

# Digital Line Graph (DLG) Reader

## FORMAT NOTES:

This format is not supported by FME Base Edition.

The Digital Line Graph (DLG) reader enables FME to import Level 3 DLG data and export it to any of the FME output formats. DLG is a published ASCII format developed by the United States Geological Survey (USGS) Federal Agency and is intended to assist in data exchange with the National Digital Cartographic Data Base (NDCDB).

The DLG reader supports all three distinct types of DLG data:

- large-scale DLG data (1:24,000-scale)
- intermediate-scale DLG (1:100,000-scale)
- small-scale DLG data (1:2,000,000-scale)

The three scales of DLG data are physically formatted into files in one of these ways: standard, optional, and graphics formats. FME supports both the standard and the optional DLG distribution formats. However, the graphics format is not supported. Most DLG data is distributed in the optional format.

## Overview

DLG data files consist of ASCII fixed field records. The records may or may not be stored with embedded carriage returns or end of line markers. The DLG reader intelligently determines the end of each record, and interprets files with or without explicit end of record markers.

The DLG file structure was designed to accommodate all categories of spatial data represented on a conventional line map. Node, line, and area data types are present within the DLG format, along with linkages and attribute codes.

Linkages are references to other features within the same DLG data set, used in a variety of contexts.

DLG files do not explicitly store attribute values but use a feature coding approach in which unique feature codes are assigned to the different types of features stored within the data set. Each geometric entity present in a DLG file may be assigned major and minor attribute codes which always appear as a pair. Together these codes often form complex relationships to assign specific attributes for each feature. The attribute coding scheme is designed to accommodate basic cartographic data categories such as hypsography, hydrography, or political and cultural features, as well as additional thematic data categories. The FME supports a maximum of 12 attribute code pairs per feature.

The FME looks for an extension of either `.dlg` or `.opt` for the input DLG files, but accepts any DLG file as input regardless of file name or extension.

Although mapping files may be created from scratch to work with the features as presented directly by the DLG reader, starting with an FME generated mapping file provides an easy way to harness the enhanced semantic interpretation of all attribute codes and linkages built into the FME distribution. This section will first outline the fea-

tures and attributes produced directly by the DLG reader. These features and attributes produced by using an FME generated mapping file are presented at the end of this section.

### DLG Quick Facts

Format Type Identifier	DLG
Reader/Writer	Reader
Licensing Level	Professional
Dependencies	None
Dataset Type	File
Feature Type	Feature category
Typical File Extensions	.dlg, .opt
Automated Translation Support	Yes
User-Defined Attributes	No
Coordinate System Support	Yes
Generic Color Support	No
Spatial Index	Never
Schema Required	No
Transaction Support	No
Geometry Type	dlg_type

Geometry Support			
Geometry	Supported?	Geometry	Supported?
aggregate	no	point	yes
circles	no	polygon	yes
circular arc	no	raster	no
donut polygon	yes	solid	no
elliptical arc	no	surface	no
ellipses	no	text	no
line	yes	z values	no
none	no		

### Reader Overview

The DLG reader simply opens the input file and immediately starts reading features and returning them to the rest of the FME for processing. The reader doesn't have any requirement for definition statements as there are no user-defined attributes.

Each feature returned by the DLG reader has its feature type set to one of the following: `dlg_point`, `dlg_line`, or `dlg_area`.

## Reader Directives

The suffixes shown are prefixed by the current <ReaderKeyword> in a mapping file. By default, the <ReaderKeyword> for the DLG reader is DLG.

### DATASET

**Required/Optional:** *Required*

The value for this directive is the file containing the DLG dataset to be read.

#### Example:

```
SHAPE_DATASET /usr/data/shape/92i080
```

## Feature Representation

In addition to the generic FME feature attributes that FME Workbench adds to all features (see *About Feature Attributes* on page 7), this format adds the format-specific attributes described in this section.

DLG features consist of geometry, linkages, and attribute code information. All DLG FME features contain the `dlg_type` attribute, which identifies the geometric type as well as several other standard attributes and are listed in the following table.

