Airstrip
	Clearing	Clearings that are related to transportation but could not be clearly attributed as a turn area, pullout, road cut and fill, etc.
	Gravel Pit / Quarry	Gravel pits related to transportation
	Pullout / Turn Area	An area associated with transportation and is intended as a vehicle pullout or turn area
	Road Cut and Fill	Cut slopes and moved earth for road construction purposes
Unknown	Clearing	A tract of land devoid (or nearly devoid) of natural land cover and suspected to be anthropogenic in nature
	Gravel Pit / Quarry	A gravel pit with unknown related industry
	Unknown	Unable to identify from imagery, but suspected to be anthropogenic
Urban	Building	Visible building or structure
	Cemetery	Cemetery
	Clearing	Miscellaneous urban clearings
	Cul-de-sac / Turn Area	A turn area associated with transportation or road cul-de-sac
	Dam	Barrier impounding water or stream
	Golf Course	Recreational golfing area
	Industrial	Areas that are designated for industrial uses: factories, tank farm, transportation area
	Institutional	Any institutional buildings and immediate cleared area: School, government, etc.
	Landfill	Site used for disposal of waste materials
	Pond	Standing body of water, created anthropogenically; includes sewage lagoons, wastewater facilities, and artificial bodies of water.
	Recreation Area	Visible disturbance in Urban / Rural parks and recreation areas
	Rural Residential	Land use in which housing predominates in an urban or community setting
	Tower	A tall structure, possibly used for communications or forestry
	Urban	Miscellaneous or unknown urban features

3.1.3 Polyline/linear surface disturbance features

The polyline feature class is best used to represent linear disturbance features visible on imagery or captured from GPS or other means. The following feature should always be captured as a line regardless of its width: trails, roads, cut lines, pipelines, utility corridors, etc. There could be exceptions for some pipeline, utility, or right of way corridors, especially if width varies greatly.

3.1.3.1 Data dictionary and attributes for polyline/linear surface disturbance features

The data dictionary of attributes used to describe linear features in the public database is shown in Table 6.

Table 6: Linear surface disturbance attributes and descriptions.

Attribute	Data Type	Domains	Description
REF_ID	Text (100)		Unique feature reference ID
DATABASE	Text (12)	Historic, Most Recent, Retired	Sub-database to which the feature belongs
TYPE_INDUSTRY	Text (20)	Table 8	Major classification of disturbance feature by industry
TYPE_DISTURBANCE	Text (30)	Table 8	Sub classification of disturbance feature
WIDTH_M*	Double		Width of feature in metres
WIDTH_CLASS**	Text (5)	HIGH, MED, LOW	Width of feature by classification
SCALE_CAPTURED	Long		Scale at which the feature was digitized
DATA_SOURCE	Text (10)	Imagery, GPS, NRN, NRWN, Other	Data source: digitized from imagery, captured by GPS, adapted from the NRN or NRWN, or obtained by other means
IMAGE_NAME	Text (100)		Filename of source imagery
IMAGE_DATE	Date		Date that imagery was captured
IMAGE_RESOLUTION	Double		Resolution of source imagery in metres
IMAGE_SENSOR	Text (35)		Name of sensor that captured source imagery

*WIDTH_M: Linear features must be attributed with a width measurement. The width of the feature can be estimated in metres from the average of multiple measurements, and rounded to the nearest whole number.
**WIDTH_CLASS: This field employs a classification scheme used by previous contractors. The width values are shown in Table 7.

Table 7: Width classification breakdown

WIDTH_CLASS	Anticipated Value Range (metres)
LOW	<4
MED	4-8
HIGH	>8

3.1.3.2 *Coded domains for industry and disturbance type attribute fields*

Table 8 shows the different coded domains that currently exist under TYPE_INDUSTRY and TYPE_DISTURBANCE for linear features.

