The Enhanced Human Footprint Inventory (HFIe) for the Oil Sands Monitoring (OSM) Region 2023

Version 1.0

Metadata Documentation



ABMI ALBERTA BIODIVERSITY MONITORING INSTITUTE

The Enhanced Human Footprint Inventory (HFI) for the Oil Sands Monitoring (OSM) Region 2023
Alberta Biodiversity Monitoring Institute

The publication can be found at https://abmi.ca/data-portal/xx.html

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Table of Contents

1. Overview 2
   1.1. Summary 2
   1.2. Description 2
   1.3. Document History 3
   1.4. Methods 4
   1.5. Credits 5
   1.6. Acknowledgments 6
   1.7. Human Footprint Definition 7
   1.8. Contact Information 7
   1.9. Keywords 8
   1.10. Citation 8
   1.11. Use Limitations 8
2. Data Product Specifications 10
   2.1. Spatial Resolution 10
   2.2. Processing Environment 10
   2.3. Extent 10
   2.4. Resource Maintenance 11
   2.5. Spatial Reference 11
   2.6. Lineage 11
3. Human Footprint Inventory Integrated Dataset 11
4. Updates to HFI Sublayers and Feature Types 12
   4.1. Seismic Lines, Trails and Other Linear Features 13
   4.2. Seismic Lines, Trails and Other Linear Features - Integrated HFI 14
   4.3 Roads 15
5. HFI Sublayers 15
   5.1. (01) Reservoirs 15
   5.2. (02) Borrow Pits, Sumps, Dugouts, and Lagoons (BPSDL) 16
   5.3. (03) Roads 20

5.4. (04) Railways 22
5.5. (05) Canals 23
5.6. (06) Verges 24
5.7. (07) Mine Sites 25
5.8. (08) Industrial Sites 28
5.9. (09) Well Sites Active 30
5.10. (10) Landfills 31
5.11. (11) Other Vegetated Surfaces 32
5.12. (12) Wind Generation Facilities 33
5.13. (13) Transmission Lines 33
5.14. (14) Confined Feeding Operations (CFO) 34
5.15. (15) Urban and Rural Residential 35
5.16. (16) Well Sites Abandoned 37
5.17. (17) Cultivation 38
5.18. (18) Timber Harvest and Woody Vegetation Removal 44
5.19. (19) Pipelines 45
5.20. (20) Seismic Lines, Trails and Other Linear Features 46
6. HFI Linear Features 52
6.1. (01) Roads Linear Features 53
6.2. (04) Railways - Linear Features 53
6.3. (13) Transmission Lines - Linear Features 53
6.4. (19) Pipelines - Linear Features 53
6.5. (20) Seismic Lines, Trails and Other Linear Features 54
7. Enhanced Human Footprint Inventory 55
8. Enhanced Attribution 55
8.1. Year of Origin Attribution 55
8.2. Sector Attribution 57
8.3. Nighttime Light Attribution 58
8.4. Vegetation Attribution 59
8.5. Noise Attribution 60
8.6. Exploration vs. Production Attribution 63

9. HFI Feature Attributes 66
9.1. Attribute List 66
9.2. Mandatory Fields 68
10. HFI Reference and Source Datasets 76
10.1. Data sources 76
10.2. Data Source Thematic and Spatial Accuracy 80

1. Overview

1.1. Summary

This dataset represents the enhanced Human Footprint Inventory for the Oil Sands Monitoring (OSM) Region for 2023 conditions – HFIeOSM2023. The HFIeOSM2023 maps human footprint features across the entire OSM watershed region of Alberta, Canada. The dataset is intended to aid human footprint and land use inquiries.

1.2. Description

The Alberta Biodiversity Monitoring Institute (ABMI) uses existing available datasets (Alberta Base Features, Inventories, Road/Railway Networks, etc.) as the starting point for this product. The dataset is then updated using imagery from the Satellite pour l'Observation de la Terre 6 (SPOT6) to interpret anthropogenic disturbances on the land surface. Thematic mapping or image interpretation requires professional judgment, skill, knowledge and expertise to create the human footprint dataset in a very complex land use environment. It is expected that the final dataset has an element of thematic accuracy. The list of expected thematic accuracies depending on data source is available in Section 10 of this document.

The 2023 SPOT6 mosaic is comprised of approximately 0.15% imagery acquired in 2021, 8.70% imagery acquired in 2022, and 91.27% imagery acquired in 2023. This SPOT6 mosaic circa 2023 was used for human footprint updates. Figure 1 displays the spatial distribution of satellite imagery coverage for years 2023, 2022, and 2021.

Representative human footprint polygons were delineated for 113 feature types, which were organized into 20 final sublayers.

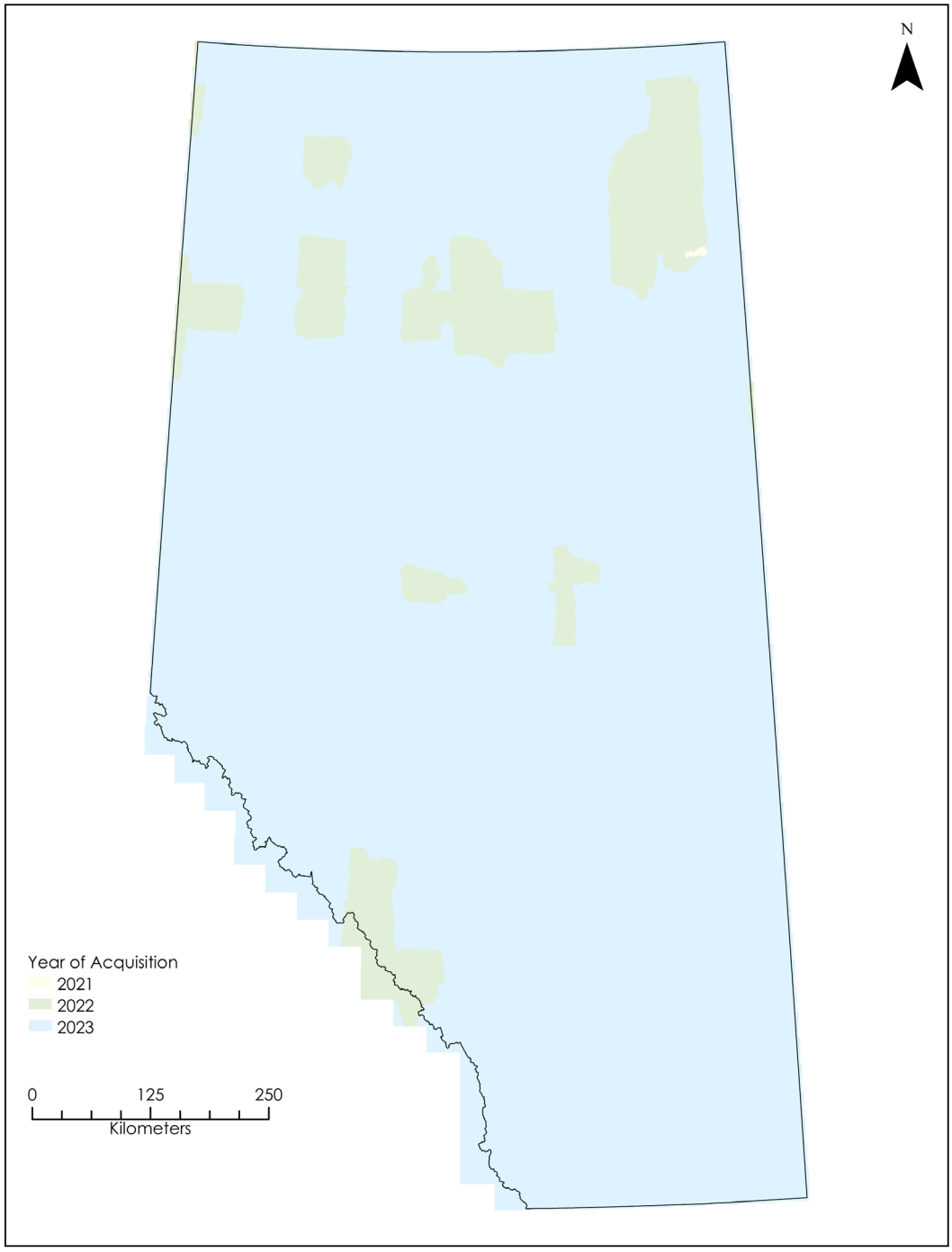


Figure 1: Spatial distribution of satellite imagery acquisition period, available for 2023 SPOT6 mosaic in Alberta.

1.3. Document History

Table 1. List of document versions and updates.

Update Date	Version	Section(s)	Description of Changes
2026-03-31	1.0	All	Initial full (final) version of HFI2023

1.4. Methods

The ABMI updates Human Footprint Inventory information annually. The OSM region was examined at a 1:30,000 scale to delineate all detectable human footprints. All the features were created and/or verified using heads-up digitizing at a 1:5,000 scale. The human footprint attributes were manually interpreted from satellite imagery. Government of Alberta Base Feature Datasets were used as a base layer.

This process was conducted for 2023 using SPOT6 satellite imagery. Year of origin was acquired from multiple imagery sources: 1950 using orthorectified aerial imagery, 1985 using orthorectified aerial imagery, 2000 using orthorectified aerial imagery, 2001 and 2004 using IRS satellite imagery for each year, Google Earth Timelapse, 2005-2012 using SPOT 5 satellite imagery for each year, and 2013-2023 using SPOT6 satellite imagery (Table 16). Manual comparisons with existing digital data such as Pulse Seismic (www.pulseseismic.com), Digitally Integrated Dispositions, Historical Cadastral Cutlines and Trails, and 1950 linear features digitized from the Historical Planimetric Maps were also conducted.

Following updating of 2023 conditions, additional enhanced attribution was added to the various features and sublayers to produce the HFIeOSM2023 (v1.2). These additional attributes included:

1. Age - ‘year of origin’ (for some features)
2. Sector - the sector from which the feature originated (for all features)
3. Vegetation - a spectrally-based estimate of vegetation ‘greenness’, from satellite (for all features)
4. Light - nighttime light radiance, from satellite (for features in the Mine Sites, Industrial Sites, Well Sites (Active and Abandoned), Confined Feeding Operations and Residential sublayers)
5. Noise - anthropogenic noise levels, modeled using human footprint, acoustic recording, and other inputs
6. Exploration vs Production - the assignment of certain features to ‘exploration’-related activities or ‘production’-related activities (for features in the Mine Sites, Industrial Sites, Well Sites (Active and Abandoned), Pipelines and Seismic Lines, Trails, and Other Linear Features sublayers)

These are further described in detail in Section 8.

IMPORTANT:

> This version of the ABMI HFIeOSM2023 does not account for succession (or reclamation) of human footprint, but treats all types of human footprint on the landscape equally. Put another way, “successional” HF (HF in which natural vegetation regenerates after human disturbance has ceased) is treated the same as “alienating” HF (HF types which are maintained permanently with altered vegetation) despite the vegetation recovery that almost certainly will have occurred since the development. The current dataset does not present the current habitat/vegetation cover within features such as harvested areas (previously referred to as cut blocks) or seismic lines.
>
> This product is not error free. We continuously work to improve the accuracy and precision of this product.

This GIS polygon layer is updated annually, and new versions will be released accordingly.

The ABMI Human Footprint Inventory is stored in ESRI File Geodatabase (ArcGIS 10.7.1) format.

1.5. Credits

In addition to the human footprint features, data originating from open sources and created by the ABMI, this dataset includes human footprint data collected and created by the Alberta Human Footprint Monitoring Program and the Alberta Biodiversity Monitoring Institute, with support from members of the Oil Sands Monitoring program.

1.6. Acknowledgments

In 2014 the Alberta Biodiversity Monitoring Institute (ABMI) initiated work to create a group of organizations to collaborate in the development of human footprint information in a program called the Alberta Human Footprint Monitoring Program (AHFMP), a collaboration initiative between the Government of Alberta, the ABMI, and non-governmental organizations. The intent was to bring the expertise and resources of various government and non-government organizations to create a common database of human footprint data. The AHFMP governance and organization structure are designed to promote relevancy, accessibility, and transparency of human footprint information. The AHFMP organization structure includes two Committees (Sub and Technical). The Sub Committee is directly involved in the assembling of the enhanced sublayers (e.g., Roads, Railways, and Well Sites) and includes members from the Government of Alberta and the ABMI. Few of the sublayers used in the public version of the Human Footprint Inventory, e.g., the enhanced sublayers for Roads, Railways, Well Sites, and Pipelines sublayers were obtained from the Government of Alberta through the AHFMP. The Technical Committee includes Subject Matter Experts from multiple Government of Alberta Ministries.

In 2019 the ABMI, AHFMP members, and members of the Oil Sands Monitoring (OSM) program initiated a working group to create the enhanced Human Footprint Inventory for the Oil Sands Region. The current dataset represents an updated 2023 version of this original dataset.

1.7. Human Footprint Definition

The ABMI defines Human Footprint (HF) as:

> *the temporary or permanent transformation of native ecosystems to support residential, recreational or industrial land uses.*

Under this definition, HF includes the geographic extent of areas under human use that either have lost their natural cover for extended periods of time (**alienating HF**; e.g., cities, roads, agricultural land, and surface mines) or whose natural cover is periodically reset to earlier successional conditions by industrial activities (**successional HF**; e.g., timber harvest areas and seismic lines).

IMPORTANT:

> This dataset does not account for succession or reclamation of human footprint. It is a cumulative record of human disturbances resulting from direct, mechanical activity. The disturbances are in various states of recovery (natural and human-influenced) and the interpretation of whether a disturbance is still considered a footprint is left to the discretion of the user and their specific requirements.
>
> Successional HF is treated the same as alienating HF despite the vegetation recovery that almost certainly will have occurred since the development. Any GIS analysis or subsequent interpretation that does not account for succession or reclamation of alienating/successional HF should be done with caution.

Physical Footprint

Definition adopted from AHFMP (Source: AHFMP Footprint Data Manual.docx):

For the purposes of the AHFMP, this includes any direct physical modifications, temporary or permanent, that humans make to the surface of private, public, or specified (i.e., allocated through Legislation) lands. This includes the pressure (i.e. boundary or area of anthropogenic pressure), and state of the modifications (i.e. attributes describing the nature of the pressure) including what type of activity (well pad, road, etc.) caused the disturbance. The boundary represents the original extent of the disturbance even if the full extent is not visible.

In some situations, the extent of the disturbance was assumed based on operational requirements to construct the feature. For example, the full extent of a well pad in native grasslands is not always visible. The extent of the original disturbance is estimated with reference to disposition boundaries or buffering to allow for the potential disturbance resulting from the equipment used in the construction of the well pad.

1.8. Contact Information

If you have questions or concerns about the data, please contact:

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Alberta Biodiversity Monitoring
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Edmonton, Alberta T5J 2Y2

Edmonton, Alberta, Canada, T6G 2E9
Email: abmiinfo@ualberta.ca

1.9. Keywords

Alberta, oil sands, anthropogenic, human footprint, reservoirs, borrow pits, sumps, dugouts, lagoons, roads, rails, canals, mines, industrial, oil and gas well pads, landfills, recreation, wind generation facilities, transmission lines, confined feeding operations (CFO), residential, cultivation, harvested areas, pipelines, seismic lines, disturbed vegetation, sector, light, radiance, noise, Normalized Difference Vegetation Index (NDVI), exploration, production

1.10. Citation

Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program. ABMI Enhanced Human Footprint Inventory (HFIe) for the Oil Sands Region of Alberta 2023. Geodatabase. Last modified March 31, 2026. https://doi.org/10.xxxx/xxxx

Available at https://abmi.ca/data-portal/xx.html

1.11. Use Limitations

1.11.1. Proprietary Sourced Data

This dataset contains data originating from proprietary sources, which has subsequently been enhanced through active visual interpretation and computer processing. The Proprietary Sourced Data shall not be used or reproduced in whole or in part or in any form. By accessing the Proprietary Sourced Data, you agree to indemnify and hold harmless the ABMI and the ABMI's subsidiaries, affiliates, related parties, officers, directors, employees, agents, independent contractors, advertisers, partners, and co-branders, from any and all actions, proceedings, claims, demands, liabilities, losses, damages, and expenses which may be brought against or suffered by the ABMI or which it may sustain, pay or incur, arising or resulting from your violation of this clause.

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IMPORTANT:

> Seismic Lines, Trails and Other Linear Features currently available in the ABMI's HFIeOSM2023 are not the complete representation of the seismic lines existing on the land surface. Low impact seismic lines might be missing from this dataset due to low detectability on SPOT imagery and due to the number of features that go beyond current capabilities of heads up digitization on the provincial scale HF dataset. The ABMI's sampling scale HF dataset (Temporal Human Footprint) within boundaries should be used for a more detailed representation of this sublayer within sampling sites (dimensions: 3 km by 7km; distributed in 20 km by 20 km spacing grid).
>
> New Cultivation features created by heads-up digitization ([SOURCE] attribute is either 'ABMI15', 'ABMI16', 'ABMI17', 'ABMI18', 'ABMI19, 'ABMI20', or 'ABMI21'') were attributed based on visual interpretation of SPOT6 satellite natural color composite mosaics. HFI dataset has not included a reattribution of existing HFI_2014 cultivation feature types to status of circa 2023.
>
> Timber Harvest might include areas that have been cleared for another purpose than timber harvesting (i.e., agricultural use, residential, mine or industrial areas expansion, or fire hazard reduction.)