Attribute Name	Contents
<code>dlg_type</code>	The DLG geometric type of this entity. <b>Range:</b> <code>dlg_point </code> <code>dlg_line </code> <code>dlg_area</code> <b>Default:</b> No default
<code>dlg_element_number</code>	The element's internal identification number. The numbers are unique, positive, and sequential within each element type. <b>Range:</b> 1 - 32000
<code>dlg_record_type</code>	The character element type of the feature. Valid values include: N = Node Element L = Line Element A = Area Element
<code>dlg_num_text_characters</code>	Number of pairs of text characters attached to the feature. Although this field is present within the DLG format, it is not currently used. <b>Range:</b> 1 - 32000

Attribute Name	Contents
dlg_linkage{#}	<p>A list of linkages. These values refer to the features by their <code>dlg_element_number</code>. These linkages have different uses depending on their context. For example, a linkage list on an area feature refers to the line features that form the boundary of the area.</p> <p><b>Note:</b> For area features, linkages with a value of zero are not included in this list.</p> <p><b>Range:</b> 1 - 32000</p>
dlg_num_attribute_codes	<p>Number of attribute codes attached to the feature.</p> <p><b>Range:</b> 1 - 32000</p>
dlg_attribute_code{#}.major	<p>A list of major attribute codes. This list will have a maximum of 12 entries.</p> <p><b>Range:</b> 0 - 999</p>
dlg_attribute_code{#}.minor	<p>A list of minor attribute codes. This list will have a maximum of 12 entries.</p> <p><b>Range:</b> 0 - 9999</p>
dlg_attribute_code{#}.padmajor	<p>This list is identical to the <code>dlg_attribute_code{#}.major</code> list except all values in this list are padded with zeros to exactly three character places.</p> <p>For example, if <code>dlg_attribute_code{0}.major</code> was 90, <code>dlg_attribute_code{0}.padmajor</code> would be 090.</p> <p><b>Range:</b> 000 - 999</p>
dlg_attribute_code{#}.padminor	<p>This list is identical to the <code>dlg_attribute_code{#}.minor</code> list except all values in this list are padded with zeros to exactly four character places.</p> <p>For example, if <code>dlg_attribute_code{0}.minor</code> was 214, <code>dlg_attribute_code{0}.padminor</code> would be 0214.</p> <p><b>Range:</b> 0000 - 9999</p>
dlg_attribute_code{#}.partminor1	<p>This list contains the first character of the corresponding entry in the <code>dlg_attribute_code{#}.padminor</code> list.</p> <p>For example, if <code>dlg_attribute_code{0}.padminor</code> was 0214, <code>dlg_attribute_code{0}.partminor1</code> would be 0.</p> <p><b>Range:</b> 0 - 9</p>

Attribute Name	Contents
<code>dlg_attribute_code{#}.partminor2</code>	This list contains the second character of the corresponding entry in the <code>dlg_attribute_code{#}.padminor</code> list. For example, if <code>dlg_attribute_code{0}.padminor</code> was 0214, <code>dlg_attribute_code{0}.partminor2</code> would be 2. <b>Range:</b> 0 - 9
<code>dlg_attribute_code{#}.partminor34</code>	This list contains the third and fourth characters of the corresponding entry in the <code>dlg_attribute_code{#}.padminor</code> list. For example, if <code>dlg_attribute_code{0}.padminor</code> was 0214, <code>dlg_attribute_code{0}.partminor34</code> would be 14. <b>Range:</b> 0 - 9
<code>dlg_code_list</code>	A text string containing all major and minor codes assigned to this feature, in the following format: <b>Range:</b> <null>   <code list> <code list> = (<major code>-<minor code> [,<major code>-<minor code>]*) For example, if the feature had major and minor code pairs of 180/201, 180/605, and 180/210, the string value of <code>dlg_code_list</code> attribute would be "(180-201,180-605,180-210)"

Depending on the geometric type, the feature may contain additional feature coding attributes specific to the geometric type. These are described in subsequent sections.