Table 8: Linear disturbance industry and disturbance type classifications

TYPE_INDUSTRY	TYPE_DISTURBANCE	DESCRIPTION
Mining	Survey / Cutline	A linear cleared area through undeveloped land, used for line-of-sight surveying; impossible to distinguish whether associated with quartz or placer mining (overlapping or unclear claims information)
	Survey / Cutline - Placer	A linear cleared area through undeveloped land, used for line-of-sight surveying; associated with placer mining (identified using claims information and/or other indicators)
	Survey / Cutline - Quartz	A linear cleared area through undeveloped land, used for line-of-sight surveying; associated with quartz mining (identified using claims information and/or other indicators)
	Trench	A long, narrow excavation dug to expose vein or ore structure
	Unknown	Unknown linear mining disturbance
Oil and Gas	Pipeline	Visible pipeline or pipeline right-of-way (above- or below-ground)
	Seismic Line	Seismic lines
Rural	Driveway	A driveway in a rural area
	Fence	A fence in a rural area
Transportation	Access Assumed	A linear feature that is assumed to be an access road, but could also be a trail
	Access Road	A road or narrow passage whose primary function is to provide access for resource extraction (i.e. mining, forestry) and may also have served in providing public access to the backcountry
	Arterial Road	A major thoroughfare with medium to large traffic capacity
	Local Road	A low-speed thoroughfare, provides access to front of properties, including those with potential public restrictions such as trailer parks, First Nations land, private estate, seasonal residences, gravel pits (NRN definition for Local Street/Local Strata/Local Unknown). Shows signs of regular use.
	Right of Way	For Road Rights as attributed in the land parcels ancillary data

Table 8 continued: Linear disturbance industry and disturbance type classifications

TYPE_INDUSTRY	TYPE_DISTURBANCE	DESCRIPTION
Transportation	Trail	Path or track (often <1.5 m wide) used for walking, cycling, ORV, or other backcountry activities (trails used for mining activities are Access Roads)
	Unpaved Road	Dirt or gravel road (often >1.5 m wide) that does not necessarily access remote resources
Unknown	Right of Way	A right of way with unknown industry type
	Survey / Cutline	A linear cleared area through undeveloped land, used for line-of-sight surveying. A cutline may not always be associated with mineral exploration, therefore, Industry Type: Unknown was used to differentiate all cutlines that were outside of mineral exploration
	Unknown	Unclassified, or unable to identify type based on imagery, but suspected to be anthropogenic
Utility	Electric Utility Corridor	Corridor usually running parallel to highway, where transmission lines or other utilities are visible
	Unknown	Unknown linear feature assumed to be a utility corridor; ancillary data is unclear.

4 Surface disturbance mapping guide for contractors

Surface disturbance mapping is performed by private contractors on a project-by-project basis. Contracts are managed by the Project Lead and data preparation is coordinated by the Department of Environment's Fish and Wildlife Branch.

4.1 Project data package for contractors

A project data package is assembled by the Government of Yukon and delivered to contractors to facilitate mapping. It has been created to standardize and streamline data collection according to the database model and schema outlined in this document.

The project data package will contain the following:

1. An ArcGIS project file (.aprx) containing:
    a. A project area outline (Project AOI)
        i. If a project is split into numerous work packages, the Project AOI will be sub-divided into multiple polygons, each representing the spatial extent of a work package
    b. A subsection of the surface disturbance database relevant to the project

    c. A template geodatabase for new mapping
    d. A tracking grid (use is optional)
2. The Mapping Standards Document and Feature Interpretation Key
3. A list of useful ancillary datasets
4. Relevant imagery & data sharing agreement
5. A guide to QA/QC of the provided surface disturbance database

4.1.1 Project area of interest shapefile

For a given project, the area of interest (Project AOI) will be provided by the Government of Yukon as a feature class. The spatial extent of individual work packages (if present) will be identified by clearly labelled polygon features within the Project AOI.

The Project AOI and work packages outline the areas of focus for mapping, but are not firm boundaries for feature digitization. If a disturbance feature lies along the boundary, digitize the whole feature (where imagery permits) to reduce feature fragmentation. Feature continuity is important, but must be balanced with the time and resources available; the priority mapping area is that which lies within the Project AOI, or work package polygon.

4.1.2 Subsection of the surface disturbance database

For ease of communication, mapped surface disturbance features that are provided to the contractor for quality checks are referred to as “old” features. Features that the contractor has newly created using the feature template are referred to as “new”.

4.1.3 Feature templates

A template ArcGIS project will be provided for each new contract. This document has been configured to use ‘Feature Templates’ when editing. Feature templates can be modified to automatically populate select fields such as DATABASE = Most Recent, SCALE_CAPTURED = 5000, CREATED_DATE = [now] etc. Some fields, such as TYPE_INDUSTRY and TYPE_DISTURBANCE, will need to be entered manually. Feature templates will increase digitizing efficiency by reducing the number of individual steps required.