The Timber Harvest [YEAR] value is the best estimation of the year when the area was harvested. It has been determined by:

- heads up digitization for years 1950, 1980, 2000, and 2005 to 2023,
- combination of reference data values and remote sensing analysis for years prior to 2013

The Pipelines dataset is an estimate of high-pressure pipeline corridors in the province and is not suitable for locating pipelines on the ground. The data will also contain some low-pressure pipelines. A pipeline corridor is defined by the AHFMP as any linear disturbance created for the purpose of constructing and maintaining pipelines. The pipeline verge estimates the extent of the direct physical disturbance of the pipeline corridor whether it is visible or not on available imagery.

Active and Abandoned Well Sites include additional attribution from a multitude of sources summarized by the AHFMP and are applied to individual well sites. This attribution includes:

"WELLSITE_FOOTPRINT_ID", "POLYGON_SOURCE", "WELL_STATUS", "FIRST_SPUD_DATE", "FIRST_SPUD_YEAR", "NUMBER_WELLHEADS", "DISP_NUM or DISPOSITION NUMBER", "LCU_ID or RIS LAND COVER ID", "VISIBLE", "AREA_HA", "OILSANDS_EVALUATION_WELL", "RECLAMATION_STATUS", "RECLAMATION_DATE", "RECLAMATION_COMMENT", "MIN_ONPRODUCTION_DATE", "MAX_LAST_PRODUCTION_DATE", "MAX_ABANDONED_DATE", "Fieldname" and "PROD_EX_P_value".

These are further defined in Table 14 in section 9 HFI Feature Attributes.

Linear Features datasets should be used as a supporting dataset to polygonal representation of HF features available in HFIeOSM2023. There are areas where human footprint is captured in polygon layers (HFIeOSM2023 and Sublayers) but is still missing in the Linear Features (Polylines).

Available attribute values of the Linear Features dataset are limited. Polygon layers (HFIeOSM and Sublayers) should be used for geographic extent and more complete thematic information (i.e., available attribution, including source of the data).

2. Data Product Specifications

2.1. Spatial Resolution

Dataset's scale denominator: 30,000

2.2. Processing Environment

Microsoft Windows 10; Esri ArcGIS 10.7.1

2.3. Extent

Geographical Extent
West: 183323.902700 m
East: 834120.257100 m

South: 5865201.446400 m
North: 6555113.378900 m

2.4. Resource Maintenance

Resource maintenance updates frequency: as needed

2.5. Spatial Reference

NAD_1983_10TM_AEP_Forest
WKID: 3400 Authority: EPSG
Projection: Transverse Mercator
False Easting: 500000.0
False Northing: 0.0
Central Meridian: -115.0
Scale Factor: 0.9992
Latitude of Origin: 0.0
Linear Unit: Meter (1.0)
Geographic Coordinate System: GCS_North_American_1983
Angular Unit: Degree (0.0174532925199433)
Prime Meridian: Greenwich (0.0)
Datum: D_North_American_1983
Spheroid: GRS_1980
Semi-major Axis: 6378137.0
Semi-minor Axis: 6356752.314140356
Inverse Flattening: 298.257222101

2.6. Lineage

The ABMI's HFIeOSM2023 was built using open sourced, proprietary, historical, and remotely sensed data. Remotely sensed data were used for visual interpretation and heads-up digitization of human footprint features. Assessment analysis was conducted to identify new and missing features, which were then digitized and added to the dataset. This dataset comprises 19 unique Human Footprint categories, i.e., sublayers. This dataset is representative of the visual interpretation of anthropogenic disturbances on the Alberta landscape as seen from various satellite image sources dated to circa 2023 or earlier.

3. Human Footprint Inventory Integrated Dataset

The HFI2023 Integrated Dataset is a product of multiple individual sublayers that have been merged into a single layer. Each sublayer is listed in the section "HFI Sublayers", including a detailed description of the layer contents, the data source, and modifications made by the ABMI.

The order of precedence applied during creation of the final HFI Integrated Dataset – i.e., the process of merging the individual sublayers – is provided in Table 2.

Table 2. The order of precedence applied during creation of the final HFI dataset, i.e., merging process of the sublayers. Note that references to sublayers and their file names often include a number indicating their order of precedence.

Order of Precedence	Sublayer
1	Reservoirs
2	Borrow Pits, Sumps, Dugouts and Lagoons
3	Roads
4	Railways
5	Canals
6	Verges
7	Mine Sites
8	Industrial Sites
9	Well Sites Active
10	Landfills
11	Other Vegetated Surfaces
12	Wind Generation Facilities
13	Transmission Lines
14	Confined Feeding Operations (CFO)
15	Urban and Rural Residential
16	Well Sites Abandoned
17	Cultivation
18	Timber Harvest and Woody Vegetation Removal
19	Pipelines
20	Seismic Lines, Trails and Other Linear Features

4. Updates to HFI Sublayers and Feature Types

In collaboration with the AHFMP, specific sublayers and feature types were renamed and defined to provide more complete information to the data and to align more with industry and government standard terminology and definitions. These new

feature types and names were discussed and agreed upon by the ABMI and Government of Alberta collaborators in the AHFMP and documented as Standard Operating Procedures (SOPs). For HFI2023, these changes include two sublayers from the HFI: o20 Seismic Lines, Trails and Other Linear Features and o03 Roads. Please see section 5.3 and 5.20 for additional information and limitations on these changes.

4.1. Seismic Lines, Trails and Other Linear Features

The seismic lines and trails sublayer in the HFI2022 included four feature types: Conventional Seismic, Low Impact Seismic, Rec Trails and Other Linear Features. The classification of features in that sublayer followed an older AHFMP understanding of seismic lines that has since been updated by the Government of Alberta Cutline and Trail Attribution Project (CTAP). The HFI2022 feature types will be retained in the attribute table as 'Archived_Feature_TY' along with the new names in the attribute table as 'Feature_TY' and associated definitions within this metadata document. The o20 Sublayer has been renamed to "o20 Seismic Lines, Trails and Other Linear Features" and is defined as "Linear corridors that have been cleared for varying uses including geophysical exploration (i.e., multiple types of seismic lines), Alberta Township Survey quarter section boundaries, fire deterrent, recreational trails, and other linear corridors not yet verified by reference datasets. Excludes all railways, transmission lines, and pipelines, and most roads". New feature type names and definitions have also been updated to represent the construction method of the seismic line and in doing so better reflect industry and government standards. These changes will be outlined in the tables below and more information on the updates can be found in section 5.20.

HFI 2023 Feature Type	Feature Type Definition
Seismic - Legacy	Formerly referred to as Conventional-Seismic. A discontinued seismic line construction method that used bulldozers to create straight corridors (typically) in forested regions of the province. This is the oldest of all construction methods. Any confirmed seismic line (usually derived from geophysical plans) with an unknown construction method will be assumed to be a legacy line.
Seismic - Avoidance	A discontinued construction method that used small bulldozers in a meandering pattern to minimize timber damage with narrower lines and less duff disturbance than Legacy lines. This method evolved into Low-Impact Seismic (LIS) techniques and both techniques coexisted for about 10 years. Avoidance lines have not been fully identified in the HFI data.
Seismic – Line of Sight	A discontinued method where straight, hand-cut lines were cut to create a line of sight for optical survey equipment.
Seismic - LIS	A meandering, mulcher or hand-cut line, with very little duff disturbance. LIS lines prior to 2000 were created with small bulldozers or hand cut and were slightly wider. LIS lines have not been fully identified or digitized in the HFI data.
Seismic – Conventional-Modern	This method allows for slightly straighter and wider lines compared to LIS. It is intended for situations requiring wider lines or in areas of dense timber where avoidance was not feasible. The increased straightness helps minimize timber damage relative to longer, more sinuous lines. However, as most conventional lines are now constructed using the same techniques as LIS, the physical characteristics of this method are more closely related to LIS.

Seismic - Unconfirmed	A temporary seismic classification used for seismic lines dated 2002 onwards until the line is verified by regulatory data.
Fire Guard	Bulldozer lines created as fuel breaks along or near the perimeter of wildfires. These lines can sometimes be found within the fire perimeter if the fire burns past the line. This data is not complete.
ATS Related	A line found along a surveyed quarter section or section boundary from the Alberta Township Survey (ATS). These are most prevalent in and near the White Area. These lines can be the result of any combination of activities such as cleared property boundary, road allowance, older survey lines, fence lines or seismic lines.
Other–Linear-Feature	A non-seismic classification indicating the line has not been identified as any of the existing HFI linear feature types. Linear features that are neither managed as recreational trails under the Crown Land Trails dataset and not verified by other reference datasets.
Rec-Trail	Crown Land Trails published by Alberta Environment and Protected areas as of Apr. 15, 2024. For more information, please visit the Open Government data link.

Standard Operating Protocol (SOP) – EPA/ABMI Human Footprint Inventory (HFI): o20 Seismic Lines, Trails, and Other Linear Features, Version 2.1, 2026

4.2. Seismic Lines, Trails and Other Linear Features - Integrated HFI

Within the integrated HFI, the sublayer Seismic Lines, Trails and Other Linear Features uses a simplified classification based on construction methods, grouping different feature types together. This is shown in the table below.

HFI 2023 Integrated Feature Type	**Integrated Feature Type Definition**	**HFI 2023 Feature Types Included**
Seismic - Legacy	Formerly referred to as Conventional-Seismic. A discontinued seismic line construction method that used bulldozers to create straight corridors (typically) in forested regions of the province. This is the oldest of all construction methods. Any confirmed seismic line (usually derived from geophysical plans) with an unknown construction method will be assumed to be a legacy line.	Seismic – Legacy
Seismic - LIS	All other geophysical exploration corridors that are not classified as legacy seismic based on construction methods. See Section 4.1 or 5.20 for individual definitions of these feature classes.	Seismic – Avoidance Seismic – Line of Sight Seismic – LIS Seismic – Conventional (Modern) Seismic-Unconfirmed

Rec-Trails	Crown Land Trails published by Alberta Environment and Protected areas as of Apr. 15, 2024. For more information, please visit the Open Government data link	Rec-Trails
Other – Linear-Features	A non-seismic classification indicating the line is either ATS related or has not been identified as any of the existing HFI linear feature types. Linear features that are neither managed as recreational trails under the Crown Land Trails dataset and not verified by other reference datasets.	Other-Linear-Features ATS Related

Standard Operating Protocol (SOP) – EPA/ABMI Human Footprint Inventory (HFI): o20 Seismic Lines, Trails, and Other Linear Features, Version 2.1, 2026

4.3 Roads

The classifications of roads are being reviewed province wide based on newly available information and data provided by various subject matter experts and the GOA. This may result in significant changes in road classifications and road densities in some areas of the province. This also may result in some 'OTHER-LINEAR-FEATURES' within the o20 Seismic Lines, Trails and Other Linear Features sublayer being reclassified as roads. As this is an on going process, the HFI2023 has added two new road feature types which are outlined in the table below.

Feature Type	**Feature Type Definition**
ROAD – VEGETATED	Linear features with an access or road disposition that lack a detectable road surface.
ROAD-VEGETATED-OSE	Linear features that act as access to an Oil Sands Exploration well, yet lack a detectable road surface.

Standard Operating Protocol (SOP) – EPA/ABMI Human Footprint Inventory (HFI): o20 Seismic Lines, Trails, and Other Linear Features, Version 2.1, 2026

5. HFI Sublayers

5.1. (01) Reservoirs

5.1.1. Feature type: RESERVOIR

5.1.1.1 Definitions

General Definition(s):	An artificial lake or storage pond resulting from human-made dam. A body of water created by excavation or the man-made damming of a river or stream

5.1.1.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Different sizes: ranging from the small ones created by damming small streams for a purpose of watering livestock to large water bodies of hydro dams.
Shape	Dam structure (straight or hyperbolic wall) must be visible on reservoirs created on streams and rivers. Sides of the water body are given by topology of the terrain. Storage pond reservoir shape is given by engineers to fulfill specific needs. There is no front wall but all sides of the storage pond are artificially created.
Shadow	No shadow
Colour	May depend on water depth, but usually in gradients of blue and brown
Texture	Fine
Associated Relationship or Context	**Dams** must be in valleys of streams and rivers. **Storm water storage ponds** are located nearby residential areas. **Irrigation storage ponds** are located nearby agriculture along with irrigation structures – canals, pumps.

5.2. (02) Borrow Pits, Sumps, Dugouts, and Lagoons (BPSDL)

5.2.1. Feature types: BORROWPITS, BORROWPIT-DRY, BORROWPIT-WET, RIS-BORROWPITS

5.2.1.1 Definitions

General Definition(s):	Excavation outside of the road right-of-way, made solely for the purpose of removing or providing borrowed material for the construction of the sub-base for a specific roadway project. It includes any other associated infrastructure such as access roads. (*ALBERTA TRANSPORTAITON; GUIDE TO RECLAIMING BORROW EXCAVATIONS – 2013 Edition*). Features are interpreted using various imagery sources and may be misclassified

Feature Type	Specific Definition
BORROWPITS	Includes pits dug for building of roads. They are usually associated with a road or another structure.
BORROWPIT-DRY	Includes pits dug for building of roads. They are usually associated with a road or another structure. No presence of water.
BORROWPIT-WET	Includes pits dug for building of roads. They are usually associated with a road or another structure. Presence of water confirmed by visual interpretation.
RIS-BORROWPITS	Identifies any area disturbed for the purpose of extraction of aggregate materials including gravel pits in oil sand mines area only.

5.2.1.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Usually smaller excavations, quite often smaller than 1 ha.
Shape	Rectangular- or square-shaped structure, occasionally might be triangular or other shape –following terrain topography and engineering design.
Shadow	No shadows
Colour	Depends whether they are dry or filled with water. Brown/Grey/Blue
Texture	Fine / coarser
Associated Relationship or Context	Always located along roadways.

5.2.2. Feature type: SUMP

5.2.2.1 Definitions

General Definition(s):	An artificial holding or treatment pond for industrial wastewater. Drilling waste storage system – holding of drilling waste on well sites or remotely. Either earthen excavation (in clayey soils) or sumps lined with a synthetic liner.

5.2.2.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Smaller to medium size water bodies.
Shape	Usually a rectangular- or square-shaped structure, occasionally might be triangular or other shape –following terrain topography and engineering design. Structural walls might be elevated above surrounding terrain for lined sump.
Shadow	Shadow might be visible if sump walls are elevated above surrounding terrain.
Colour	May depend on water depth, but usually in gradients of blue and brown
Texture	Fine
Associated Relationship or Context	**Sumps** are industrial structures built as part of the water treatment process, so they are usually located nearby industrial sites and well pads. There is usually a single drilling waste storage structure built for a single well pad/industrial site.

5.2.3. Feature type: DUGOUT

5.2.3.1 Definitions

General Definition(s):	Small water storage excavations that collect water from runoff from summer rains, a surplus of surface water that occurs during snowmelt in the spring or from groundwater. *(Alberta Agriculture and Rural Development, QUALITY FARM DUGOUTS).*

5.2.3.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Usually smaller excavations, quite often smaller than 1 ha.
Shape	A rectangular-, square- or elliptical-shaped structure.
Shadow	No shadows
Colour	Depends whether they are dry or filled with water. Brown/Grey/Blue
Texture	Fine / coarser
Associated Relationship or Context	Usually located along pastures, farms and agriculture areas.

5.2.4. Feature type: LAGOON

5.2.4.1 Definitions

General Definition(s): An artificial holding or treatment ponds for agricultural or municipal wastewater. Human made water and sewage lagoons used for municipal purposes.

5.2.4.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Smaller to medium sized water bodies.
Shape	Usually a rectangular- or square-shaped structure, occasionally might be triangular or other shape –following terrain topography and engineering design. Structural walls are usually elevated above surrounding terrain.
Shadow	Shadow might be visible as lagoons are usually elevated above surrounding terrain.
Colour	May depend on water depth, but usually in gradients of blue and brown
Texture	Fine
Associated Relationship or Context	**Lagoons** are municipal structures built as part of water treatment facilities, so they are usually located nearby residential areas and within industrial zones. Many times there are more than two lagoons built by each other creating a cluster of water bodies

5.3. (03) Roads

The classifications of roads are being reviewed based on newly available information and data provided by various subject matter experts and the GOA. This may result in significant changes in road classifications and road densities in some areas of the province. This also may result in some 'OTHER-LINEAR-FEATURES' within the o20 Seismic Lines, Trails and Other Linear Features being reclassified as roads.

5.3.1. Feature types: ROAD-GRAVEL-xx, ROAD-PAVED-xx, ROAD-UNPAVED-xx, etc.

5.3.1.1 Definitions

General Definition(s): Impermeable surfaces used for motorized vehicle or aircraft transportation or access corridors that lack a detectable road surface.

Feature Type	Specific Definition
AIRP-RUNWAY	An active landing facility for aircraft, usually associated with paved and lighted runways, an operating control tower, and services for aircraft and passengers.
INTERCHANGE-RAMP	A series of roadways (ramps) constructed to permit access to and from intersecting paved roads. These ramps are usually at different levels, and form an overpass / underpass.
RIS-AIRP-RUNWAY	Identifies operator owned landing facility for airplanes and related transportation in oil sand mines area only.
RIS-ROAD	Identifies roads that are not specifically part of other disturbed features in oil sand mines area only.
ROAD-GRAVEL-1L	A roadway surfaced with gravel constituting a main access route. The road surface is about 6 metres in width, and the road clearing is about 20 metres or greater in width. The surface, ditches, bridges and intersections are in good condition.
ROAD-GRAVEL-2L	A roadway surfaced with gravel constituting as a main access route. The road surface is 7 metres or greater in width, and the road clearing is 30 metres or greater in width. The surface, ditches, bridges and intersections are in good condition.
ROAD-PAVED-1L	A roadway, paved with asphalt or concrete, consisting of one (1) lane.