## Points

**dlg\_type:** `dlg_point`

DLG point features specify a single x and y coordinate. While the DLG format does allow for points to be defined as degenerate lines—lines containing two identical points—the DLG reader converts these into standard points with a single set of coordinates.

There is one attribute specific to point features.

Field Name	Description
<code>dlg_num_linkage_records</code>	The number of linkages associated with this feature. This number indicates the number of entries in the <code>dlg_linkage{#}</code> attribute list. <b>Range:</b> 1 - 32000

## Lines

**dlg\_type:** `dlg_line`

DLG line features represent two-dimensional linear features.

There are several attributes specific to line features.

Field Name	Description
dlg_num_coordinates	The number of coordinates associated with this line feature. <b>Range:</b> 1 - 32000
dlg_starting_node	This number refers a node feature which is located at the initial point of the line. The value refers to the feature by its <code>dlg_element_number</code> . <b>Range:</b> 1 - 32000
dlg_ending_node	This number refers a node feature which is located at the final point of the line. The value refers to the feature by its <code>dlg_element_number</code> . <b>Range:</b> 1 - 32000
dlg_left_area	This number refers an area feature which is located to the immediate left of the line. The value refers to the feature by its <code>dlg_element_number</code> . <b>Range:</b> 1 - 32000
dlg_right_area	This number refers an area feature which is located to the immediate right of the line. The value refers to the feature by its <code>dlg_element_number</code> . <b>Range:</b> 1 - 32000

## Areas

**dlg\_type:** `dlg_area`

DLG area features represent polygonal features in 2D. These features are actually point features with one x and one y coordinate. This coordinate location may have little utility, as the boundary of the area is specified indirectly through the use of the `dlg_linkage{}` list attribute. Each entry in this list refers to a `dlg_line` which, together, form the boundary of the area. Additional attributes assigned to this area are attached to the original `dlg_area` feature.

There are several attributes specific to area features.

Field Name	Description
dlg_num_islands	The number of islands or holes within this area feature. <b>Range:</b> 1 - 32000
dlg_num_linkage_records	The number of entries in the <code>dlg_linkage{#}</code> list attribute. This list contains references to the line features that define the border of the area. Note: linkages with a value of zero are not included in this count. <b>Range:</b> 1 - 32000

Field Name	Description
dlg_num_points_area_list	The number of coordinates associated with the linear features necessary to define the border of this area feature. <b>Range:</b> 1 - 32000

## Features Created by Generated DLG Mapping Files

The attribute and geometric information within DLG data sets are encoded indirectly with major, minor, and linkage codes. The FME generates mapping files that can interpret all of these codes. The suggested method of creating custom mapping files for reading DLG data is to start with a generated mapping file. This provides an easy way to harness the enhanced semantic interpretation of all attribute codes and linkages built into the FME distribution. The following information pertains to the features and attributes produced by the mapping files generated to read DLG data.

## Feature Representation

The DLG features produced by the generated mapping file consist of geometry and explicit attribute information. Each feature that has passed through all of the factories in the generated mapping file has its feature type set to one of the following: HP, HY, SC, NV, BD, SM, RD, RR, MT, MS, or PL. These features correspond to the category abbreviations as outlined in the DLG standards – see the table *DLG Categories*. The geometry of each feature is appropriate to the `dlg_type`: `dlg_point` features have a single coordinate pair, `dlg_line` features contain multiple coordinates, and `dlg_area` features define closed polygons with holes where appropriate.

### DLG Categories

Name in Full	Abbreviation
Hypsography	HP
Hydrography	HY
Vegetative Surface Cover	SC
Non-Vegetative Features	NV
Boundaries	BD
Survey Control and Markers	SM
Roads and Trails	RD
Railroads	RR
Pipelines, Transmission Lines, and Miscellaneous Transportation Features	MT
Man-made Features	MS
U.S. Public Land Survey System	PL
Wetlands	WL
Unrecognized Category	UNKNOWN

All features share several attributes however, the feature will contain additional feature coding specific to the feature type. These are described in subsequent sections. All features tagged with major and minor codes of zero, indicating an outside area, are deleted.