Note: Feature templates are provided as a recommendation but contractors can develop their own templates or methodology, as long as all fields are correctly populated.

4.1.4 Tracking grid

Contractors will be provided with a tracking grid of 1 km^2 cells that may be used to track mapping progress, imagery quality issues, and ongoing quality checks. It may help to more clearly convey spatially specific comments and concerns to the project lead.

Use of the tracking grid is not compulsory. Contractors may use the tracking grid provided, or replace it with their own method (to be discussed with and approved by the project lead).

4.1.5 Guidance documents

Contractors will be provided with the most recent version of the Mapping Standards Document (this document), and a Feature Interpretation Key to aid the accurate mapping of disturbance features, and classification of those features by industry type and disturbance type.

4.1.6 Ancillary datasets for feature identification

When possible, external ancillary datasets will be used as references to determine the source, and thus industry type, of the disturbance. For example, land tenures, placer claims, and quartz claims datasets can be layered in GIS to aid feature identification.

Disturbances should be collected in the surface disturbance dataset EVEN if it is collected in another dataset and ONLY if it is also visible in the imagery; the only exception to this is if the feature already exists in the National Road Network (NRN) or the National Railway Network (NRWN). With the exception of the NRN and NRWN, all features identified through relevant ancillary data sources that are visible within the imagery should be digitized and attributed appropriately.

There are a number of ancillary dataset available on the Corporate Spatial Warehouse (CSW), or available to download from GeoYukon (http://mapservices.gov.yk.ca/GeoYukon/), or Open Government (https://open.canada.ca/en). Contractors will be provided with a spreadsheet detailing a list of available resources.

4.1.7 Imagery selection

Imagery will be provided on a project-by-project basis, under a Government of Yukon license agreement where required. Imagery is not included as part of the template dataset. Contractors will work with Government of Yukon staff to gain access to the best available imagery for the project.

Best available imagery is defined by the following parameters:

1) New imagery is preferred to old imagery
2) High resolution is preferred to low resolution
3) Cloud/snow/shadow-free imagery is preferred to imagery with cloud/snow/shadow
4) Multispectral imagery is preferred to black & white aerial photography

5 Quality checks of previously mapped features

Before any new mapping can be completed, all previously mapped features must be reviewed and subjected to a thorough quality check. Quality check methods may vary by project; please consult with the project manager for additional details and requirements.

5.1 Feature retirement

If a previously mapped feature does not accurately represent the disturbance visible in the imagery, it may be retired from the database. Note: accuracy is gauged relative to the source imagery used to create the feature (or a contemporary equivalent), not new imagery provided for re-mapping.

Table 9 describes a number of fields relating to feature retirement that will be provided to contractors completing surface disturbance mapping.

Table 9: Attributes that characterize feature retirement

Attribute	Data Type	Domains	Description
RETIRED_BY	Text (25)	USER	User that retired a feature
RETIRED_DATE	Date		Date feature was retired
RETIRED_REASON	Text (50)	RETIRED_REASON	Reason the feature was retired; see Table 11

In addition to the fields outlined in Table 9, the DATABASE field must be updated to indicate feature retirement: DATABASE = “Retired”. A complete list of mandatory fields for feature retirement are shown in Table 10.

Table 10: Mandatory attribute fields when a feature has been retired, listed by feature type

Field Name	Polygon	Line
DATABASE	YES	YES
RETIRED_BY	YES	YES
RETIRED_DATE	YES	YES
RETIRED_REASON	YES	YES

A list of possible coded domain values describing the reason a feature may be retired are shown in Table 11. New reasons can be added as needed, as long as they are consistent, necessary, and clearly explained by the contractor in their final report.

Table 11: Table of coded domain values and descriptions for the field RETIRED_REASON where DATABASE = Retired

RETIRED_REASON	Additional Details
Error Suspected	A digitization error is suspected; the feature is not visible, or does not represent an anthropogenic surface disturbance feature (e.g. an esker is captured as a linear feature)
Location Error	The geometry of a feature is correctly captured, but in the wrong location; likely an issue of misaligned projections during digitization
Low Resolution	The feature was captured using > 2 m resolution imagery in an area where mapping is now being performed with < 2 m resolution imagery.
NRN Overlap	Duplicate features characterizing NRN roads must be retired.
NRN Erasure Error	Previous contracts erased areal features that lay within a buffer distance of the NRN; this is not in line with the current data model. These features must be retired and replaced with continuous areal features that overlap with the NRN, digitized with the same imagery as the retired feature.
Winter Disturbance Only	A disturbance feature has been digitized using winter imagery, but is not present in summer months. (Example: an ice road over a lake)
Replaced - North Yukon	DO NOT USE: reason related to a specific previous project
Replaced 2018	DO NOT USE: reason related to a specific previous project
Replaced 2021	DO NOT USE: reason related to a specific previous project

