

US GeoData Digital Line Graphs

Digital line graph data

Digital line graph (DLG) data are digital representations of cartographic information. DLG's of map features are converted to digital form from maps and related sources. U.S. Geological Survey (USGS) DLG data are classified as large, intermediate, and small scale.

Data sources

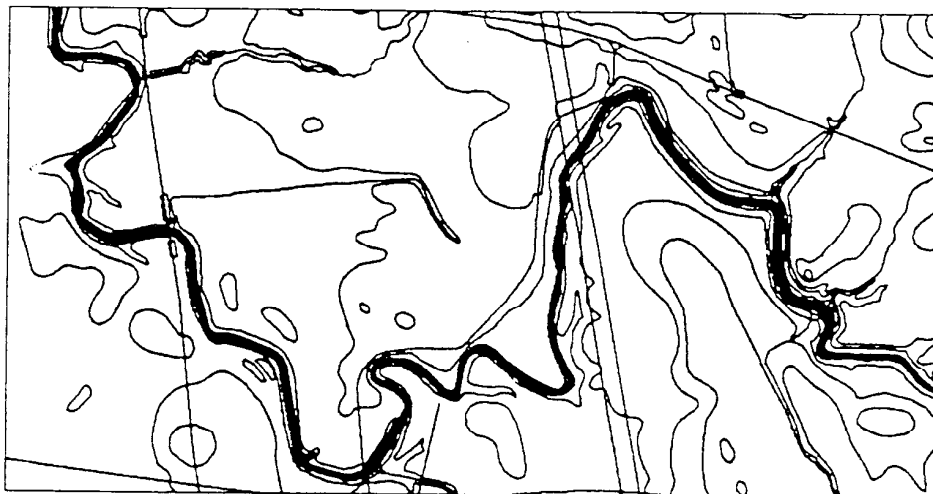
Large-scale DLG data are derived from USGS 1:20,000-, 1:24,000-, and 1:25,000-scale 7.5-minute topographic quadrangle maps. If 7.5-minute maps are not available, sources are used in the following order of preference: (1) advance manuscripts for 7.5-minute maps; (2) published 15-minute quadrangles at 1:62,500 scale (1:63,360 scale for Alaska); and (3) archival compilation materials for 15-minute quadrangles such as 1:48,000-scale compilations.

Intermediate-scale DLG data are derived from USGS 1:100,000-scale 30- by 60-minute quadrangle maps. If these maps are not available, Bureau of Land Management planimetric maps at a scale of 1:100,000 are used, followed by archival compilation materials.

Small-scale DLG data are derived from such maps as the USGS 1:2,000,000-scale sectional maps of the National Atlas of the United States of America. Alaska hydrography data were collected at 1:1,000,000 scale from Landsat images from 1979. Other categories of data were revised from 1979-80 sources.

Unit size and file extent

Large-scale DLG data are produced in 7.5-minute units that correspond to USGS 1:20,000-, 1:24,000-, and 1:25,000-scale topographic quadrangle maps. However, some older units in the western United States cover 15-minute areas and correspond to maps at 1:62,500 scale. The unit sizes in Alaska vary depending on latitude. Units south of 59° N. cover



Plot of DLG data—northwest corner of Bombay, New York-Quebec Quadrangle, 1:24,000-scale showing hydrography, roads and trails, railroads, miscellaneous transportation, and hypsography.

15- by 20-minute areas; between 59° and 62° N., 15- by 22.5-minute areas; between 62° and 68° N., 15- by 30-minute areas; and north of 68° N., 15- by 36-minute areas (all values are latitude and longitude, respectively).

Intermediate-scale DLG data are sold in 30-minute units that correspond to the east or west half of USGS 30- by 60-minute 1:100,000-scale topographic quadrangle maps. Each 30-minute unit is produced and distributed as four 15- by 15-minute cells, except in high-density areas, where the 15-minute cells may be divided into four 7.5-minute cells.

Intermediate-scale hydrography and transportation DLG data are sold on compact disc-read only memory (CD-ROM). Each disc contains all the 15- by 15-minute cells within the 1:100,000-scale quadrangles that cover a State or States. Currently 3 areas within 14 planned sectional regions in the United States are available: Area 3—southeastern States of NC, SC, and GA; Area 4—FL; and Area 13—northwestern States of WA, OR, and ID.

Small-scale DLG data that correspond to USGS 1:2,000,000-scale sectional maps of the National Atlas are sold in 21 units. Fifteen sections cover the continental United States, five cover Alaska, and one

covers Hawaii. These sectional DLG's are usually sold in multi-State units. Some, however, may cover only one State or a portion of a State. All 21 units are available on a single CD-ROM.

All nonstandard quadrangles with neat-lines that extend beyond the standard unit size to accommodate overedge boundaries are collected as multiples of the standard unit size. Data covering a 7.5- by 8.5-minute quadrangle area would, therefore, be sold as two 7.5-minute units.