ROAD-PAVED-2L	A major roadway, which is paved with asphalt or concrete, and consists of two (2) roadbeds separated by a median. Each road bed usually consists of two (2) or more lanes.
ROAD-PAVED-3L	A major roadway, which is paved with asphalt or concrete, and consists of 3 roadbeds separated by a median.
ROAD-PAVED-4L	A major roadway, which is paved with asphalt or concrete, and consists of 4 roadbeds separated by a median.
ROAD-PAVED-5L	A major roadway, which is paved with asphalt or concrete, and consists of 5 roadbeds separated by a median.
ROAD-PAVED-6L	A major roadway, which is paved with asphalt or concrete, and consists of 6 roadbeds separated by a median.
ROAD-PAVED-7L	A major roadway, which is paved with asphalt or concrete, and consists of 7 roadbeds separated by a median.
ROAD-PAVED-DIV	A major roadway, which is paved with asphalt or concrete, and consists of two (2) roadbeds separated by a median. Each road bed usually consists of two (2) or more lanes.
ROAD-PAVED-UNDIV-1L	A roadway, paved with asphalt or concrete, consisting of one (1) lane, and usually found servicing rural acreages that are close to large urban centres.
ROAD-PAVED-UNDIV-2L	A roadway, paved with asphalt or concrete, and consisting of two (2) adjacent lanes, with no median to separate them.
ROAD-PAVED-UNDIV-4L	A roadway, paved with asphalt or concrete, and consisting of four (4) adjacent lanes, with no median to separate them.
ROAD-UNCLASSIFIED	A temporary coding for an unknown class of road, which will be updated after a field check or verification. (Source: road_album_2.ppt)
ROAD-UNIMPROVED	A roadway surfaced with dirt, which is constituted as a minor access route. The road surface is up to 7 metres in width, and the road clearing is up to 20 metres in width. The surface and ditches are poorly maintained, and the bridges are narrow.
ROAD-UNPAVED-1L	A roadway surfaced with dirt, which is constituted as a minor access route.
ROAD-UNPAVED-2L	A roadway surfaced with dirt, which is constituted as a minor access route.
ROAD-VEGETATED-OSE	Linear features that act as access to an Oil Sands Exploration well, yet lack a detectable road surface.

ROAD – VEGETATED	Linear features with an access or road disposition that lack a detectable road surface.
ROAD-WINTER	A clearing that is vehicular accessible in winter only.
TRUCK-TRAIL	A roadway surfaced with dirt or low vegetation constituting a minor access route.

Details of AHFMP processing steps and user guide are included in these documents:

AHFMP - Road Processing 2014 Footprint.pdf

AHFMP - Road User Guide 2014 Footprint.pdf

5.3.1.2 Interpretation Elements and Rules

Interpretation elements and rules for the different Road sublayer feature types vary from feature type to feature type, and are not listed in detail here. For further information, please refer to the following document:

> Alberta Biodiversity Monitoring Institute. (2019). Human Footprint Inventory Interpretation Guide, Version 1.0. Alberta Biodiversity Monitoring Institute, Geospatial Centre, Human Footprint Mapping Group. July 2019.

5.4. (04) Railways

5.4.1. Feature types: RLWY-ABANDONED, RLWY-DBL-TRACK, RLWY-MLT-TRACK, RLWY-SGL-TRACK, RLWY-SPUR

5.4.1.1. Definitions

General Definition(s): Hard, steel rail lines designed for train use.

Feature Type	Specific Definition
RLWY-ABANDONED	An abandoned road or track for trains, consisting of parallel steel rails, supported on wooden cross beams that are no longer in use.
RLWY-DBL-TRACK	A road or track for trains, consisting of parallel steel rails, supported on wooden cross beams. The Double track consists of two parallel sets of tracks.

RLWY-MLT-TRACK	A road or track for trains, consisting of parallel steel rails, supported on wooden cross beams. A multiple track railway consists of many parallel sets of tracks.
RLWY-SGL-TRACK	A road or track for trains, consisting of parallel steel rails, supported on wooden cross beams. The single track consists of one parallel set of tracks.
RLWY-SPUR	A short length of railway leading off a main line, to a dead end. Spur lines usually lead to a commercial/industrial site, or may be used as a turnaround along a rail line.

5.4.1.2. Interpretation Elements and Rules

Interpretation elements and rules for the different Railways sublayer feature types vary from feature type to feature type, and are not listed in detail here. For further information, please refer to the following document:

> Alberta Biodiversity Monitoring Institute. (2019). Human Footprint Inventory Interpretation Guide, Version 1.0. Alberta Biodiversity Monitoring Institute, Geospatial Centre, Human Footprint Mapping Group. July 2019.

5.5. (05) Canals

5.5.1. Feature type: CANAL

5.5.1.1 Definitions

General Definition(s):	A human-made watercourse built to convey water for irrigation. An irrigation canal is larger than a ditch, with reinforced banks that are usually well maintained. A human-made drainage of network channels built to prepare wetland areas for anthropogenic land use.

5.5.1.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	A linear feature usually up to 40 meters in width with reinforced banks that are usually well maintained.
Shape	Linear
Shadow	No shadow

Colour	Depends whether they are dry or filled with water. Brown/Grey/Blue
Texture	Fine/coarser
Associated Relationship or Context	Located along irrigated cultivation fields

5.6. (06) Verges

5.6.1. Feature types: VEGETATED-EDGE-ROADS, VEGETATED-EDGE-RAILWAYS

5.6.1.1 Definitions

General Definition(s): Disturbed vegetation alongside road edges and railway edges including ditches.

5.6.1.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Linear feature - various widths
Shape	Linear
Shadow	No shadow
Colour	Shades of green
Texture	Fine/coarser
Associated Relationship or Context	Usually located along roads and railways

Details of AHFMP processing steps and user guide are included in these documents:

AHFMP - Road Processing 2014 Footprint.pdf

AHFMP - Road User Guide 2014 Footprint.pdf

5.7. (07) Mine Sites

5.7.1. Feature types: GRVL-SAND-PIT, MINES-COAL, OPEN-PIT-MINE, etc.

5.7.1.1 Definitions

General Definition(s): Human footprint features directly related to mining activities.

Feature Type	Specific Definition
GRVL-SAND-PIT	An area of surface disturbance for the purpose of extracting sand and/or gravel consistently open and/or expanding over multiple years, usually close to lakes or rivers.
MINES-COAL	Heavy industry use with bare and/or vegetated ground and low human density for the purpose of coal mining.
MINES-OILSANDS	Heavy industry use with bare and/or vegetated ground and low human density for the purpose of oil sands mining.
MINES-PITLAKE	Areas of ground where surface water is collected into the existing mine pit usually after mining activity is finished.
OPEN-PIT-MINE	An area of surface disturbance for the purpose of mining (with the exception of sand and/or gravel), consistently open and/or expanding over multiple years, usually close to lakes or rivers.
PEAT	An area of surface disturbance for the purpose of mining peat, consistently open and/or expanding over multiple years, usually in bogs or fens.
RIS-DRAINAGE	Identifies surface disturbance for the purpose of managing surface water features.
RIS-MINES-OILSANDS	Identifies areas where overburden removal has commenced for the purposes of preparing an area for open pit mining and all mine pit features.
RIS-OILSANDS-RMS	Identifies reclamation material stockpiles (RMS). Each RMS may have several material types and corresponding volumes.
RIS-OVERBURDEN-DUMP	Includes all areas where overburden and interburden is placed out-of-pit or in-pit for disposal.

RIS-RECLAIM-READY	Identifies areas where landform construction has been completed and the site is ready for clean cap, subsoil and surface soil placement. This definition is consistent with that used for annual reporting which identifies land "no longer required for mine or plant purposes and available for reclamation but where reclamation activities have not yet commenced.
RIS-RECLAIMED-CERTIFIED	Identifies polygons of reclaimed areas which have received a reclamation certificate.
RIS-RECLAIMED-PERMANENT	Identifies polygons which meet the definition of permanent reclamation - land is considered permanently reclaimed when landform construction and contouring, clean material placement (as required), reclamation material placement and revegetation has taken place.
RIS-RECLAIMED-TEMP	Identifies polygons which meet the definition of temporary reclamation – areas being managed where vegetation has been seeded, planted, or ingressed, where there is an expectation that future disturbance may occur at that location. This does not include cleared areas (planned for future disturbance) that have naturally revegetated through ingress.
RIS-SOIL-REPLACED	Identifies areas which have had subsoil or topsoil placed and which have not been revegetated.
RIS-SOIL-SALVAGED	Identifies areas where soil salvage is occurring but where overburden removal has not commenced.
RIS-TAILING-POND	Identifies all areas associated with tailings including toe berms, dykes, beaches, ponds and drying areas.
RIS-WASTE	Identifies all areas associated with waste and by-product storage on-site.
RIS-WINDROW	Includes areas where a line of reclamation material (soil or vegetation) is heaped up by a machine.
TAILING-PILE	An area used to store waste materials produced in mining processes.
TAILING-POND	Body of water on/in close proximity to an oil sands mine comprising acids, benzene, hydrocarbons, residual bitumen, fine silts, and water.

NOTE: “RIS” features were imported from the Government of Alberta’s Reclamation Information System to the ABMI HFI 2014 dataset, based on a cross-reference table (see Table 3.).

Table 3. Government of Alberta Reclamation Information System cross-reference table, showing the conversions to ABMI HFI feature types.

Reclamation Information System	**ABMI HFI 2014**

Landcover	Feature Type	Feature Type	Sublayer
CLEARED	Cleared other industry	RIS-CLEARING-UNKNOWN	08 Industrial Sites
	<null>	RIS-CLEARING-UNKNOWN	08 Industrial Sites
	Oil sands cleared	RIS-CLEARING-UNKNOWN	08 Industrial Sites
DISTURBED	Aerodrome	AIRP-RUNWAY-ACTIVE	03 Roads
	Borrow pit	RIS-BORROWPITS	02 Borrow Pits, Sumps, Dugouts, Lagoons
	Camp housing	RIS-CAMP-INDUSTRIAL	08 Industrial Sites
	Disturbed other industry	RIS-FACILITY-UNKNOWN	08 Industrial Sites
	Disturbed unclassified	RIS-FACILITY-UNKNOWN	08 Industrial Sites
	Drainage	RIS-DRAINAGE	07 Mine Sites
	<null>	RIS-FACILITY-UNKNOWN	08 Industrial Sites
	Mine pit	RIS-MINES-OILSANDS	07 Mine Sites
	Operations	RIS-FACILITY-OPERATIONS	08 Industrial Sites
	Other	RIS-FACILITY-UNKNOWN	08 Industrial Sites
	Overburden dump	RIS-OVERBURDEN-DUMP	07 Mine Sites
	Pipeline	RIS-PIPELINE	19 Pipelines
	Plant site	RIS-PLANT	08 Industrial Sites
	Powerline	RIS-TRANSMISSION-LINE	13 Transmission Lines
	Ready to reclaim	RIS-RECLAIM-READY	07 Mine Sites
	Reclamation material stockpile (RMS)	RIS-OILSANDS-RMS	07 Mine Sites
	River water intake structure	RIS-RESERVOIR	01 Reservoir
	Road	RIS-ROAD	03 Roads
	Soil placed	RIS-SOIL-REPLACED	07 Mine Sites
	Soil salvaged	RIS-SOIL-SALVAGED	07 Mine Sites
	Tailings	RIS-TAILING-POND	07 Mine Sites
	Tank farm	RIS-TANK-FARM	08 Industrial Sites
	Utilities	RIS-UTILITIES	08 Industrial Sites
	Waste	RIS-WASTE	07 Mine Sites

	Wellsite	RIS-WELL	09 Well Sites Active
	Windrow	RIS-WINDROW	07 Mine Sites
RECLAIMED			07 Mine Sites
	Certified	RIS-RECLAIMED-CERTIFIED	07 Mine Sites
	<null>	RIS-RECLAIMED-UNKNOWN	07 Mine Sites
	Permanent	RIS-RECLAIMED-PERMANENT	07 Mine Sites
	Temporary	RIS-RECLAIMED-TEMP	07 Mine Sites
	Temporary (dam safety)	RIS-RECLAIMED-TEMP	07 Mine Sites

5.7.1.2 Interpretation Elements and Rules

Interpretation elements and rules for the different Mine Sites sublayer feature types vary from feature type to feature type and are not listed in detail here. For further information, please refer to the following document:

> Alberta Biodiversity Monitoring Institute. (2019). Human Footprint Inventory Interpretation Guide, Version 1.0. Alberta Biodiversity Monitoring Institute, Geospatial Centre, Human Footprint Mapping Group. July 2019.

5.8. (08) Industrial Sites

5.8.1. Feature types: CAMP-INDUSTRIAL, OIL-GAS-PLANT, MILL, MISC-OIL-GAS-FACILITY, etc.

5.8.1.1 Definitions

General Definition(s): Human footprint features related to various industrial activities.

Feature Type	Specific Definition
CAMP-INDUSTRIAL	Buildings used for temporary residence by employees on or in close proximity to an industrial activity such as mining, forestry, or oil and gas activities.
CLEARING-UNKNOWN	A human-made clearing with unknown purposes and contains no visible buildings, fences or equipment.
CLEARING-WELLPAD-UNCONFIRMED	Roughly square in shape clearing, roughly 90-120 meters wide (approximately 1 ha). Not confirmed as a well pad by available reference sources.

FACILITY-OTHER	Industrial facilities characterized by large non-residential buildings most often surrounded by concrete for parking purposes. The purpose of the facility is not disclosed.
FACILITY-UNKNOWN	Industrial facilities characterized by large non-residential buildings most often surrounded by concrete for parking purposes. The purpose of the facility is unknown.
MILL	Intense industrial and commercial development for the purpose of pulp or paper production.
MISC-OIL-GAS-FACILITY	Industrial facility used for the purpose of oil and gas. BATTERY SITE, COMPRESSOR SITE, FLARE STACK, METER STATION SITE, VALVE SITE
OIL-GAS-PLANT	Industrial facility used for oil production. REFINERIES, PLANTS, FACTORIES
RIS-CAMP-INDUSTRIAL	Identifies areas disturbed for the purposes of housing camp workers.
RIS-CLEARING-UNKNOWN	Identifies all areas where vegetation has been removed for the purposes of preparing the land for drainage, soil removal, overburden removal, mining, etc. but where soil has been left mostly intact and relatively undisturbed. May include any or all of: tree removal, shrub removal, and/or grubbing (stump removal). Identifies areas cleared for by other industries and not for the purposes of forest harvesting or for oil sands development.
RIS-FACILITY-OPERATIONS	Designated for areas which are not part of the plant site, e.g., may include laydown areas not integrated with the main plant site(s), tailings lines, water lines, compressor station, buildings away from the main plant site, flare stack, communications tower.
RIS-FACILITY-UNKNOWN	Identifies areas where the reclamation liability associated with the disturbance is currently held by another industry operator.
RIS-PLANT	Includes areas associated with extraction, processing, upgrader. Plant sites may have multiple non-contiguous polygons.
RIS-TANK-FARM	Identifies areas where products of extraction or upgrading are stored. Products stored for on-site use can be identified under plant site or operations.
RIS-UTILITIES	Identifies areas specifically disturbed for the purposes of utilities (power generation).
URBAN-INDUSTRIAL	An industrial facility within the boundary of an urban residence.

NOTE: “RIS” features were imported from the Government of Alberta’s Reclamation Information System to the ABMI HFI 2014 dataset, based on a cross-reference table (see Table 3.).

5.8.1.2 Interpretation Elements and Rules

Interpretation elements and rules for the different Industrial Sites sublayer feature types vary from feature type to feature type, and are not listed in detail here. For further information, please refer to the following document:

> Alberta Biodiversity Monitoring Institute. (2019). Human Footprint Inventory Interpretation Guide, Version 1.0. Alberta Biodiversity Monitoring Institute, Geospatial Centre, Human Footprint Mapping Group. July 2019.

5.9. (09) Well Sites Active

5.9.1. Feature types: WELL-BITUMEN, WELL-OIL, WELL-GAS, WELL-CASED, etc.

5.9.1.1 Definitions

General Definition(s):	Ground cleared for an oil/gas well pad where at least one well is currently active. For additional information on wellsite attribution please see Table 14.

Feature Type	Specific Definition
WELL-BITUMEN	Well site - ground cleared for a bitumen well pad.
WELL-CASED	Well site - ground cleared and well cased.
WELL-CLEARED-DRILLED	Well site - confirmation of drilling and the boundary outline is provided by reference sources.
WELL-CLEARED-NOT-CONFIRMED	Well site - confirmation of the boundary outline is not provided by reference sources.
WELL-CLEARED-NOT-DRILLED	Well site - confirmation of the boundary outline is provided by reference sources.
WELL-DRILLED-OTHER	Well site - confirmation of drilling is provided by reference sources.
WELL-GAS	Well site - ground cleared for a gas well pad.
WELL-OIL	Well site - ground cleared for an oil well pad.
WELL-OTHER	Well site - clearing, purpose is unknown.
WELL-UNKNOWN	Well site - ground cleared, well status unknown or license location

NOTE: “RIS” features were imported from the Government of Alberta’s Reclamation Information System to the ABMI HFI 2014 dataset, based on a cross-reference table (see Table 3.).