5.2 Feature modification

Occasionally, information about existing features will need to be updated or corrected. When an existing feature is modified in any way, information about who edited the feature, when, and why must be captured. Table 12 describes a number of fields relating to feature modification that will be provided to contractors completing surface disturbance mapping.

Table 12: Attributes that characterize feature modification

Attribute	Data Type	Domains	Description
EDITED_BY	Text (25)	USER	User that edited a feature
EDITED_DATE	Date		Date feature was edited
EDITED_FIELD	Text (50)	EDITED_FIELD	The name of the field(s) that was modified; note that some fields may NOT be modified.

Fields that may commonly be updated and modified include:

- ✓ DATABASE
- ✓ TYPE_INDUSTRY
- ✓ TYPE_DISTURBANCE
- ✓ WIDTH_M
- ✓ WIDTH_CLASS

Fields that should NEVER be modified in any way include:

- x REF_ID
- x SCALE_CAPTURED
- x DATA_SOURCE
- x IMAGE_NAME
- x IMAGE_DATE
- x IMAGE_RESOLUTION
- x IMAGE_SENSOR
- x CREATED_BY
- x CREATED_DATE

Any typos or other errors identified in these fields should be reported to the project lead for correction, referencing the feature REF_ID.

A complete list of mandatory fields for feature modification are shown in Table 13. Note that the field name may differ from the field alias in this instance, if prior feature modification has occurred. For example, if EDITED_BY already exists for a specific feature, the contractor will be provided with a field named “EDIT_2_BY”, with field alias “EDITED_BY”.

Table 13: Mandatory attribute fields when a feature has been modified, listed by feature type

FIELD NAME	POLYGON	LINE
EDITED_BY	YES	YES
EDITED_DATE	YES	YES
EDITED_FIELD	YES	YES

6 Mapping surface disturbance

6.1 Digitization methods

Unless otherwise agreed upon, a heads-up digitizing method will be employed for data capture. This refers to manual digitization, or tracing with a mouse, of features identifiable on imagery when displayed on a computer monitor, and capturing those features in vector format. All mapping must be completed in the NAD 1983 CSRS Yukon Albers, unless otherwise discussed with and agreed upon by the contract manager.

For imagery with 1.5 m or higher resolution, features should be identified and digitized at a scale of 1:5000; a larger scale may be used for higher resolution imagery. To get best feature width, a scale of 1:2500 should be used to do multiple measurements, and then average to the nearest whole number. The scale used for digitization must be noted in the SCALE_CAPTURED field of the attribute table.

6.1.1 Topology rules

Attribution of all features must follow the data model outlined in Section 3 and the following general topology rules:

1. Polygons must not overlap polygons where DATABASE = Most Recent.
    a. Most Recent features may overlap Historic features, but Most Recent areal features may not overlap each other.
2. Lines must not overlap lines, but CAN overlap polygons. Digitization of clearly defined linear features within polygons is required.
3. Features must be single part.

When areal features that are adjacent to each other are digitized, the *Auto Complete Polygon* tool can be used to ensure the topology rules are followed.

Additional rules relating to linear features:

1. Linear features should snap to each other and/or areal disturbances where appropriate.
2. Linear features may intersect each other, but may not overlap.
3. Linear features should be represented by polyline geometry regardless of their width, with the exception of airports and airstrips that should be collected as polygon features.

6.2 Mapping conceptual model

All anthropogenic surface disturbance visible in the imagery must be mapped. All previously mapped surface disturbance features should be re-mapped using the imagery provided for the contract. A previously mapped disturbance cannot be omitted from new mapping without an explanation.

As shown in Figure 2, all unmapped surface disturbance features must be mapped. If a feature already exists in the provided disturbance database, that feature must be re-mapped as a visible or interpolated feature, retired from the database, or marked “Historic” with justification.

The following sections provide additional details on disturbance mapping standards.