## DLG Attributes

The following table lists the different DLG attributes attached to every feature which has passed through the generated mapping file.

Field Name	Description
<code>dlg_element_number</code>	The element's internal identification number. The numbers are unique, positive, and sequential within each element type. <b>Range:</b> 1 - 32000
<code>dlg_type</code>	The DLG geometric type of this entity. <b>Range:</b> <code>dlg_point</code>   <code>dlg_line</code>   <code>dlg_area</code> <b>Default:</b> No default
<code>dlg_code_list</code>	A text string containing all Major and Minor codes assigned to this feature, in the following format: <b>Range:</b> <code>&lt;null&gt;   &lt;code list&gt;</code> <code>&lt;code list&gt; = (&lt;major code&gt;--&lt;minor code&gt; [,&lt;major code&gt;--&lt;minor code&gt;]*)</code> For example, if the feature had major and minor code pairs of 180/201, 180/605, and 180/210, the string value of <code>dlg_code_list</code> attribute would be "(180-201,180-605,180-210)"
<code>category</code>	The full length text string of the feature's category, as defined in the DLG standards. See <i>DLG Categories</i> on page 535.
<code>description</code>	A text string containing all descriptive terms assigned to the feature through the Major and Minor codes. The source of these strings are the DLG standards documentation. Each description is separated by a semicolon. For example, if the feature had major and minor code pairs of 180/201, 180/605, and 180/210, the string value of <code>description</code> would be "Railroad; Underpassing; Arbitrary line extension [Code Deleted 07/95]"
<code>coincidentFeature</code>	If not null, this value indicates the other feature it is coincident with. The value refers to the coincident feature by its <code>dlg_element_number</code> . <b>Range:</b> 1 - 32000

## Hypsography

FEATURE\_TYPE: HP

This category of data consists of information on topographic relief – primarily contour data – and supplementary spot elevations.

There is one attribute specific to Hypsography features.

Field Name	Description
elevation	The elevation of the feature. The <code>description</code> attribute indicates whether the units are feet or metres. <b>Range:</b> -99999999.9 to +99999999.

## Hydrography

FEATURE\_TYPE: HY

This category of data consists of all flowing water, standing water, and wetlands.

There are several attributes specific to Hydrography features.

Field Name	Description
elevation	The elevation of the feature. The <code>description</code> attribute indicates whether the units are feet or meters. <b>Range:</b> -99999999.9 - +99999999.9
rotationAngle	The angle of clockwise rotation of the feature.

## Vegetative Surface Cover

FEATURE\_TYPE: SC

This category of data consists of information about vegetative surface cover such as woods, scrub, orchards, and vineyards. Vegetative features associated with wetlands, such as marshes and swamps, are collected under Hydrography.

There are no attributes specific to Vegetative Surface Cover features.

## Non-Vegetative Features

FEATURE\_TYPE: NV

This category of data consists of information about the natural surface of the Earth as symbolized on the map such as lava, sand, and gravel features. This category is not all inclusive, as other non-vegetative surface features, such as glaciers, are found in the category of Hydrography.

There are no attributes specific to Non-Vegetative Features.

## Boundaries

FEATURE\_TYPE: BD

This category of data consists of:

- political boundaries that identify States, counties, cities, and other municipalities, and
- administrative boundaries that identify areas such as national and State forests.

Political and administrative boundaries are always collected as a single data set. There are several attributes specific to Boundaries features.

Field Name	Description
state	The full name of the American state or the state equivalent. <b>Range:</b> "ALABAMA" to "VIRGIN ISLANDS"
county	The full name of an American county or a county equivalent for all states. <b>Range:</b> "Abbeville" to "Ziebach"
township	The full name of an American civil township or a civil township equivalent for all states. <b>Range:</b> "Aasu" to "Zwolle"
population1990	The 1990 complete-count population of the American county or the county equivalent.
monument	The alphanumeric monument number of the feature.