Details of AHFMP processing steps and User Guide are included in these documents:

AHFMP - Well Pad Procedures for 2014 Footprint.pdf

AHFMP - Well Pad User Guide 2014 Footprint.pdf

5.9.1.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Various sizes
Shape	Various shapes
Shadow	No shadow
Colour	Grey/brown/green
Texture	Coarse

5.10. (10) Landfills

Historical Landfills (Table 16) was utilized across the province and it will be further implemented in future HFI years.

5.10.1. Feature types: LANDFILL, TRANSFER_STATION

5.10.1.1 Definitions

General Definition(s):	Human footprint used for the transportation, storage, and disposal of waste/garbage

Feature Type	Specific Definition
LANDFILL	Larger area of raised land, indicating buried garbage. Some landfills have evidence of surface revegetation and garbage dispersed throughout designated extent. They may also have large perimeter berms or fences.
TRANSFER_STATION	Smaller area of land, less than one hectare, usually fenced with a U-shaped road and two entry ways. Used primarily for garbage drop-off and located close to municipalities or present in rural areas.
UNVERIFIED_LANDFILL	Disturbance identified as a landfill by the Historic Landfill data (Table 12) but could not yet be confirmed by subject matter experts or imagery.

5.10.1.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Various sizes, often larger polygons of landfills than transfer stations
Shape	Often a rectangular- or square-shaped structure
Shadow	No shadow
Colour	Various colours
Texture	Fine/coarser
Associated Relationship or Context	Usually located in proximity to residential areas

5.11. (11) Other Vegetated Surfaces

5.11.1. Feature types: CAMPGROUND, GOLFCOURSE, GREENSPACE, etc.

5.11.1.1 Definitions

General Definition(s): Human footprint related to vegetated facilities and recreation.

Feature Type	Specific Definition
CAMPGROUND	Disturbed vegetation with frequently changing facilities of RVs and tents used for overnight stay. Most often consists of several individual clearings surrounded by vegetation and gravel or asphalt roads connecting clearings.
GOLFCOURSE	Large recreational area comprising a series of grass patches surrounded by trees.
GREENSPACE	Greenspace used for recreation within a residential area including parks, schools, school yards and sport fields.
RECREATION	Urban/rural greenspace and recreation that does not fit into other categories (e.g. graveyards, baseball diamonds, parks, shelterbelts, ski hills, clearings from old industrial activity that is now vegetated). This layer was also used to identify green-space features that do not fit into other categories such as storage areas and parking lots.
RUNWAY	Vegetated runway.
SURROUNDING-VEG	Disturbed vegetation surrounding airport runways, highway ramps and other industrial features.

5.11.1.2 Interpretation Elements and Rules

Interpretation elements and rules for the different Other Vegetated Surfaces sublayer feature types vary from feature type to feature type, and are not listed in detail here. For further information, please refer to the following document:

> Alberta Biodiversity Monitoring Institute. (2019). Human Footprint Inventory Interpretation Guide, Version 1.0. Alberta Biodiversity Monitoring Institute, Geospatial Centre, Human Footprint Mapping Group. July 2019.

5.12. (12) Wind Generation Facilities

5.12.1. Feature Type: WINDMILL

5.12.1.1 Definitions

General Definition(s):	Structures designed and built for the purposes of generation of wind energy.

5.12.1.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Various sizes
Shape	Often a rectangular- or square-shaped structure for land cover disturbance. Turbine structure visible for finished facilities
Shadow	Tower and turbine shadows.
Colour	Steel colours
Texture	Individual structure of turbine visible
Associated Relationship or Context	Usually clustered into “wind energy farms”

5.13. (13) Transmission Lines

5.13.1. Feature types: TRANSMISSION-LINE, RIS-TRANSMISSION-LINE

5.13.1.1 Definitions

General Definition(s):	Cleared corridors designated for the location of power transmission line infrastructure.

Feature Type	Specific Definition
TRANSMISSION-LINE	A utility corridor >10 m wide with poles, towers and lines for transmitting high voltage electricity (voltage greater than 69 kV).
RIS-TRANSMISSION-LINE	Include the right of way area designated for the power line.

5.13.1.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Linear shape – corridor in landscape. Tower structure visible
Width	Buffered to 19 m - each side from the centerline (38 m in total width of the corridor) for AHFMP and BASEFE features. Buffered to measured width for features in HFI 2014 and onward.
Shadow	Tower shadows.
Colour	Shades of green or brown/grey depending on vegetation cover of the corridor
Texture	Usually finer texture as a result even vegetation on the corridor
Associated Relationship or Context	Corridor connects energy users with energy providers

5.14. (14) Confined Feeding Operations (CFO)

Natural Resource Conservation Board (NRCB) (Table 16) was utilized across the province to verify and add new Confined Feeding Operations, and it will be further implemented in future HFI years.

5.14.1. Feature type: CFO

5.14.1.1 Definitions

General Definition(s): Confined feeding operations and other high density livestock features.

5.14.1.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Various sizes
Shape.	Often regular shape.
Shadow	Shadows of building and facilities associated with CFO features
Colour	Various colours
Texture	Usually coarser texture
Associated Relationship or Context	Usually in proximity of farm fields, residential or industrial features

5.15. (15) Urban and Rural Residential

5.15.1. Feature type: COUNTRY-RESIDENCE

5.15.1.1 Definitions

General Definition(s): Country-residential developments with density of 10 - 100 buildings per quarter section.

5.15.1.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Minimum size of the polygon should be 0.4 Ha (1 Acre) in case one country-residential property creates an acreage polygon. More often – multiple country-residential developments are captured into one polygon therefore maximum size of polygon is not limited
Shape.	Multi-vertices polygons, where boundaries follow property lines, fences, clearings of country-residential development
Shadow	No shadow
Colour	No unique colours
Texture	No unique texture
Associated Relationship or Context	**Country residential areas** are often grouped together with a road system as a backbone of such residential development.

5.15.2. Feature type: RURAL-RESIDENCE

5.15.2.1 Definitions

General Definition(s):	Rural-residential developments with density of less than 10 buildings per quarter section.

5.15.2.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Various sizes. Usually one polygon per rural residence
Shape.	Multi-vertices polygons, where boundaries follow property lines, fences, clearings of rural-residential development
Shadow	No shadow
Colour	No unique colours
Texture	No unique texture
Associated Relationship or Context	**Rural residences** are often isolated by other human footprint types (cultivation) or native landscape (lodges). They are connected to the other areas by access road

5.15.3. Feature type: URBAN-RESIDENCE

5.15.3.1 Definitions

General Definition(s):	Residential areas in cities, towns, villages, hamlets and ribbon developments. Areas that are dominated by dwellings.

5.15.3.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Various sizes. Usually one polygon per urban residence

Shape	Multi-vertices polygons, where boundaries follow property lines, fences, clearings of urban-residential development
Shadow	No shadow
Colour	No unique colours
Texture	No unique texture
Associated Relationship or Context	**Urban residences** are often surrounded by other human footprint types (recreational –GREENSPACE, industrial – URBAN-INDUSTRIAL)

5.15.4. Feature type: RESIDENCE_CLEARING

5.15.4.1 Definitions

General Definition(s): Areas cleared for building developments that do not yet have any buildings

5.15.4.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Various sizes. Usually one polygon per residence clearing
Shape.	Multi-vertices polygons, where boundaries follow property lines, fences, clearings of residential development
Shadow	No shadow
Colour	No unique colours
Texture	No unique texture
Associated Relationship or Context	**Residence clearings** are often in the vicinity of existing urban residence

5.16. (16) Well Sites Abandoned

5.16.1. Feature type: WELL-ABAND

5.16.1.1 Definitions

General Definition(s): Ground cleared for an oil/gas well pad where the well is currently abandoned. For additional information on wellsite attribution please see Table 14.

Details of AHFMP processing steps and User Guide are included in these documents:

AHFMP - Well Pad Procedures for 2014 Footprint.pdf

AHFMP - Well Pad User Guide 2014 Footprint.pdf

5.16.1.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Various sizes
Shape	Various shapes
Shadow	No shadow
Colour	Brown/green
Texture	Coarse

5.17. (17) Cultivation

5.17.1. Feature type: CROP

5.17.1.1 Definitions

General Definition(s): Cultivated cropland or cropland planted with annual crop species, including farmlands that are in cultivation rotation.

Cropland includes: **small grains** (wheat, barley, oats and mixed grains), **oilseeds** (canola, flax), **specialty crops** (peas, lentils), **row crops** (potatoes, sugar beets, corn, vegetables).

Fallow describes areas used for the production of the crops that do not exhibit visible vegetation as the result of being cultivated.

5.17.1.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Variable size from smaller fields, usually next to a rural residential area, up to very large polygons covering multiple townships

Shape.	Often a rectangular, square or multi-vertex shape with distinct round corners as a result of active cultivation by agricultural equipment and machinery Circular shape for irrigated crop fields
Shadow	No shadows
Colour	Variable - depending on type of the cropland and imagery acquisition date
Texture	Consistent smooth, fine texture for cropland / coarser texture for fallow
Structure:	Often visible tillage lines as a result of active cultivation by agricultural equipment (field cultivator, disk and plow)
Associated Relationship or Context	No evidence of grazing as livestock are restricted from these fields during the growing season

5.17.2. Feature type: TAME_PASTURE

5.17.2.1 Definitions

General Definition(s):	Lands where the soil has been disturbed and planted to perennial grass species used primarily for grazing livestock. Tame pasture represents areas of grasses, legumes or grass-legume mixtures planted for livestock grazing or hay collection.

5.17.2.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Variable size from smaller fields, usually next to a rural residential area, up to very large polygons covering multiple townships
Shape.	Often a rectangular, square or multi-vertex shape with distinct round corners as a result of active cultivation by agricultural equipment and machinery Circular shape for irrigated hay fields
Shadow	No shadows
Colour	Variable - depending on the type of the pasture (grazing/hay) and imagery acquisition date
Texture	Coarser texture compared to the crop
Structure	Often visible hay collection lines or hay bales

Associated Relationship or Context	Evidence of grazing by livestock – trails, dugouts

5.17.3. Feature type: ROUGH_PASTURE

5.17.3.1 Definitions

General Definition(s):	Lands where the forest and/or shrubs have been removed so that native or introduced grasses can flourish for the grazing of livestock. This pastureland has not been irrigated or fertilized and the soil has not been disturbed to improve productivity.

5.17.3.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Variable
Shape.	Variable
Shadow	No shadows
Colour	Usually shades of green - depending on imagery acquisition date
Texture	Coarser texture for new clearings, smoother for old ones
Structure	There might be remains of cleared wood/shrub lands on new clearings– wood piles, timber
Associated Relationship or Context	Usually still surrounded by forest or wooded/shrubby remains. Quite often nearby existing farmland and crop/tame pasture fields

5.17.4. Feature type: CULTIVATION_ABANDONED

5.17.4.1 Definitions

General Definition(s):	Agricultural land that has been formally seeded and tilled, but no evidence of present day production use. Landscape appears to have a heterogeneous mix of vegetation and closely resembles natural cover.

5.17.4.2 Interpretation Elements and Rules

A standard set of interpretation elements and rules for CULTIVATION_ABANDONED are not available at this time.

5.17.5. Feature type: FRUIT-VEGETABLES

5.17.5.1 Definitions

General Definition(s):	Agriculture and Agri-Food Canada (AAFC) 2014 Crop Types: Vegetables, Tomatoes, Potatoes, Sugar beets, Other Vegetables, Fruits, Berries, Blueberry, Cranberry, Other Berry, Orchards, Other Fruits, Herbs. HFI_2014 dataset cultivation Feature Types were based on AAFC 2014 classification (ISO 19131 AAFC Annual Crop Inventory, Agriculture and Agri-food Canada, 2014). AAFC 2014 classification crop types were overlaid onto HFI_2014 polygons and area coverage of individual AAFC crop types within HFI polygon was computed. Cross-referencing all cultivation polygons to Crop Type values based on AAFC 2014 classification is displayed in Table 4

Details of AHFMP processing steps and User Guide are included in these documents:

AHFMP_Cultivation_User_Guide_Footprint_HFI_2014FTv2.pdf

AHFMP_Cultivation_User_Guide_HFI_2014.pdf

Details about AAFC 2014 processes are available in this document:

ISO 19131_AAFC_Annual_Crop_Inventory_Data_Product_Specifications.pdf

IMPORTANT:

New cultivation features created by heads-up digitization ([SOURCE] either ABMI15, ABMI16, ABMI17, ABMI18, ABMI19, or ABMI20) were attributed based on visual interpretation of SPOT6 satellite natural color composite mosaics. Current HFI2023 dataset has not included a reattribution of existing HFI_2014 cultivation Feature Types to status of circa 2023.

Table 4. Cross-reference table used to convert the AAFC2014 labels into ten ABMI human footprint feature types for the HFI2014 product

AAFC	ABMI HFI 2014	AAFC
Code	Label	Code
10	Cloud	10
20	Water	HYDRO

30	Exposed Land and Barren	NATIVE-NATURAL
34	Urban and Developed	URBAN-INDUSTRIAL
35	Greenhouses	NA
50	Shrubland	NATIVE-NATURAL
80	Wetland	WETLAND
110	Grassland	NATIVE-NATURAL
120	Agriculture	CROP
122	Pasture and Forages	TAME-PASTURE
130	Too Wet to be Seeded	CROP-WETLAND
131	Fallow	CROP
132	Cereals	CROP
133	Barley	CROP
134	Other Grains	CROP
135	Millet	CROP
136	Oats	CROP
137	Rye	CROP
138	Spelt	CROP
139	Triticale	CROP
140	Wheat	CROP
141	Switchgrass	TAME-PASTURE
145	Winter Wheat	CROP
146	Spring Wheat	CROP
147	Corn	CROP
148	Tobacco	CROP
149	Ginseng	AGRICULTURE-OTHER
150	Oilseeds	CROP
151	Borage	CROP
152	Camelina	CROP
153	Canola and Rapeseed	CROP
154	Flaxseed	CROP
155	Mustard	CROP

156	Safflower	CROP
157	Sunflower	CROP
158	Soybeans	CROP
160	Pulses	CROP
162	Peas	CROP
167	Beans	CROP
174	Lentils	CROP
175	Vegetables	FRUIT-VEGETABLES
176	Tomatoes	FRUIT-VEGETABLES
177	Potatoes	FRUIT-VEGETABLES
178	Sugarbeets	FRUIT-VEGETABLES
179	Other Vegetables	FRUIT-VEGETABLES
180	Fruits	FRUIT-VEGETABLES
181	Berries	FRUIT-VEGETABLES
182	Blueberry	FRUIT-VEGETABLES
183	Cranberry	FRUIT-VEGETABLES
185	Other Berry	FRUIT-VEGETABLES
188	Orchards	FRUIT-VEGETABLES
189	Other Fruits	FRUIT-VEGETABLES
190	Vineyards	AGRICULTURE-OTHER
191	Hops	AGRICULTURE-OTHER
192	Sod	AGRICULTURE-OTHER
193	Herbs	FRUIT-VEGETABLES
194	Nursery	AGRICULTURE-OTHER
195	Buckwheat	CROP
196	Canaryseed	CROP
197	Hemp	CROP
198	Vetch	TAME-PASTURE
199	Other Crops	AGRICULTURE-OTHER
200	Forest	NATIVE-NATURAL
210	Coniferous	NATIVE-NATURAL

220	Broadleaf	NATIVE-NATURAL
230	Mixedwood	NATIVE-NATURAL

5.17.5.2 Interpretation Elements and Rules

A standard set of interpretation elements and rules for FRUIT-VEGETABLES are not available at this time.

5.18. (18) Timber Harvest and Woody Vegetation Removal

The timber harvesting classifications will have the highest accuracy in the Green Area of the province and on provincial crown land in the White Area where regulatory data can assist with identification. Additional reference data for Timber Harvest may be introduced for future HFI's which may affect attribution for this sublayer. The removal of trees on private land, Metis Settlements and First Nation Reserves cannot be confirmed as timber harvesting since ABMI must rely solely on imagery. These clearings may be due to other activities.

5.18.1. Feature types: TIMBER-HARVEST-GREEN-AREA, TIMBER-HARVEST-WHITE-AREA, WOODY-VEGETATION-REMOVAL

5.18.1.1 Definitions

General Definition(s): Areas where woody vegetation has been removed either by the forestry industry (clear-cut, selective harvest, salvage logging, etc.) or by private landowners and municipalities

Feature Type	Specific Definition
TIMBER-HARVEST-GREEN-AREA	Areas in Alberta's forested Green Area where forestry operations have occurred (clear-cut, selective harvest, salvage logging, etc.).
TIMBER-HARVEST-WHITE-AREA	Areas in Alberta's unforested White Area where forestry operations have occurred (clear-cut, selective harvest, salvage logging, etc.)
WOODY-VEGETATION-REMOVAL	Areas in Alberta's unforested White Area where woody vegetation (i.e., shrubs, trees, etc.) has been cleared for purposes unrelated to the forestry industry (e.g. by private landowners or municipalities for fence line clearings, property development etc.)

Standard Operating Protocol (SOP) – EPA/ABMI Human Footprint Inventory (HFI): HFI o18_HarvestAreas_and_WoodyVegetationRemoval (2024)

IMPORTANT:

TIMBER HARVEST might include areas that have been cleared for another purpose than timber harvesting (i.e. agricultural use, residential, mine and industrial areas expansion.)