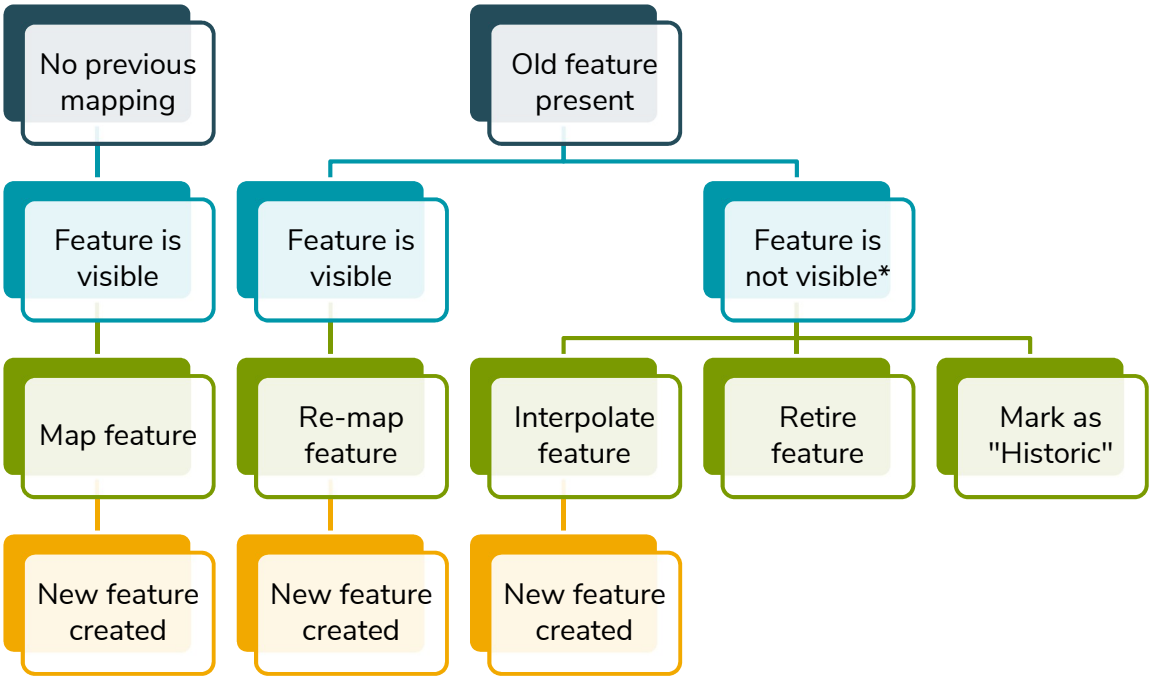

Figure 2: Process for mapping surface disturbance features based on whether the feature has been previously mapped, and its visibility in the imagery.
**See Section 6.5 "Re-mapping old features that are not visible" for more detail.*

6.3 Mapping new features

When a feature is digitized, the creator of that feature is identified using the CREATED_BY and CREATED_DATE fields outlined in Table 14. The visibility of the feature is also noted.

Table 14: Attributes that characterize feature creation/digitization

Attribute	Data Type	Domains	Description
CREATED_BY	Text (25)	USER	User that created/digitized a feature
CREATED_DATE	Date		Date feature was created/digitized
FEATURE_VISIBILITY	Text (25)	VISIBLE, INTERPOLATED	Indicates whether the feature is visible and interpreted from the imagery, or if it was interpolated because the feature was obscured, but known to be present.

In some instances, a known surface disturbance feature is obscured from view in imagery due to clouds, shadows, or other anomalies related to image quality. The presence of the disturbance feature may be known from previous disturbance mapping, or logically inferred, such as when a cloud passes over a portion of a continuous linear feature. Whether a feature was directly visible in the imagery or was interpolated by other means, it is indicated in the field FEATURE_VISIBILITY.

6.3.1 Mandatory fields

For each feature, all mandatory attribute fields must be filled out, so there are no <Null> values. All other fields may be considered optional; optional fields may not be required for every feature and can be left as <Null> when appropriate. Mandatory fields differ depending on the action being performed: a new feature is being created (Table 15), or an existing feature is being retired (Table 10) or modified (Table 13).