## Survey Control and Markers

FEATURE\_TYPE: SM

This category of data consists of information about points of established horizontal position and third order or better elevations used as fixed references in positioning and correlating map features.

There are several attributes specific to Survey Control and Markers features.

Field Name	Description
elevation	The elevation of the feature. The <code>description</code> attribute indicates whether the units are feet or meters. <b>Range:</b> -99999999.9 to +99999999.9
state	The full name of the American state or the state equivalent. <b>Range:</b> "ALABAMA" to "VIRGIN ISLANDS"
county	The full name of an American county or a county equivalent for all states. <b>Range:</b> "Abbeville" to "Ziebach"

## Roads and Trails

FEATURE\_TYPE: RD

This category of data includes major transportation systems.

There are several attributes specific to Roads and Trails features.

Field Name	Description
numberOfLanes	The number of lanes the road or trail has.
routeNumber	The alphanumeric route number or the road or the trail.
routeType	This attribute indicates whether the route is an Interstate, U.S., State, County, Reservation, Park, or Military Route.

## Railroads

FEATURE\_TYPE: RR

This category of data includes major transportation systems.

There are several attributes specific to Railroads features.

Field Name	Description
numberOfTracks	The number of tracks the railroad has.
rotationAngle	The angle of clockwise rotation of the feature.

## Pipelines, Transmission Lines, and Miscellaneous Transportation Features

FEATURE\_TYPE: MT

This category of data includes major transportation systems.

There is one attribute specific to Pipelines, Transmission Lines, and Miscellaneous Transportation Features.

Field Name	Description
rotationAngle	The angle of clockwise rotation of the feature.

## Man-made Features

FEATURE\_TYPE: MS

This category of data includes cultural features not included in the other major data categories, such as buildings and other related industrial, commercial, and residential features.

There are several attributes specific to Man-made Features.

Field Name	Description
featureWidth	Width in mils of feature to scale.
rotationAngle	The angle of clockwise rotation of the feature.

## Wetlands Features

FEATURE\_TYPE: WL

This category of data is not found in DLG files produced by USGS. However, some agencies create DLG data of this type.

There are no attributes specific to Wetlands Features.

## U.S. Public Land Survey System

FEATURE\_TYPE: PL

This category of data describes the rectangular system of land surveys which is administered by the U.S. Bureau of Land Management. Public Land Survey System (PLSS) data exist only for areas falling solely or in part within the States which were formed from the public domain. The PLSS subdivides the public domain and represents property boundaries or references to property boundaries. These DLG data are not intended to be official or authoritative. They are presented as cartographic reference information. The only legal basis for determining land boundaries remains the original survey.

There are several attributes specific to U.S. Public Land Survey System features.

Field Name	Description
section	The alphanumeric Section Identifier number.
township	Township Identifier numbers north and south of baseline, including fractions. Examples: "101 South", "23 1/2 North"
range	Range Identifier numbers east and west of principal meridian including fractions, duplicate, and triplicate notification. Examples: "5 East", "79 1/2 West", "47 West, duplicate to north or east of the original township"
origin	Full text string identifying the origin of the survey, including township, state, and date. Examples: "Boise - PM ID 1867", "Ohio River - OH OH,IN 1785"
nonsectionID	Full text string of the Non-Section Identifier. Examples: "51", "W", "San Ignacio de la Canoa grant in Arizona", "Pueblo of Santa Ana grant in New Mexico"

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Field Name	Description
monument	Land grant corner, location, or mineral monument number. <b>Range:</b> 0000 - 9999

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## Unknown Features

FEATURE\_TYPE: UNKNOWN

This category is used to catch any DLG features that do not belong to one of the previous categories. This can happen if the original data was not produced by USGS. The major/minor codes associated with the feature are saved with it, and should be used in consultation with the producing agency to interpret the feature.

There are no attributes specific to this type of feature.