TIMBER HARVEST [YEAR] value is the best estimation of the year when the area was harvested. It has been determined by:

- heads up digitization for years 1950, 1980, 2000, and 2005 to 2023,
- combination of reference data values and remote sensing analysis for years prior to 2013

5.18.1.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Variable
Shape.	Variable
Shadow	No shadows
Colour	Usually shades of green - depending on imagery acquisition date
Texture	Coarser texture for new clearings, smoother for older ones
Associated Relationship or Context	Usually still surrounded by forest or wooded/shrubby remains.

5.19. (19) Pipelines

5.19.1. Feature type: PIPELINE

5.19.1.1 Definitions

General Definition(s): A line of underground and overground pipes, of substantial length and capacity, used for the conveyance of petrochemicals.

The physical clearing that contains underground and above-ground high pressure pipelines.

These clearings may contain one or multiple pipelines.

IMPORTANT:

The Pipeline feature class was created by the Geographic Science Team (GScT) of Alberta Environment and Protected Areas for the Alberta Human Footprint Monitoring Program (AHFMP). The data is used to monitor the total area of pipeline corridors in the province of Alberta. The data is an *estimate* of the high-pressure pipelines in the province and is not suitable for locating pipelines on the ground. The data will also contain some low-pressure pipelines. A pipeline corridor is defined by the AHFMP as any linear disturbance created for the purpose of constructing and maintaining pipelines. The pipeline verge estimates the extent of the direct physical disturbance of the pipeline corridor whether it is visible or not on imagery. The verges were derived from the Digitally Integrated Dispositions (DIDs), Rural Cadastral pipeline right of ways and from manual digitizing using SPOT imagery. Some verges were also buffered using the estimated pipeline centre lines within the pipeline centre line feature class. The Alberta Energy Regulator (AER) pipeline dataset was

used as reference to locate the pipeline corridors. The data was designed specifically for monitoring human footprint and may not be suitable for some cartographic purposes.

Data created by Alberta Human Footprint Monitoring Program (AHFMP) was consequently modified by ABMI. Digitized pipelines interpreted from satellite imagery (year 2017) were added to the source dataset to create the final HFI sublayer that represents estimated status of pipelines up to year 2017.

Pipelines might include corridors that contain pipelines built for another purpose than the conveyance of petrochemicals, e.g. municipal water.

Details of AHFMP processing steps and user guide are included in these documents:

AHFMP - Pipeline Procedures Manual for 2016 Footprint - Ver 3.pdf

AHFMP - Pipeline User Guide for 2016 Footprint - Ver 2.pdf

5.19.1.2 Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Variable
Shape.	Variable
Shadow	No shadows
Colour	Shades of green or brown/grey depending on vegetation cover of the corridor
Texture	Usually finer texture as a result even vegetation on the corridor
Associated Relationship or Context	Corridor connects energy users with energy providers

5.20. (20) Seismic Lines, Trails and Other Linear Features

HFI 2023 classifications within this sublayer have been changed to match the standards of the Government of Alberta's Cutline and Trail Attribution Project (CTAP) and be more in line with government and industry terminology. These classifications are based on the construction method of the seismic line and determined by consultation with various subject matter experts (SME) and newly available regulatory and industry data. Regulatory and industry data related to seismic lines were used to identify, date, classify and determine the reported width of the seismic lines. These datasets included the Exploration Application System (ExAS), hardcopy geophysical plans and Seismic Data Listing Service (SDLS). SDLS data was obtained by the GoA and transferred to the HFI data by the GoA through the CTAP program. The SDLS year of origin may have been superseded by other construction year sources.

Seismic line dates within the Green Area were obtained from the Seismic Data Listing Service (SDLS), a private vendor specializing in seismic data. The Government of Alberta (GoA) obtained these dates for the Green Area through the Cutline and Trail Attribution Project (CTAP). With SDLS permission, the GoA transferred the original construction dates (the year each line was created) from CTAP to the seismic lines in the Human Footprint Inventory (HFI), with the date source attributed as 'SDLS.'

The SDLS dates provide the best available dates for seismic lines built prior to 2002 other than the limited use of the older regulatory data. The SDLS dates also help confirm that a linear feature is a seismic line, so both the date and line classification sources are attributed to SDLS.

For detailed information on specific seismic lines, including potential reuse by other seismic programs, visit sdlsinc.com.

5.20.1. Feature types: SEISMIC-LEGACY, SEISMIC-AVOIDANCE, SEISMIC-LINE-OF-SIGHT, SEISMIC-LIS, SEISMIC-CONVENTIONAL-MODERN, SEISMIC-UNCONFIRMED, FIRE-GUARD, ATS-RELATED, REC-TRAIL, OTHER-LINEAR-FEATURES

5.20.1.1 Definitions

General Definition: Linear corridors that have been cleared for varying uses including geophysical exploration (i.e., multiple types of seismic lines), Alberta Township Survey quarter section boundaries, fire deterrent, recreational trails, and other linear corridors not yet verified by reference datasets. Excludes all railways, transmission lines, pipelines, and most roads.

Feature Type	Definition
SEISMIC-LEGACY	Formerly referred to as Conventional-Seismic. A discontinued seismic line construction method that used bulldozers to create straight corridors (typically) in forested regions of the province. This is the oldest of all construction methods. Any confirmed seismic line (usually derived from geophysical plans) with an unknown construction method will be assumed to be a legacy line.
SEISMIC-AVOIDANCE	A discontinued construction method that used small bulldozers in a meandering pattern to minimize timber damage with narrower lines and less duff disturbance than Legacy lines. This method evolved into Low-Impact Seismic (LIS) techniques and both techniques coexisted for about 10 years. Avoidance lines have not been fully identified in the HFI data.
SEISMIC-LINE-OF-SIGHT	A discontinued method where straight, hand-cut lines were cut to create a line of sight for optical survey equipment.
SEISMIC - LIS	A meandering, mulcher or hand-cut lines, with very little duff disturbance. LIS lines prior to 2000 were created with small bulldozers or hand cut and were slightly wider. LIS lines have not been fully identified or digitized in the HFI data.
SEISMIC-CONVENTIONAL-MODERN	This method allows for slightly straighter and wider lines compared to LIS. It is intended for situations requiring wider lines or in areas of dense timber where avoidance was not feasible. The increased straightness helps minimize timber damage relative to longer, more sinuous lines. However, as most conventional lines are now constructed using the same techniques as LIS, the physical characteristics of this method are more closely related to LIS.
SEISMIC-UNCONFIRMED	A temporary seismic classification used for seismic lines dated 2002 onwards until the line is verified by regulatory data
FIRE-GUARD	Bulldozer lines created as fuel breaks along or near the perimeter of wildfires. These lines can sometimes be found within the fire perimeter if the fire burns past the line. This data is not complete.

ATS-RELATED	A line found along a surveyed quarter section or section boundary from the Alberta Township Survey (ATS). These are most prevalent in and near the White Area. These lines can be the result of any combination of activities such as cleared property boundary, road allowance, older survey lines, fence lines or seismic line.
REC-TRAIL	Crown Land Trails published by Alberta Environment and Protected areas as of Apr. 15, 2024. For more information, please visit the Crown Land Trails - Open Government data link.
OTHER-LINEAR-FEATURES	A non-seismic classification indicating the line has not been identified as any of the existing HFI linear feature types. Linear features that are neither managed as recreational trails under the Crown Land Trails dataset and not verified by other reference datasets.

Standard Operating Protocol (SOP) – EPA/ABMI Human Footprint Inventory (HFI): o20 Seismic Lines, Trails, and Other Linear Features, Version 2.1, 2026

5.20.2. Integrated HFI Feature Types

To simplify HFI feature types within the integrated version certain features in the sublayer have been grouped together. This is shown by the table below.

5.20.2.1 Definitions

Integrated Feature Type	Integrated Definition	Feature Types Included
SEISMIC-LEGACY	Formerly referred to as Conventional-Seismic. A discontinued seismic line construction method that used bulldozers to create straight corridors (typically) in forested regions of the province. This is the oldest of all construction methods. Any confirmed seismic line (usually derived from geophysical plans) with an unknown construction method will be assumed to be a legacy line.	Seismic – Legacy
SEISMIC - LIS	All other geophysical exploration corridors that are not classified as legacy seismic based on construction methods. See previous table for individual definitions of these feature types.	Seismic – Avoidance Seismic – Line of Sigh Seismic – LIS Seismic – Conventional (Modern) Seismic-Unconfirmed
REC-TRAIL	Crown Land Trails published by Alberta Environment and Protected areas as of Apr. 15, 2024. For more information, please visit the. Open Government data link.	Rec-Trails
OTHER-LINEAR-FEATURES	A non-seismic classification indicating the line is either ATS related or has not been identified as any of the existing HFI linear feature types. Linear features that are neither managed as recreational trails under the Crown Land Trails dataset and not verified by other reference datasets.	Other-Linear-Features ATS Related

Standard Operating Protocol (SOP) – EPA/ABMI Human Footprint Inventory (HFI): o20 Seismic Lines, Trails, and Other Linear Features, Version 2.1, 2026

5.20.3. Seismic Line Width Buffering

The line widths in the footprint data are based on the constructed width (direct physical disturbance) of the seismic lines, which can differ from the corridor width as corridor width accounts for natural spacing between trees. Table 5 displays how the construction method of a seismic line is associated with the width of the line in the HFIe2023.

Constructed Width - The width of the direct physical disturbance created when the seismic line was constructed. This width is often obtained from the regulatory data. It can also be obtained through consultation with subject matter experts.

Corridor Width - It is the full width of the line from tree trunk to tree trunk. It includes the constructed width plus any natural spacing between trees. In younger, dense stands there may be very little difference between corridor and constructed widths. However, in older mature timber, there can be a significant difference between the two measurements.

Buffered Width - The width applied by GIS post processing methods to seismic lines based on reported constructed width from regulatory data, where available, or from assigned values (expert opinion, Table 5) where reference data are not available.

Table 5. Construction methods of seismic lines and their associated buffer widths in the HFIe 2023.

Construction Method	Classification Source	Era	Current Status	Total Buffer Width	Cut Method	Survey Method
SEISMIC-LEGACY	Final Plan, SDLS, Interpreted	~1940 to ~2002	Discontinued	<1980: 8m >= 1980: 6m	Bulldozer	Optical
SEISMIC-AVOIDANCE	Final Plan	~1988 to 1999	Discontinued	5m	Small Bulldozer	Optical, Differential GPS
SEISMIC-LINE-OF-SIGHT	EXAS	Unknown to 2025	Discontinued	EXAS (1.3-5m)	Hand Cut	Optical
SEISMIC - LIS	Final Plan, Interpreted	1990 to 2000	Cut Method Discontinued	4m	Small Bulldozer	Optical, Differential GPS
SEISMIC - LIS	EXAS	2000 to present	Active	EXAS 1.8 or 2.8m*	Mulcher, Hand Cut	Uncorrected GPS
SEISMIC-CONVENTIONAL-MODERN	EXAS	2000 to 2025	Not known	EXAS 1.8 or 2.8*	Mulcher, Small Bulldozer, Hand Cut	Uncorrected GPS

Standard Operating Protocol (SOP) – EPA/ABMI Human Footprint Inventory (HFI): o20 Seismic Lines, Trails, and Other Linear Features, Version 2.1, 2026

*SEISMIC - LIS and SEISMIC – CONVENTIONAL – MODERN will range from 1.8 metres on receiver lines to 2.8 metres on source and combination lines. However, there will be outliers where a wider line width has been reported to the regulator and has been included in this data.

5.20.4. HFI Attributes

Attribution for this sublayer retains the original, and now archived, feature type, source, year and year source from the HFI2022. It also includes the new feature type and source, year and year source, width and, for the first time, width source. How the attributes will appear in the attribute table can be seen below. 'ARCHIVED_YEAR' and 'ARCHIVED_YEAR_SOURCE' are from the HFI2022 and are based on Pulse Seismic data, Historical Orthophotos and SPOT imagery. 'YEAR' and 'YEAR_SOURCE' are taken from CTAP data utilizing regulatory and industry data from SDLS where available. Where not available Pulse Seismic, Historical Ortho and SPOT imagery dates were used.

Attribute	Definition
ARCHIVED_FEATURE_TY	Original HFI feature type, last used in HFI2022 and now archived
ARCHIVED_SOURCE	Original HFI Source, last used in HFI2022 and now archived
ARCHIVED_YEAR	Original feature's construction year or first year disturbance was seen in imagery, or from Pulse Seismic reference data obtained prior to 2023. Last used in HFI222 and now archived.
ARCHIVED_YEAR_SOURCE	Source for the original construction year, last used in HFI2022 and now archived
HFI_ID	Unique alpha-numeric feature identifier
FEATURE_TY	Current type or category of HFI feature. For sublayer 20, this feature classification replaces "ARCHIVED_FEATURE_TY"
SOURCE	The source of the feature in the dataset
YEAR	An integer number representing the feature's "year of origin": the construction year or first year disturbance was seen in imagery. The value is either from regulatory and industry sources or based on imagery year. YEAR value has not been determined for all features.
YEAR_SOURCE	The source from which the feature's YEAR attribute (i.e., "year of origin") was determined.
WIDTH	The lines constructed width (total width)
WIDTH_SOURCE	The source used to determine the feature's width

Disclaimer:

Seismic lines, Trails and Other Linear Features currently available in the ABMI's HFIeOSM2023 are not complete representation of the seismic lines existing on the land surface. The ABMI's sampling scale Temporal Human Footprint dataset (THF) should be used for a more detailed representation of this sublayer.

Please do not use the centreline or polygonal sublayers in their raw form to estimate the remaining seismic lines in the province. These layers represent a cumulative collection of seismic lines and other linear disturbances, many of which have been subsequently replaced by other anthropogenic land uses. Using these sublayers

without accounting for overlapping land use will significantly overestimate the total length and area of remaining seismic lines to obtain a more accurate estimate, intersect the seismic line sublayers with the integrated human footprint layer and erase any overlapping features before calculating the remaining seismic lines.

This sublayer contains seismic and non-seismic features. When reporting on seismic lines, please ensure to separate the non-seismic features from the data to avoid over reporting of mapped seismic lines. As indicated by Feature Types starting with 'Seismic'.

Due to the number of features, limited access to regulatory data and changes in disturbance, this dataset is intended for landscape-level analysis. If you plan to use it for field plot selection or to study specific seismic line types, please contact the ABMI. You will be placed in contact with subject matter experts who can assist in verifying the classification of the lines being sampled.

Avoidance features and early Low Impact Seismic (LIS) lines established prior to 2000 are not fully captured in this dataset. This is due to the high volume of features, narrow widths which are not visible in SPOT imagery, and the challenges associated with interpreting the older scanned final plans required to identify them. As a result, these features are underrepresented and, if still visible in imagery, are likely classified as legacy seismic lines.

5.20.5. Outcome of Merged Dataset

Table 6 below showcases how HFI2022 feature types were transferred to the new HFI2023 Seismic Lines, Trails and Other Linear Features sublayer for all of Alberta. There have been substantial changes to the classification of lines within this sublayer to better reflect industry and government standards.

Table 6. Transfer of seismic lines feature types from HFI2022 "ARCHIVED_FT_TY" to HFI2023.

HFI 2023 FEATURE TYPE	KM	ABMI 2022 FEATURE TYPE (ARCHIVED_FT_TY)	KM
Seismic - Legacy	647,633	CONVENTIONAL-SEISMIC	604,665
		LOW-IMPACT-SEISMIC	8,837
		OTHER-LINEAR-FEATURES	34,130
Seismic - Avoidance	1,481	CONVENTIONAL-SEISMIC	1,242
		LOW-IMPACT-SEISMIC	185
		OTHER-LINEAR-FEATURES	54
Seismic – Line of Sight	0.5	CONVENTIONAL-SEISMIC	--
		LOW-IMPACT-SEISMIC	0.5
		OTHER-LINEAR-FEATURES	--
Seismic - LIS	107,926	CONVENTIONAL-SEISMIC	31,790
		LOW-IMPACT-SEISMIC	70,670
		OTHER-LINEAR-FEATURES	5,465
Seismic – Conventional (Modern)	16,727	CONVENTIONAL-SEISMIC	3,027
		LOW-IMPACT-SEISMIC	13,390
		OTHER-LINEAR-FEATURES	310
ATS Related	45,214	CONVENTIONAL-SEISMIC	40,879
		LOW-IMPACT-SEISMIC	1,249
		OTHER-LINEAR-FEATURES	3,085
Other – Linear-Features	181,990	CONVENTIONAL-SEISMIC	42,413

		LOW-IMPACT-SEISMIC	3,309
		OTHER-LINEAR-FEATURES	136,267

Standard Operating Protocol (SOP) – EPA/ABMI Human Footprint Inventory (HFI): o20 Seismic Lines, Trails, and Other Linear Features, Version 2.1, 2026

5.20.6. Interpretation Elements and Rules

Element	Rules and Guidelines
Size	Long, linear features
Shape	Long straight or sinuous linear features
Shadow	No shadows
Colour	Green/brown/grey; depends on vegetation cover
Texture	Fine/coarser
Associated Relationship or Context	Located in areas developed for oil and gas extraction; can be spaced in a pattern 100s of metres apart or more densely depending on type

6. HFI Linear Features

In addition to an integrated dataset and polygonal sublayers, the HFIeOSM2023 also contains a set of linear feature layers. These are digital representations of linear feature centrelines (i.e. polyline geometry type) for five sublayers that are linear in nature. These include:

- (03) Roads
- (04) Railways
- (13) Transmission Lines
- (19) Pipelines
- (20) Seismic Lines and Trails

Disclaimer:

> The linear features dataset should be used as a supporting dataset to polygonal representation of HF features available in HFIeOSM2023. There are areas where human footprint is captured in polygon layers (HFIeOSM2023 and sublayers) but is still missing in the linear features (polylines).
>
> Available attribute values of the linear features dataset are limited. Polygon layers (HFIeOSM2023 and sublayers) should be used for geographic extent and more complete thematic information (i.e., available attribution, including source of the data).