Table 15: Mandatory attribute fields for the creation of new features, by feature type

Field Name	Polygon	Line
DATABASE	YES	YES
TYPE_INDUSTRY	YES	YES
TYPE_DISTURBANCE	YES	YES
WIDTH_M		YES
WIDTH_CLASS		YES
SCALE_CAPTURED	YES	YES
DATA_SOURCE	YES	YES
IMAGE_NAME	YES	YES
IMAGE_DATE	YES	YES
IMAGE_RESOLUTION	YES	YES
IMAGE_SENSOR	YES	YES
CREATED_BY	YES	YES
CREATED_DATE	YES	YES
FEATURE_VISIBILITY	YES	YES

6.3.2 Attribute domains and exceptions

Domains have been enabled within the template feature classes to ensure consistency and save time; instead of manually typing in field values, users may select from a drop down menu of possible values. If the values given in the domains do not satisfy the requirements of the features being digitized, new domains can be added, however this must be noted in the project deliverables report. Every effort should be made to create standardized and consistent values.

If the INDUSTRY_TYPE and DISTURBANCE_TYPE of a captured feature cannot be identified on the imagery with the aid of ancillary datasets, then a value of “Unknown” can be selected instead of <NULL> values.

Consistent data interpretation is critical; interpretation criteria should be documented and constantly applied throughout the project.

6.3.3 Classifying width measurements of linear features

The width of linear features can be measured in one of two ways:

1. By using the *Measure* tool in ArcGIS, or
2. By counting relevant pixels and multiplying by the known pixel width. For example, if the raster resolution of the image is 5 m, and the linear feature is 4 pixels wide, it can be estimated that the width is 20 m.

Several width measurements should be taken along the length of the linear feature and averaged to produce an overall width estimate (in metres), rounded to the nearest whole number. Width measurements will be made at a scale of 1:2500.

Linear features are grouped by width (WIDTH_CLASS) according to the classification scheme outlined in Table 7.

6.3.4 Data to exclude when digitizing

Features that have been derived from the NRN and NRWN datasets are considered time stable until their source dataset is updated. These features should not be re-mapped from imagery. All other anthropogenic surface disturbance features that are visible in the imagery must be digitized and included in the database.

6.4 Re-mapping old features that are visible

The surface disturbance database has been restructured to accommodate repeat characterization of disturbance features through time. In the previous data model, features that already existed in the surface disturbance database were not recaptured. In the current model, all disturbance features should be captured for the given time period, regardless of whether they have been mapped previously.

When an existing feature is re-mapped using newer imagery, the newer feature becomes the Most Recent feature, and the older one becomes Historic. Each feature represents a moment in time when the disturbance was observed on the landscape, as shown in Figure 3.

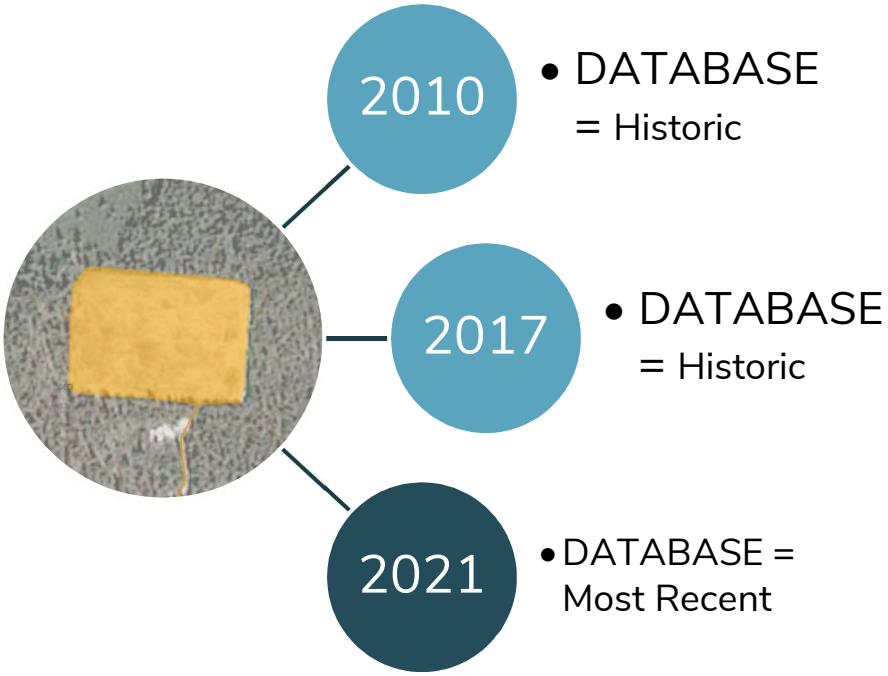

Figure 3: Example of a feature captured and re-captured through time

Rules for DATABASE definition:

1. The DATABASE field is required within the restricted domain, and cannot be null.
2. Most Recent areal features CANNOT overlap each other.
   Most Recent features CAN overlap Historic features.
   Historic features CAN overlap Historic features.