6.1. (01) Roads Linear Features

Feature class: o03_RoadsCenterlines_HFIeOSM2023

Feature types: 'AIRP-RUNWAY' 'FORD-WINTER-XING' 'INTERCHANGE-RAMP' 'RIS-ROAD' 'ROAD' 'ROAD-GRAVEL-1L' 'ROAD-GRAVEL-2L' 'ROAD-PAVED-1L' 'ROAD-PAVED-2L' 'ROAD-PAVED-3L' 'ROAD-PAVED-4L' 'ROAD-PAVED-5L' 'ROAD-PAVED-6L' 'ROAD-PAVED-7L' 'ROAD-PAVED-DIV' 'ROAD- PAVED-UNDIV-1L' 'ROAD-PAVED-UNDIV-2L' 'ROAD-PAVED-UNDIV-4L' 'ROAD-UNCLASSIFIED' 'ROAD-UNIMPROVED' 'ROAD-UNPAVED-1L' 'ROAD-UNPAVED-2L', 'ROAD-VEGETATED', 'ROAD-VEGETATED-OSE', 'ROAD-WINTER-ACCESS' 'ROAD-WINTER-ROAD' 'TRAIL-ATV' 'TRUCK-TRAIL'

See the Roads sublayer section for more details regarding these different feature types. Details of AHFMP processing steps and user guide are included in these documents:

AHFMP - Road Processing 2014 Footprint.pdf

AHFMP - Road User Guide 2014 Footprint.pdf

6.2. (04) Railways - Linear Features

Feature class: o04_RailwaysCenterlines_HFIeOSM2023

Feature types: 'RLWY-ABANDONED' 'RLWY-DBL-TRACK' 'RLWY-MLT-TRACK' 'RLWY-SGL-TRACK' 'RLWY-SPUR'

See the Railways sublayer section for more details regarding these different feature types.

6.3. (13) Transmission Lines - Linear Features

Feature class: o13_TransmissionLineCenterlines_HFIeOSM2023

Feature types: 'TRANSMISSION-LINE'

See the Transmission Lines sublayer section for more details regarding this feature type.

6.4. (19) Pipelines - Linear Features

Feature class: o19_PipelineCenterlines_HFIeOSM2023

Feature types: 'PIPELINE'

See the Pipeline sublayer section for more details regarding this feature type.

IMPORTANT:

The Pipeline Centre Line feature class was created by the Geographic Science Team (GScT) of Alberta Environment and Protected Areas for the Alberta Human Footprint Monitoring Program (AHFMP). The data is used to monitor the linear density of pipeline corridors in the province of Alberta. The data is an estimate of the high-pressure pipelines in the province and is not suitable for locating pipelines on the ground. The data will also contain some low- pressure pipelines. A pipeline corridor is defined by the AHFMP as any linear disturbance created for the purpose of constructing and maintaining pipelines. The center line represents the linear distance of the corridor and a single center line is placed in the corridor regardless of the number of pipelines in that corridor. The data was derived from the Digitally Integrated Dispositions (DIDs), Rural Cadastral pipeline right of ways and SPOT imagery using a combination of raster processing and manual digitizing. The Alberta Energy Regulator (AER) pipeline dataset was used as reference to locate the pipeline corridors. The data was designed specifically for monitoring human footprint and may not be suitable for some cartographic purposes.

Data created by Alberta Human Footprint Monitoring Program (AHFMP) was consequently modified by ABMI. Digitized pipelines interpreted from satellite imagery (year 2017) were added to the source dataset to create a final HFI sublayer that represents estimated status of pipelines up to year 2023.

Details of AHFMP processing steps and user guide are included in these documents:

AHFMP - Pipeline Procedures Manual for 2016 Footprint - Ver 3.pdf

AHFMP - Pipeline User Guide for 2016 Footprint - Ver 2.pdf

6.5. (20) Seismic Lines, Trails and Other Linear Features

Feature class: o20_SeismicLines_and_Trails_Centerlines_HFI_2023

Feature types: SEISMIC-LEGACY, SEISMIC-AVOIDANCE, SEISMIC-LINE-OF-SIGHT, SEISMIC-LIS, SEISMIC-CONVENTIONAL-MODERN, SEISMIC-UNCONFIRMED, FIRE-GUARD, ATS-RELATED, REC-TRAIL, OTHER-LINEAR-FEATURES

See section 4.2 for more information about recent updates and section 5.20, the Seismic Lines and Trails sublayer section, for more details regarding these different feature types.

Details of AHFMP processing steps and user guide are included in this document:

Standard Operating Protocol (SOP) – EPA/ABMI Human Footprint Inventory (HFI):
o20 Seismic Lines, Trails, and Other Linear Features, Version 2.1, 2026

Disclaimer: Please do not use the centreline or polygonal sublayers in their raw form to estimate the remaining seismic lines in the province. These layers represent a cumulative collection of seismic lines and other linear disturbances, many of which have been subsequently replaced by other anthropogenic land uses. Using these sublayers without accounting for overlapping land use will significantly overestimate the total length and area of remaining seismic lines. To obtain a more accurate estimate, intersect the seismic line sublayers with the integrated human footprint layer and erase any overlapping features before calculating the remaining seismic lines.

This sublayer contains seismic and non-seismic features. When reporting on seismic lines, please ensure to separate the non-seismic features from the data to avoid over reporting of mapped seismic lines. As indicated by Feature Types starting with ‘Seismic’.

Due to the number of features, limited access to regulatory data and changes in disturbance, this dataset is intended for landscape-level analysis.

7. Enhanced Human Footprint Inventory

The HFIeOSM2023 is an enhanced version of the ABMI's original HFI dataset in that it contains additional information about the following for particular sublayers and features:

- the origin of each human footprint:
    - year of the origin - [YEAR]
    - industry that created human footprint - [SECTOR_HFIe],
- vegetation on the human footprint:
    - Normalized difference vegetation index – [NDVI_mean]
    - Day/night band radiance [VIIRS_DNB]
    - anthropogenic noise - [Noise]
- exploration- vs production-related activities:
    - exploration vs. production - [EXPL_V_PROD]

More details about these and other dataset attribute fields can be found in Section 7 below, and in the Appendix.

8. Enhanced Attribution

8.1. Year of Origin Attribution

Table 7 shows the percentage of features that have been given an age attribute, by number and by area in each HFI polygon sublayer.

Table 7: Summary of the percent of features in each OSR HFIe 2023 polygon sublayer that have age attribution, within the Oil Sands Watershed and Administrative boundaries. Percentages are provided by number of features and by total area.

Sublayer		Percent of Features Aged	
		Watershed Boundary	Administrative Boundary
01 - Reservoirs	Number	100	100
	Area	100	100
02 - Borrow Pits, Sumps Dugouts, and Lagoons	Number	100	100
	Area	100	100

03 - Roads	Number	68.8	80.5
	Area	51.1	83.7
04 - Railways	Number	100	100
	Area	100	100
05 – Canals	Number	100	100
	Area	100	100
06 – Verge	Number	58.1	77.3
	Area	43.2	84.2
07 – Mine Sites	Number	100	100
	Area	100	100
08 – Industrial Sites	Number	100	100
	Area	100	100
09 – Well Sites (Active	Number	100	100
	Area	100	100
10 – Landfills	Number	100	100
	Area	100	100
11 – Other Veg Surfaces	Number	100	100
	Area	100	100
12 – Wind Gen Facility	Number	100	100
	Area	100	100
13 – Transmission Lines	Number	100	100
	Area	100	100
14 – CFO	Number	100	100
	Area	100	100
15 – Residential	Number	100	100
	Area	100	100
16 – Well Sites (Abandoned)	Number	100	100
	Area	100	100
17 – Cultivation	Number	91.9	80.2
	Area	91	80.4
18 – Harvest Area	Number	100	100
	Area	100	100
19 – Pipelines	Number	88.2	100
	Area	86.6	100
20 – Seismic Lines	Number	98.6	98.6
	Area	99.1	99.1

'YEAR_SOURCE' was added in 2022 for HFI 2019 (AHFMP and ABMI 2020). As 'Year' attribution has been occurring since as early as 2015 some features have an attribute 'YEAR' without 'YEAR_SOURCE'. This attribution is derived from the sources listed above. The HF team is continually adding 'YEAR' and 'YEAR_SOURCE' attribution. 'YEAR' and 'YEAR_SOURCE' attributes were acquired from multiple imagery sources. 1950 using orthophotos, 1980 using orthophotos, 2000 using orthophotos, 2001 and 2004 using IRS satellite imagery for each year, 2005-2012 using SPOT5 satellite imagery for each year, 2013 -2023 using SPOT6 satellite imagery. As well as a series of reference datasets including Digitally Integrated Dispositions, Historical Cadastral Cutline Trails, Pulse Seismic, and 1950 linear features digitized from the Historical Planimetric Maps.

As the year value has not been determined for all polygons, the HFI is not suitable for trend analysis for all sublayers. The ABMI is updating the human footprint inventory dataset including filling in year values. It is expected that the next release of the HFI dataset will contain more human footprint features with a known year of origin than the current version.

8.2. Sector Attribution

Table 8 lists definitions for each of the sector attribute values. These were determined using a combination of HF feature type and local landscape context in relation to other nearby HF features.

Table 8. Sector definitions used in the HFIeOSM2023 dataset.

Sector	Definition
AGRICULTURE	Land disturbed for agricultural purposes such as crop and tame pasture.
ANTHROPOGENIC_WATER	Human-made water features.
BITUMEN_INSITU	Bitumen is a low-grade of crude oil which is composed of complex, heavy hydrocarbons with a high viscosity and will not flow to a well. In-situ (in the original place) requires enhanced recovery methods such as SAGD (steam assisted gravity drainage) to recover the resource. The AER designated three areas in the province Cold Lake, Peace River and Athabasca as oil sands areas where this recovery method is employed. These designated oil sands areas do not include the AER designated surface mining area.
BITUMEN_MINING_SURFACE	Bitumen is a low-grade of crude oil which is composed of complex, heavy hydrocarbons with a high viscosity. Mining Surface is an area defined by the AER (Alberta Energy Regulator) where the recovery of this resource is accomplished by removing overburden to physically access the resource.
ENERGY/INDUSTRIAL_OTHER	Industrial or energy disturbances unrelated to oil and gas.
ENERGY_TRANSMISSION	Disturbances related to the transportation of oil and gas products through pipelines to and from facilities and the transmission of electrical energy through power lines from power generating sources such as power plants, windmills, etc. to the consumers.

FORESTRY	Disturbances related to the harvesting of timber.
FORESTRY-UNCONFIRMED	A potential timber-harvest area or other forestry-related activity such as a log storage yard that has not been verified. This classification is applied mainly (but not exclusively) to older timber harvest areas that predate the Phase 3 Forest Inventory, where there are very few reference data available for confirmation. (Source: AHFMP)
MINING_SURFACE_OTHER	Mining sites unrelated to oil and gas. i.e. coal, peat, gravel, etc.
MUNICIPAL_INDUSTRIAL	Industry related to municipal services or within the municipal boundary.
MUNICIPAL_RECREATIONAL	Recreational areas within a municipal boundary.
MUNICIPAL_RESIDENTIAL	All residential areas.
OIL_GAS_BITUMEN_UNKNOWN	Infrastructure in close proximity to and maybe related to Bitumen/oil and gas that is not obvious.
OIL_GAS_CONVENTIONAL	Conventional oil and gas refers to petroleum, or crude oil, and raw natural gas extracted from the ground by the natural pressure from the wells and pumping operations and do not require enhanced recovery methods.
RECREATIONAL/OTHER	Recreational facilities located outside a municipal boundary.
TRANSPORTATION_MAJOR	A roadway, which is paved with asphalt or concrete or surfaced with gravel and constituted as a main access route.
TRANSPORTATION_MINOR	A roadway surfaced with dirt or low vegetation constituting a minor access route.
UNKNOWN	Any feature too ambiguous to assign a specific sector.

8.3. Nighttime Light Attribution

8.3.1. Data Source and Description

Nighttime light values were attributed to HFIeOSM2023 features using information from the Visible Infrared Imaging Radiometer Suite's (VIIRS's) Stray Light Corrected Nighttime Day/Night Band (DNB) Composites Version 1. These data are provided by the Earth Observation Group, Payne Institute for Public Policy, Colorado School of Mines (), and were accessed and processed using Google's online Earth Engine (GEE) platform (GEE product "NOAA/VIIRS/DNB/MONTHLY_V1/VCMSLCFG").https://payneinstitute.mines.edu/eog/

The above data product offers monthly average radiance composite images from the VIIRS DNB. Data are cloud-masked and have been corrected for stray light. However, Version 1 data has not been filtered to remove light from aurora phenomena, fires, boats, or other temporal lights. The product covers the globe from latitudes 75^0N to 65^0S and are produced in 15 arc-second geographic grids. The products available through the GEE Data Catalog are provided at a spatial resolution of 463.8 m, and in units of nanoWatts/cm^2/sr. More information about the data can be found here:

https://developers.google.com/earth-engine/datasets/catalog/NOAA_VIIRS_DNB_MONTHLY_V1_VCMSLCFG#description.

8.3.2. Processing Steps

A JavaScript custom script was used in the online GEE platform to access and process the VIIRS DNB monthly composite data. This script:

1) combines monthly average Day/Night Band composites for the months of January through March, and October through December,
2) creates a mean DNB radiance value composite from the selected images,
3) exports the result from GEE using the Alberta NAD83 10TM Forest coordinate system.

Once exported, the mean DNB composite raster is used in a zonal statistics geostatistical process (run in ArcGIS software) to extract per-feature mean DNB radiance values. These are assigned to the [DNB_VIIRS_mean] attribute of the relevant human footprint features. Where feature polygons cannot be attributed with DNB values in this way (i.e., they are too small, or are oddly shaped), a point placed within the boundary of the polygon is used to extract a DNB value for that point; this value is then assigned to the polygon. The approach used to attribute various features is captured in the [MethodLight] attribute, whereby a '1' indicates the use of zonal statistics, and a '2' indicates the use of a point-based value.

Features within the following sublayers are attributed with a nighttime light ([VIIRS_DNB]) attribute (Table A.1):

- Mine Sites
- Industrial Sites
- Well Sites (Active and Abandoned)
- CFO
- Urban and Rural Residential

8.4. Vegetation Attribution

8.4.1. Data Source and Description

Vegetation is represented by spectral Normalized Difference Vegetation Index (NDVI) values, which are extracted from the European Space Agency's (ESA'S) Harmonized Sentinel-2A and Sentinel-2B MultiSpectral Instrument optical satellite sensor surface reflectance data. These data are provided by the ESA's Copernicus Mission (https://sentinels.copernicus.eu/web/sentinel/home), and were accessed and processed using Googles online Earth Engine (GEE) platform (GEE product "COPERNICUS/S2_SR_HARMONIZED").

The data above offer 13 band, multi-spectral surface reflectance image scenes at a global scale, on an equatorial frequency of every 5 days. They have been atmospherically- and geometrically-corrected, and are accompanied by cloud and other quality flags for further processing. NDVI calculations with these data used surface reflectance in bands 4 (red visible) and 8 (near-infrared), both provided at a 10 m spatial resolution. More information about the data can be found here: https://developers.google.com/earth-engine/datasets/catalog/COPERNICUS_S2_SR_HARMONIZED#description.

8.4.2. Processing Steps

A JavaScript custom script was used in the online GEE platform to access and process the Sentinel-2A and -2B imagery into an annual NDVI composite. This script:

1) combines individual Sentinel-2A and -2B surface reflectance scenes covering the area of interest, from the months of June through September,
2) uses quality assurance flags to identify and remove cloud and cirrus effects from the imagery,
3) calculates per-scene NDVI using the equation [Band 8 – Band 4]/[Band 8 + Band 4],
4) creates a mean NDVI annual composite for 2023 from the stack of NDVI images,
5) exports the result from GEE using the Alberta NAD83 10TM Forest coordinate system.

Once exported, the mean NDVI composite raster is used in a zonal statistics geostatistical process (run in ArcGIS software) to extract per-feature mean NDVI values from each composite. These are assigned to the [NDVI_mean] attribute of the relevant human footprint features. Where feature polygons cannot be attributed with NDVI values in this way (i.e., they are too small, or are oddly shaped), a point placed within the boundary of the polygon is used to extract an NDVI values for that point; this value is then assigned to the polygon. The approach used to attribute various features is captured in the [MethodMean] attribute, whereby a '1' indicates the use of zonal statistics, and a '2' indicates the use of a point-based value.

8.4.3. Value Description

Values of NDVI range from -1 to +1 and represent the scattering of near-infrared wavelengths by healthy green leaves, and the absorption of red wavelengths by plant chlorophyll. Negative NDVI values (i.e., those approaching -1) correspond to water surfaces, while values close to zero (-0.1 to 0.2) generally indicate areas of barren rock, soil, or snow. Low, positive values generally represent shrub and grassland (~0.2 to 0.4), and higher positive values often reflect treed vegetation such as temperate or tropical forests (see https://custom-scripts.sentinel-hub.com/sentinel-2/ndvi/ for more information).

8.5. Noise Attribution

8.5.1. Data Source and Description

Anthropogenic noise was modeled over the Oil Sands Region of Alberta following the methods outlined in the following:

> *Hedley, R.W. 2021. Chapter 3: Mapping Anthropogenic Noise in Alberta' Oil Sands Region Using Passive Acoustic Monitoring. In ABMI Geospatial Report 2020-2021: Oil Sands Monitoring - Geospatial Program Development Report (2020-2021 Work Plan CC-2-1920), March 2021, pp. 32 - 48.*

Modeling involved the application of boosted regression tree machine learning, and involved inputs from 3,400 acoustic sound recording locations distributed across the region, alongside information on the presence and distribution of various human footprint features over the same area. The latter was derived from the ABMI's HFI 2023 dataset. The approach predicts both the probability of anthropogenic noise under a given condition (i.e., during a recording window), and the amount or level of this noise under this condition. Combining these two predictions together produced an overall

prediction of expected average noise levels for any location across the area of interest. Only human footprint features identified as producing anthropogenic noise were used in analysis.

8.5.2. Processing Steps

Once modeled, the anthropogenic noise raster is used in a zonal statistics geostatistical process (run in ArcGIS software) to extract per-feature mean noise values. These are assigned to the [Noise] attribute of the relevant human footprint features. Where feature polygons cannot be attributed with Noise values in this way (i.e., they are too small, or are oddly shaped), a point placed within the boundary of the polygon is used to extract a Noise value for that point; this value is then assigned to the polygon. The approach used to attribute various features is captured in the [MethodNoise] attribute, whereby a '1' indicates the use of zonal statistics, and a '2' indicates the use of a point-based value.

Table 9 lists the HFIe sublayers and specific feature types that were used in anthropogenic noise modeling and attributed with the [Noise] attribute in the HFIeOSM2023.

Table 9: HFIeOSM2023 sublayers and features types to which [Noise] is attributed.

Sublayer	Feature Type(s)
02 - Borrow Pits, Sumps, Dugouts and Lagoons	BORROWPIT-DRY BORROWPITS BORROWPIT-WET RIS-BORROWPITS
03 - Roads	All
04 - Railways	RLWY-MLT-TRACK RLWY-SPUR RLWY-SGL-TRACK
07 - Mine Sites	GRVL-SAND-PIT MINES-OILSANDS MINES-PITLAKE OPEN-PIT-MINE PEAT RIS-MINES-OILSANDS RIS-OILSANDS-RMS RIS-OVERBURDEN-DUMP RIS-TAILING-POND RIS-WASTE TAILING-PILE TAILING-POND

08 - Industrial Sites	CAMP-INDUSTRIAL FACILITY-OTHER FACILITY-UNKNOWN MILL MISC-OIL-GAS-FACILITY OIL-GAS-PLANT RIS-CAMP-INDUSTRIAL RIS-FACILITY-OPERATIONS RIS-FACILITY-UNKNOWN RIS-PLANT RIS-TANK-FARM RIS-UTILITIES URBAN-INDUSTRIAL
09 - Well Sites (Active)	RIS-WELL WELL-BIT WELL-CASED WELL-CLEARED-DRILLED WELL-CLEARED-NOT-CONFIRMED WELL-CLEARED-NOT-DRILLED WELL-DRILLED-OTHER WELL-GAS WELL-OIL WELL-OTHER
10 - Landfills	All
11 - Other Veg Surfaces	CAMPGROUND RECREATION RUNWAY
12 - Win Gen Facility	All
13 - Transmission Lines	All
14 - CFO/High Density Livestock	All
15 - Urban/Rural Residential	COUNTRY-RESIDENCE RURAL-RESIDENCE URBAN-RESIDENCE

19 - Pipelines	All
20 - Seismic Lines	CONVENTIONAL-SEISMIC TRAIL

8.5.3. Values Description

Modeled anthropogenic noise is provided in decibels (dB), and the 2023 model produced values ranging from 0 dB to 21.4 dB. It is important to note that the output of this model was constrained to positive values (i.e. greater than zero).

8.6. Exploration vs. Production Attribution

The attribution of whether a human footprint feature is exploration- or production-related is captured using the [EXPL_v_PROD] field. Valid values include:

- ‘Expoloration’,
- ‘Produciton’,
- ‘NA’ (for *not applicable*), and
- ‘Unknown’ (where the feature’s designation is unknown or as of yet undetermined).

Features designated as “exploration” are defined as those associated with the search for reservoirs of oil and gas, including geophysical surveys (e.g., seismic lines), and drilling of exploration wells (i.e., those that never reported production). For the purposes of this dataset, it is assumed that 4D seismic lines are “exploration”, as data to determine otherwise is not currently available.

Features designated as “production” in the current attribution comprise everything that is downstream of exploration-related features and activities. This includes all oil and gas reclamation features, as designated by the Alberta Reclamation Information System (RIS). “Production” attribution is given to features such as: well pads that have reported bringing well fluids to the surface, or are injection or disposal wells; open pit oil sands mines; facilities (e.g., for crushing, separating, storing, waste processing, upgrading, refining etc.); and, transport via pipeline (note: batteries and trucking are not currently included in the latter type of feature). Features that are not within the scope of this current exploration vs production attribution work include: coal and peat mines, and energy transmission lines, though it is recognized that the latter do form a component of the energy footprint on the Alberta landscape.

The feature sublayers to which this attribute is added for the HFIeOSM2023 dataset include:

- 07 Mine Sites
- 08 Industrial Sites
- 09 Well Sites Active
- 16 Well Sites Abandoned
- 19 Pipelines

- 20 Seismic Lines and Trails

Steps and rules for assigning an 'EXPL_v_PROD' attribute value to the features in these sublayers are outlined in the Table 10 below.

Assignation of this attribute is not applicable to features within the following HFIeOSM2023 sublayers (i.e. features in these sublayers will have an 'NA' value in them):

- 01 Reservoirs
- 05 Canals
- 12 Wind Generation Facilities
- 14 CFO and other High Density Livestock
- 17 Cultivation
- 18 Timber Harvest and Woody Vegetation Removal

Finally, the below sublayers are not attributed with 'Exploration' vs 'Production' values for HFIeOSM2023 dataset. Future versions of the product may include this attribution for some or all of the following sublayers. They require further efforts to develop appropriate approaches and decision rules for determining such attribution, as many are multi-use features

- 02 Borrow Pits, Sumps, Dugouts and Lagoons
- 03 Roads
- 04 Railways
- 06 Verges
- 10 Landfills
- 11 Other Vegetated Surfaces
- 13 Transmission Lines
- 15 Urban and Rural Residential

The decision rules developed for attributing the selection of OSR HFIe 2023 features with "Exploration", "Production", "NA", or "Unknown" are provided in Table e below. These rules largely rely on a feature's type and its designated sector (see Section 3.2 Sector attribution). However, for well site sublayers, existing attribution provided by collaborators in the Alberta Human Footprint Monitoring Program (AHFMP) in the form of a provided well bore PROD_EX_P attribute, is used to designate these features as exploration, production or unknown, as appropriate.

Table 10. Instructions and decision rules for assigning values to the EXPL_v_PROD attribute for OSMHFIe2023 feature sublayers, based on existing FEATURE_TY and SECTOR attributes. Valid values include: 'Exploration', 'Production', 'NA' (for not applicable), and 'Unknown'.

HFI Sublayer	EXPL_v_PROD Attribution
07 Mine Sites	Mine features that meet one of the following criteria are attributed as "Production": • Their FEATURE_TY

	○ is “MINES-OILSANDS” ● Their FEATURE_TY ○ begins with “RIS-” Mine features that do not meet these criteria are attributed as “NA” (this includes gravel and coal mines, peat, etc.).
08 Industrial Sites	Industrial features that meet one of the following criteria are attributed as “Production”: ● Their FEATURE_TY ○ begins with “RIS-” **or** ○ is “MISC-OIL-GAS-FACILITY” or “OIL-GAS-PLANT” ● Their FEATURE_TY ○ is “CAMP-INDUSTRIAL” **and** their SECTOR ○ is “BITUMEN_MINING_SURFACE”, “BITUMEN_INSITU”, or “OIL_GAS_CONVENTIONAL” Industrial features that meet one of the following criteria are attributed as “Unknown”: ● Their FEATURE_TY ○ is “FACILITY-OTHER”, “FACILITY-UNKNOWN”, or “CLEARING-UNKNOWN” **and** their SECTOR ○ is “BITUMEN_MINING_SURFACE”, “BITUMEN_INSITU”, “OIL_GAS_CONVENTIONAL”, “INDUSTRIAL_OTHER”, “MINING_SURFACE_OTHER”, or “MUNICIPAL_INDUSTRIAL” Industrial features that meet one of the following criteria are attributed as “NA”: ● Their FEATURE_TY ○ is “MILL” or “URBAN-INDUSTRIAL” ● Their FEATURE_TY ○ is “FACILITY-OTHER”, “FACILITY-UNKNOWN”, “CLEARING-WELLPDAD-UNCONFIRMED”, or “CLEARING-UNKNOWN” **and** their SECTOR ○ is “ENERGY_TRANSMISSION”, “AGRICULTURE”, “FORESTRY”, “MUNICIPAL_RESIDENTIAL”, “MUNICIPAL_RECREATION”, “RECREATIONAL_OTHER”, “TRANSPORTATION_MAJOR”, or “TRANSPORTATION_MAJOR”

09 Well Sites Active	All wells that meet one or more of the following criteria are to be attributed as "Production": ● They have a 'PROD_X_P_value" value of **2** (the ABMI numerical value equivalent to the AHFMP value of 'PRODUCTION AND RELATED') ● The have been drilled ● They possess a production-related information (i.e., a SPUD date) All wells that meet the following criteria are to be attributed as "Exploration": ● They have a 'PROD_X_P_value" value of **1** (the ABMI numerical value equivalent to the AHFMP value of 'EXPLORATION AND RELATED') Any remaining wells are to be attributed as "Unknown"
16 Well Sites Abandoned	All wells that meet one or more of the following criteria are to be attributed as "Production": ● They have a 'PROD_X_P_value" value of **2** (the ABMI numerical value equivalent to the AHFMP value of 'PRODUCTION AND RELATED') ● The have been drilled ● They possess a production-related information (i.e., a SPUD date) All wells that meet the following criteria are to be attributed as "Exploration": ● They have a 'PROD_X_P_value" value of **1** (the ABMI numerical value equivalent to the AHFMP value of 'EXPLORATION AND RELATED') Any remaining wells are to be attributed as "Unknown"
19 Pipelines	"Production"
20 Seismic Lines	"Exploration"

9. HFI Feature Attributes

9.1. Attribute List

Table 11: List of mandatory and enhanced attributes per sublayer in the OSMHFIe2023 dataset. Note that not all features in a given sublayer are attributed with Noise - see Section 8.5 (Noise Attribution) for details.

Sublayer	Attributes								
	HFI_ID	FEATURE_TY	SOURCE	YEAR	SECTOR	VIIRS_DNB	NDVI	Noise	EXPLR_V_PROD
01 - Reservoirs	✔	✔	✔	1950 – 2023	✔		✔		

02 - Borrow Pits, Sumps, Dugouts, and Lagoons	✔	✔	✔	1950 – 2023	✔		✔	✔	
03 - Roads	✔	✔	✔	NULL 1884 – 2023	✔		✔	✔	
04 - Railways	✔	✔	✔	1905 – 2023	✔		✔	✔	
05 - Canals	✔	✔	✔	1950 – 2023	✔		✔		
06 - Verges	✔	✔	✔	NULL 1884 – 2023	✔		✔		
07 - Mine SItes	✔	✔	✔	1936 - 2023	✔	✔	✔	✔	✔
08 - Industrial Sites	✔	✔	✔	1950 - 2023	✔	✔	✔	✔	✔
09 - Well Sites Active	✔	✔	✔	1916 - 2023	✔	✔	✔	✔	✔
10 - Landfills	✔	✔	✔	1980 - 2023	✔		✔	✔	
11 - Other Vegetated Surfaces	✔	✔	✔	1942 - 2023	✔		✔	✔	
12 - Win Generation Facilities	✔	✔	✔	2022- 2023	✔				
13 - Transmission Lines	✔	✔	✔	NULL 1950 - 2023	✔		✔	✔	
14 - CFO	✔	✔	✔	1950 - 2023	✔	✔	✔	✔	
15 - Urban and Rural Residential	✔	✔	✔	NULL 1950 - 2023	✔	✔	✔	✔	
16 - Well Sites Abandoned	✔	✔	✔	1894 - 2023	✔	✔	✔		✔
17 - Cultivation	✔	✔	✔	NULL 1937 - 2023	✔		✔		
18 – Timber Harvest and Woody Vegetation Removal	✔	✔	✔	1940 - 2023	✔		✔		
19 - Pipelines	✔	✔	✔	NULL 1900 – 2023	✔		✔	✔	✔

20 - Seismic Lines and Trails	✔	✔	✔	NULL 1950 – 2023	✔		✔	✔	✔

9.2. Mandatory Fields

The following tables list and describe the various attributes or fields that accompany features in the HFIe dataset. They are organized by: mandatory attributes (all features are required to have these filled), and optional attributes (some features have these filled). Note that not all features have YEAR and YEAR_SOURCE because these attributes became mandatory only in the last few years.

Table 12. Mandatory attributes or fields that must be filled for all features in the HFIe dataset.

Attribute	Description	List of Valid Values
HFI_ID	Alpha-numeric identifier sometimes used for additional analysis	E.g. '{F5CDF76F-40E7-4651-8739-AA028F1CA4D0}'
FEATURE_TY	The type or category of human footprint feature	See the sublayer sections for lists of valid values. E.g., 'WELL-BITUMEN', 'LOW-IMPACT-SEISMIC', 'CFO', 'GREENSPACE'
SOURCE	The data source for the feature in the dataset.	'ABMI' – data updated by ABMI prior to HFI_2014 update 'ABMI00' – data updated by ABMI during HFI_2000 update 'ABMI10' – data updated by ABMI during HFI_2010 update 'ABMI12' – data updated by ABMI during the HFI_2012 update 'ABMI14' – data updated by ABMI during HFI_2014 update 'ABMI15' – data updated by ABMI during HFI_2015 update 'ABMI16' – data updated by ABMI during HFI_2016 update 'ABMI17' – data updated by ABMI during HFI_2017 update 'ABMI18' – data updated by ABMI during HFI_2018 update 'ABMI19' – data updated by ABMI during HFI_2019 update 'ABMI21' – data updated by ABMI during HFI_2021 update

		ABMI22' – data updated by ABMI during HFI_2022 update 'ABMI23' – data updated by ABMI during HFI_2023 update 'ABMI80' - data updated by ABMI during the HFI_1980 and HFI_1950 update 'ABMI37' – data updated by ABMI during temporal human footprint on sample scale update, 'AHFMP'– data updated by Alberta Human Footprint Mapping Program 'Air Photo' – Feature was interpreted from an air photo 'ATS' - Feature follows a surveyed ATS line 'AVIE' – data derived from the Alberta Vegetation Inventory obtained from the Government of Alberta 'AVI' – data derived from the Alberta Vegetation Inventory obtained from the Government of Alberta 'BASEFE' – data obtained from the Government of Alberta under the Open Data License. Data source: http://www.altalis.com/products/base/20k_base_features.html 'BUFF10' – data updated by ABMI during HFI_2010 update by the buffering of residential centroid points 'GVI' – data derived from the Grassland Vegetation Inventory obtained from the Government of Alberta 'GVIed' – data derived from the Grassland Vegetation Inventory obtained from the Government of Alberta updated by ABMI 'NA' – data source not available 'Pulse' - Identified using Pulse Seismic Data 'PLVI' – data derived from the Primary Land and Vegetation Inventory obtained from the Government of Alberta 'PLVIed' – data derived from the Primary Land and Vegetation Inventory obtained from the Government of Alberta updated by ABMI 'Regulatory' - Derived from geophysical final plans, dispositions, OSE Maps, etc. 'RIS' – Reclamation Information System *(*RIS*)* data obtained from the Government of Alberta, Alberta Environment and Parks

		'SDLS' - SDLS data indicates the line was used for seismic and helps supports its classification as a seismic line 'SRDSPT' – Special Areas data obtained from the Government of Alberta, Alberta Environment and Parks 'SPAREA' – Special Areas data obtained from the Government of Alberta, Alberta Environment and Parks
YEAR	A year integer number representing a feature's "year of origin". This value is either introduced to the HFIe dataset from other sources (along with original features) or it is being attributed by ABMI processes. When a feature is updated by ABMI, the YEAR value is updated based on available imagery in the ABMI mosaic catalogue – years of 1949-1951, 1999-2003, and 2004 to 2023. A Google Earth Engine Timelapse App was used as a reference tool for year of origin determination of some features (https://earthengine.google.com/timelapse/).	E.g. 1950, 1980, 2000, 2001, 2004, 2005, etc.
YEAR_SOURCE	The source from which a feature's YEAR attribute (i.e. 'year of origin') was determined Information on 'YEAR_SOURCE' attribution for o20 Seismic Lines, Trails and Other Linear Features can be found in section 5.20	'Historical CAD' - Historical Cadastral Cutline Trails data 'GEE-Timelapse' – Google Earth Engine Timelapse app 'IRS 2001-2004' – IRS satellite imagery from 2001 to 2004 'L7' – Landsat 7 imagery 'Landsat 1984' – Landsat imagery from 1984 'ortho 1950' – 1950s orthophotography 'ortho 1980' or 'Ortho_1980' – 1980s orthophotography 'Pulse Seismic' – data from Pulse Seismic (www.pulseseismic.com) 'SDLS' – Seismic Data Listing Service 'SPOT 2005-2012' – SPOT satellite imagery from 2005 to 2012

		'SPOT 2013-2023' – SPOT satellite imagery from 2013 to 2023 'valtus 2000' – orthomosaic imagery accessed through Valtus Imagery Services (www.valtus.com)
OBJECTID	Automatic, geodatabase-specific unique ID number generated by ArcGIS for each row in an attribute table	---
Shape_Length	Feature geometry shape length value automatically generated by ArcGIS, in units of the selected coordinate system	---
Shape_Area	Feature geometry shape area value automatically generated by ArcGIS, in units of the selected coordinate system	---

"Year of origin" started to be added to the HFI in 2017. All sublayers except Roads, Verges, Cultivation, Pipelines and Seismic Lines, Trails and Other Linear Features are 100% dated. The YEAR attribute value is the best estimation of the year when the feature was created. It has been determined by regulatory and industry data or visual interpretation based on available aerial/satellite imagery. For imagery sources (IRS, SPOT, GEE, 1980ORTHO, 1950ORTHO and VALTUS) it is less accurate for the years prior to 2005, as there was no sequential higher spatial resolution mosaic available for the entire province of Alberta.