If two features overlap, the feature digitized from more recent imagery will have DATABASE = Most Recent, whereas the feature digitized from older imagery will have DATABASE = Historic.

6.4.1 Feature geometry duplication

If a disturbance feature remains unchanged since the last time it was mapped, the geometry of the mapped feature should remain unchanged as well. In this instance, the old feature is duplicated to maintain consistent geometry, and the attribute table is cleared and repopulated as a new feature. Refer back to Table 15 for a list of mandatory fields for the creation of a new feature.

This approach is particularly important for linear features, but the principle should be kept in mind for areal features too.

Areal features may shrink over time and the width of linear features may change; this will be reflected in the feature geometry for areal features, and the feature attributes (WIDTH_M and WIDTH_CLASS) for linear features.

6.5 Re-mapping old features that are not visible

If a previously mapped feature is completely absent from more recent imagery, the reason for the change must be identified. These reasons, and the processes for identifying them, are summarized in Figure 4. Note that a feature can only be omitted from re-mapping if the vegetation within the previously mapped feature has no perceptible spectral differences from surrounding vegetation.

Figure 4: Appropriate actions when a pre-existing feature is not visible in newer imagery.

6.5.1 Interpolating features

Surface disturbance may be obscured from view in imagery due to clouds, shadows, or other anomalies related to image quality.

When poor image quality obscures the detection of a disturbance feature that has been mapped previously, the disturbance is assumed to still be present in its last-known

characterization until proven otherwise. As with feature re-mapping, follow the procedure for feature geometry duplication and mark FEATURE_VISIBILITY = INTERPOLATED.

Interpolating features helps to create a more continuous characterization of surface disturbance for a particular time frame. Interpolated new features may be included in the Most Recent database, rendering old features Historic.

6.5.2 Retiring features

If a feature appears to have been erroneously mapped from previous imagery, the feature may be retired with RETIRED _REASON = "Error Suspected" or "Location Error", as appropriate. If the quality of newer imagery (clouds, etc.) impedes the visibility of a previously mapped feature, its location can be interpolated, as described in the previous section.

6.5.3 Marking features as historic

Important: Marking features as Historic and not remapping them should ONLY be considered to describe features that have completely disappeared from the landscape: i.e. the vegetation within the previously mapped feature has no perceptible spectral differences from surrounding vegetation. If vegetation is present, but different from the surrounding vegetation, the feature is still considered disturbed and MUST be re-mapped.

If a feature was visible and accurately mapped in previous imagery, but now appears to have completely revegetated and is no longer visible on the landscape in any way, the feature may be marked Historic with an appropriate value for HISTORIC_REASON indicated (see Table 16 for a complete list of values).

Table 16: Table of coded domain values and descriptions for the field HISTORIC_REASON where DATABASE = Historic. Populating this field indicates that a feature is historic and not re-captured in the database.

HISTORIC_REASON	Additional Details
Line Replaced by Polygon	A visually distinct linear feature no longer exists because it has been widened or absorbed into an areal feature. The feature is now captured as a polygon.
Suspected Revegetation	A feature is no longer present on the landscape due to suspected revegetation.
Suspected Revegetation-Previous Higher Resolution	The feature was originally captured at a higher resolution than was used to review it, and the feature is suspected to be revegetated because the feature is no longer visible on the landscape.
Fire	A feature is no longer visible on the landscape due to recent fire activity.

For example, when a linear feature has been completely replaced by an areal feature, it can be marked as historic with a HISTORIC_REASON = “Line Replaced by Polygon”, as shown in Figure 5.

Figure 5: A road is torn up and converted into an areal feature; the linear feature that previously characterized the road is marked as Historic with RETIRED_REASON = "Line Replaced by Polygon". Photo credit: Kate Powell

Capturing vegetation regrowth or regeneration is complex and requires clear definitions of regeneration and how it can be detected using satellite imagery. Untrained visual estimates of percent vegetation cover are too subjective to be useful in any analysis, and thus do not merit inclusion. In the absence of this information, the degree of vegetation regrowth is not currently addressed within the framework for surface disturbance mapping.