Table 13. Optional attributes or fields that can be filled for some features in the HFIe dataset.

Attribute	Description	List of Valid Values
NAME	The name of the particular location	–
BNDRY_SOURCE	The source of the feature boundary	–

Table 14. Additional attributes or fields that can be filled for features in the Well Sites Active and Well Sites Abandoned sublayers in the HFIe dataset. Originally sourced from the Government of Alberta's AHFMP – Well Pad Procedures for 2021 Footprint Version 1.3 document.

Attribute	Description	List of Valid Values
WELLSITE_FOOTPRINT_ID	Unique numeric ID, generated from a feature's OBJECTID; will change each product version	E.g., 349281, 71668
POLYGON_SOURCE	Indicates the source from which the wellbore data associated with the well pad was sourced	1 – DIDs (Digital Integrated Dispositions) Application 2 – DIDs Application 3 – DIDs Conflict 4 – Manually digitized (SPOT) 5 – Manually digitized (High Resolution Orthophotos) 6 – Manually digitized (Survey Plan) 7 – Manually digitized (Other) 8 – RIS (Reclamation Information System) 9 – Buffer 10 – AVI (Alberta Vegetation Inventory) 11 – DIDs Modified 13 – Alberta Energy
WELL_STATUS	Indicates the dominant type of wellbore found on the well pad	In order of precedence: 6 – Bitumen 5 – Oil 4 – Gas 3 – Drilled and Cased 2 – Other 1 – Abandoned 0 – Status Unknown 999 – Cleared, Not Drilled

FIRST_SPUD_DATE	The date when drilling first began on the well pad (full date)	E.g., 2007-06-25
FIRST_SPUD_YEAR	The year when drilling first began on the well pad	E.g., 2007
NUMBER_WELLHEADS	The total number of wellbores on the well pad	E.g., 0, 1, 2, […]
DISP_NUM or DISPOSITION NUMBER	The DIDs (Digital Integrated Dispositions) number for a well pad	E.g. 'MLS001147'
LCU_ID or RIS LAND COVER ID	An ID used for tabular joins with the RIS (Reclamation Information System) data	E.g. '12982007A'
VISIBLE	Derived from work done by Alberta Energy; reflects the state of visibility of a footprint as of circa 2016, based on SPOT, 1.5 m colour imagery	0 – Not visible 1 – Fully visible 2 – Partially visible
AREA_HA	Well pad area, in hectares	E.g., 1.197867
OILSANDS_EVALUATION_WELL	Indicates whether the well pad contains and Oil Sands Evaluation (OSE) well	NULL – No OSE well present 1 – OSE well present
RECLAMATION_STATUS	Indicates the reclamation status of the well pad Note: a well pad is reclaimed if it has any reclaimed wellbores on it, regardless of the presence of other active well bores	1 – Not reclaimed 2 – Reclamation exempt 3 - Reclaimed
RECLAMATION_DATE	Indicates the year (not full date) of the most recent reclamation certification issued to the well pad	E.g., 1998
RECLAMATION_COMMENT	Provides additional context to a well's reclamation status	1 – No comment 2 – Has active well 3 – OneStop (Alberta Energy Regulator application review technology)

MIN_ONPRODUCTION_DATE	Indicates the first (earliest) reported year a well went into production	E.g., 1976
MAX_LAST_PRODUCTION_DATE	Indicates the latest (most recent) reported year of production at a well	E.g., 2019
MAX_ABANDONED_DATE	Indicates the latest (most recent) year a well was abandoned	E.g., 2010
fieldname	Indicates the oil sands region in which the well pad is located	NULL ATHABASCA Oil Sands COLD LAKE Oil Sands PEACE RIVER Oil Sands
PROD_EX_P_value	Indicates whether wells on the well pad have every reported production or injection volumes	1 – Exploration and related; well pad only contains wells that have not reported production or injection volumes 2 – Production and related; well pad contains wells that have reported production or injection volumes

Table 15. Additional attributes or fields that can be filled for features in the Seismic Lines, Trails and Other Linear Features sublayers in the HFI dataset. Standard Operating Protocol (SOP) – EPA/ABMI Human Footprint Inventory (HFI): o20 Seismic Lines, Trails, and Other Linear Features, Version 2.1, 2026

Attribute	Description	List of Valid Values
ARCHIVED_FEATURE_TY	Original HFI feature type, last used in HFI2022 and now archived	CONVENTIONAL-SEISMIC, LIS
ARCHIVED_SOURCE	Original HFI Source, last used in HFI2022 and now archived	AHFMP, ABMI22
ARCHIVED_YEAR	Original feature's construction year or first year disturbance was seen in imagery, or from Pulse Seismic reference data obtained prior to 2023. Last used in HFI222 and now archived	2021, 1980, 2001
ARCHIVED_YEAR_SOURCE	Source for the original construction year, last used in HFI2022 and now archived	1980ORTHO, SPOT, Valtus

WIDTH	The lines constructed width (total width)	8, 2.8
WIDTH_SOURCE	The source used to determine the feature's width	Regulatory, SME

10. HFI Reference and Source Datasets

10.1. Data sources

Table 16: Data source references used in HFIe 2023 creation.

Title	Association Type	Location/Reference
Alberta Vegetation Inventory (AVI)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project (AHFMP), https://open.alberta.ca/opendata/ahfmp
Grassland Vegetation Inventory (GVI)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project (AHFMP), https://open.alberta.ca/opendata/ahfmp
Primary Land and Vegetation Inventory (PLVI)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project (AHFMP), https://open.alberta.ca/opendata/ahfmp
Alberta Human Footprint Mapping Project (AHFMP)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project (AHFMP), https://open.alberta.ca/opendata/ahfmp
Reclamation Information System (RIS)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project (AHFMP), https://open.alberta.ca/opendata/ahfmp
Government of Alberta (SRDSPT)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project, (AHFMP), https://open.alberta.ca/opendata/ahfmp
Digitally Integrated Dispositions (DIDs)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project (AHFMP), https://open.alberta.ca/opendata/ahfmp
Alberta Vegetation Inventory Enhanced (AVIE)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project (AHFMP), https://open.alberta.ca/opendata/ahfmp
Special Areas (SPAREA)	Source	The Special Areas; specialareas.ab.ca
Land Use Classification in the Special Areas of Alberta	Source	Publication No. 731; technical Bulletin No.39; Issued: February. 1942
SPOT6, 2014	Source	Alberta Environment and Parks, 2020. Air, Biodiversity and Policy Integration Branch, Policy and Planning Division, Provincial coverage of pan sharpened and multispectral SPOT6, years 2010 to 2017. [Edmonton, AB: Alberta Environment and Parks, 2020].

SPOT6, 2017	Source	Alberta Environment and Parks, 2020. Air, Biodiversity and Policy Integration Branch, Policy and Planning Division, Provincial coverage of pan sharpened and multispectral SPOT6, years 2010 to 2017. [Edmonton, AB: Alberta Environment and Parks, 2020].
SPOT6, 2019	Source	Alberta Environment and Parks, 2020. Air, Biodiversity and Policy Integration Branch, Policy and Planning Division, Provincial coverage of pan sharpened and multispectral SPOT6, years 2017 to 2019. [Edmonton, AB: Alberta Environment and Parks, 2020]
SPOT6, 2020	Source	Alberta Environment and Protected Areas, 2021. Lands Planning Branch, Lands Division, Provincial coverage of pan sharpened and multispectral SPOT6, years 2018 to 2020. [Edmonton, AB: Alberta Environment and Protected Areas, 2021]
SPOT6, 2021	Source	Alberta Environment and Protected Areas, 2022. Lands Planning Branch, Lands Division, Provincial coverage of pan sharpened and multispectral SPOT6, years 2020 to 2021. [Edmonton, AB: Alberta Environment and Protected Areas, 2022]
SPOT6, 2022	Source	Alberta Environment and Protected Areas, 2024. Lands Planning Branch, Lands Division, Provincial coverage of pan sharpened and multispectral SPOT6, years 2021 to 2022. [Edmonton, AB: Alberta Environment and Protected Areas, 2024]
SPOT6, 2023	Source	Alberta Environment and Protected Areas, 2025. Lands Planning Branch, Lands Division, Provincial coverage of pan sharpened and multispectral SPOT6, years 2021 to 2023. [Edmonton, AB: Alberta Environment and Protected Areas, 2025]
Valtus Orthophoto Mosaic ca 2000	Reference	Alberta Environment and Parks, 2016. Informatics Branch
IRS Satellite	Reference	Alberta Environment and Parks, 2016. Informatics Branch
Base Features (BASEFE)	Source	Government of Alberta, 2016. Open Data License, Retrieved from http://www.altalis.com/products/base/20k_base_features.html
Google Maps	Reference	https://maps.google.ca
Google Earth Timelapse	Reference	https://earthengine.google.com/timelapse/
Alberta Recycling Management Authority	Reference	http://www.albertarecycling.ca/collection-site-search-results
City of Calgary	Source	https://data.calgary.ca/Base-Maps/Land-Use-Polygons/gbpb-ymc5/about https://maps.calgary.ca/CalgaryImagery/

Alberta Environment and Sustainable Resource Development	Reference	Alberta Environment and Sustainable Resource Development, 2016. Informatics Branch, 1.5 m Colour SPOT 6 Mosaic. Retrieved from http://environment.alberta.ca/
Valtus Imagery Services	Reference	Valtus Imagery Services, 2010. Valtus Imagery. Retrieved from http://www.valtus.com/
Valtus Imagery Services	Reference	Valtus Imagery Services, 2011. Valtus Imagery. Retrieved from http://www.valtus.com/
Valtus Imagery Services	Reference	Valtus Imagery Services, 2012. Valtus Imagery. Retrieved from http://www.valtus.com/
Valtus Imagery Services	Reference	Valtus Imagery Services, 2013. Valtus Imagery. Retrieved from http://www.valtus.com/
Valtus Imagery Services	Reference	Valtus Imagery Services, n.d. Valtus Imagery. Retrieved from http://www.valtus.com/
Quality Farm Dugouts (3rd Edition)	Reference	http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex15866
Alberta Vegetation Inventory Standards and Data Model Documents	Reference	https://www.agriculture.alberta.ca/app21/forestrypage?cat1=Vegetation%20Inventory%20Standards
Grassland Vegetation Inventory Standards	Reference	https://geodiscover.alberta.ca/geoportal/catalog/search/resource/details.page?uuid=%7BD3AB9031-8EC0-4589-9335-C1E50AE05992%7D
Primary Land and Vegetation Inventory Standards	Reference	https://geodiscover.alberta.ca/geoportal/catalog/search/resource/details.page?uuid=%7BF640CD9D-C232-481D-9CFF-7A7B66E51E49%7D
road_album_2.ppt	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)
Alberta Transportation Guide to Reclaiming Borrow Excavations – 2013 Edition	Reference	www.transportation.alberta.ca/Content/docType245/Production/borrowguide.pdf
AHFMP_Footprint Data Manual.docx	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP),
AHFMP - Road Processing 2014 Footprint.pdf	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP),
AHFMP - Well Pad User Guide 2014 Footprint.pdf	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)
AHFMP - Well Pad Procedures for 2014 Footprint.pdf	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)
AHFMP - Well Pad User Guide 2014 Footprint.pdf	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)
AHFMP_Cultivation_User_Guide_Footprint_HFI_2014FTv2.pdf	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)

AHFMP_Cultivation_User_Guide_HFI_2014.pdf	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)
ISO 19131_AAFC_Annual_Crop_Inventory_Data_Product_Specifications.pdf	Reference	Agriculture and Agri-Food Canada (AAFC); AAFC Crop Inventory, 2014
AHFMP - Seismic User Guide 2014 Footprint Ver3.docx	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)
AAFC Annual Crop Inventory Data	Source	http://www.agr.gc.ca/atlas/data_donnees/agr/annualCropInventory/tif/
SENTINEL - 2	Reference	European Space Agency (ESA); The Copernicus Sentinel-2 mission; https://sentinel.esa.int/web/sentinel/missions/sentinel-2
Visible Infrared Imaging Radiometer Suite (VIIRS)	Reference	Image and Data processing by NOAA's National Geophysical Data Center. DMSP data collected by the US Air Force Weather Agency.
Pulse Seismic Inc.	Reference	Pulse Seismic Inc., pulseseismic.com
Historical Orthophotos ca 1980s	Reference	Alberta Environment and Parks, 2019. Provided by the Government of Alberta's Air Photo Library, through the Alberta Human Footprint Mapping Program (AHFMP)
Historical Orthophotos ca 1950s	Reference	Alberta Environment and Parks, 2019. Provided by the Government of Alberta’s Air Photo Library, through the Alberta Human Footprint Mapping Program (AHFMP)
Historical Cadastral Cutlines and Trails (CAD)	Reference	Alberta Environment and Parks, 2017. Provided by the Government of Alberta’s Air Photo Library, through the Alberta Human Footprint Mapping Program (AHFMP)
1950 linear features from Historical Planimetric Maps (PSC)	Reference	Alberta Environment and Parks, 2023. Provided by the Government of Alberta’s Air Photo Library, through the Alberta Human Footprint Mapping Program (AHFMP)
Confined Feeding Operations	Reference	Natural Resource Conservation Board, 2024. Open data, https://www.nrcb.ca/confined-feeding-operations/cfo-search
Historical Landfills	Reference	Alberta Environment and Protected, Areas 2023. Government of Alberta. https://open.alberta.ca/opendata/gda-37b0fbc2-f334-4d0f-9092-ef61f91c023f#detailed. Open Government Licence - Alberta
Cutline Trail Attribution Project	Reference	Government of Alberta dataset, provided by Alberta Human Footprint Mapping Project (AHFMP)
Recreation Trails	Reference	Government of Alberta, 2024. Alberta Environment and Protected Areas, https://open.alberta.ca/publications/albertas-public-land-trail-guide. Open Government Licence - Alberta
Alberta Municipal Data Sharing Partners	Reference	Alberta Municipal Data Sharing Partners, 2024. https://amdsp.ca/index.html

Alberta Township System	Reference	2016. Government of Alberta. https://www.altalis.com/. Open Government Licence - Alberta
Seismic Data Listing Service	Reference	2025. Seismic Data Listing Service. http://www.sdlsinc.com/
Historic Wildfire Data	Reference	2024. Government of Alberta. https://open.alberta.ca/opendata/wildfire-data. Open Government Lincene Alberta
Regulatory Regulatory Data Derived from geophysical final plans and OSE Maps	Referece	2025. Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)

10.2. Data Source Thematic and Spatial Accuracy

Table 17: Known thematic accuracy of source data used in HFIe 2023 creation.

Source	Collection	Source Category	Accuracy (%)
External	Inventories	AVI - Photo Interpretation Audit	≥ 90%
		GVI	≥ 65%
		PLVI	≥ 90%

Table 18: Known spatial (horizontal) accuracy of source data used in HFIe 2023 creation.

Source	Collection	Source Category	Accuracy (+/- metres)
External	Base features	1:20 000 Provincial Digital Mapping Program	5
		Alberta 1:50 000 Access Mapping	50
		GPS field data	25
		IRS-1C/1D imagery	25
		NTDB data	100
		Federal hydrography	100
		Orthophoto imagery	10
		Aerial photography	10
		SRD regional investigation	25
		Ikonos imagery	10
		Derived from supplementary data	25
		SPOT imagery	2.5
		Alberta Vegetation Inventory	20

	Inventories	GVI upland	5
		GVI wetland	2
		PLVI	5
	Cadastral	Cadastral urban	0.15
		Cadastral rural	3
ABMI	ABMI	Heads-up digitization SPOT "green zone"	10 – 20
Buffer	Buffer	Calculated RMSE per feature type	