Data content

Large-scale DLG data are available in nine categories: (1) hypsography, including contours and supplementary spot elevations; (2) hydrography, including flowing water, standing water, and wetlands; (3) vegetative surface cover, including woods, scrub, orchards, vineyards, and vegetative features associated with wetlands; (4) non-vegetative features, including lava, sand, and gravel; (5) boundaries, including State, county, city, and other national and State lands such as forests and parks; (6) survey control and markers, including horizontal and vertical positions (third order or better); (7) transportation, including roads and trails, railroads,

pipelines, and transmission lines; (8) manmade features, including cultural features not collected in other major data categories such as buildings; and (9) the Public Land Survey System, including township, range, and section line information.

Presently, intermediate-scale DLG's are sold in five categories: (1) Public Land Survey System; (2) boundaries; (3) transportation; (4) hydrography; and (5) hypsography.

Small-scale DLG data are sold in three categories: (1) boundaries, including political and administrative boundaries; (2) transportation, including roads and trails, railroads, and cultural features (airports and the Alaska pipeline); and (3) hydrography, including streams and water bodies, and hypsography (Continental Divide only). All of these categories are also included in the 1:2,000,000-scale CD-ROM.

Data structure

All DLG data distributed by the USGS are DLG - Level 3 (DLG-3), which means the data contain a full range of attribute codes, have full topological structuring, and have passed certain quality-control checks. The DLG-3 concept is based on graph theory in which a two-dimensional diagram is expressed as a direct graph composed of a set of nodes, lines, and areas that express logical relationships with minimal redundancy. Nodes define the end points of lines. A line is an ordered set of points that describe the position and shape of a linear feature of the map. An area is a continuous, unbroken region of the map bounded by lines. Applied to a map, this concept expresses spatial relationships between map elements that are obvious when the map is examined. The spatial relationships between features on a map include concepts such as location, adjacency, and connections. Data that maintain the spatial relationships inherent in the map are topologically structured.

Attribute codes

Attribute codes are used to describe the physical and cultural characteristics of DLG node, line, and area elements. Attribute codes are used to reduce redundant information, provide enough reference

information to support integration with larger data base, and describe the relationships between cartographic elements. Each DLG element has one or more attribute codes composed of a three-digit major code and a four-digit minor code. For example, with the 1:2,000,000-scale DLG data, the line attribute code 290 5001 has a major code (290), meaning road, with a minor code (5001) identifying the road as an interstate.

Data formats

Large- and intermediate-scale DLG's are available in standard and optional formats. The standard format has reduced storage requirements, 144-byte logical record length, an internal file coordinate system (thousandths of a map inch), and topological linkages contained only in the line elements. The optional format is easy to use with an 80-byte logical record length, a ground planimetric coordinate system (Universal Transverse Mercator), and topological linkages contained in node, line, and area elements.

Small-scale DLG's are available in standard, optional, and graphic formats. The standard format is the same as the large- and intermediate-scale DLG's. The optional format is also the same as the large and intermediate scales, except that it uses the ground planimetric coordinate system of the Albers Equal-Area Conic projection. The graphic format is compatible with Geological Survey Cartographic Automatic Mapping (GS-CAM) plotting software, with a 20-byte logical record length; a geographic (latitude-longitude) coordinate system expressed in degrees, minutes, and seconds; and no topological linkages. All three formats are available on the 1:2,000,000-scale CD-ROM.

Data records

The standard format data are organized into 9 record types and the optional format data into 11 record types. For descriptions of these record types, refer to Data Users Guide 1—Digital Line Graphs from 1:24,000-Scale Maps, Data Users Guide 2—Digital Line Graphs from 1:100,000-Scale Maps, and Data Users Guide 3—Digital Line Graphs from 1:2,000,000-Scale Maps.

The graphic format data are DLG line records organized by feature type and

reformatted into two record types: one line identifier record and multiple latitude-longitude records.

Data accuracy validation

DLG data do not carry quantified accuracy statements. However, the data files are checked and validated before they are released for distribution for file fidelity and completeness, attribute accuracy, and topological fidelity. For large- and intermediate-scale DLG's, additional data validation such as edge matching and quality control flagging is performed.

US GeoData Sampler

The US GeoData Sampler is available for a nominal charge. Data contents include the 7.5-minute digital elevation model (DEM) and the 1:24,000-scale DLG for Tumwater, Washington; the 1:100,000-scale DLG for Tacoma, Washington; the 1:2,000,000-scale DLG for the northwestern States (WA, OR, and ID); the 1- by 2-degree land use and land cover data for Seattle, Washington; the 1- by 1-degree DEM for Seattle, Washington East; and the Geographic Names Information System data for the State of Washington.

Ordering instructions

DLG data are written as ANSI-standard ASCII characters in fixed-block format on unlabeled or ANSI labeled nine-track magnetic tape at a 1,600-bpi or 6,250-bpi density. DLG's may be ordered by specifying the scale, format, maximum block size, tape density, tape label, and either the topographic quadrangle name or section, or the southeast latitude and longitude corner coordinates of the sales unit.

The US GeoData Sampler can be ordered by name and is offered in standard or optional ASCII DLG formats, on either one 6,250-bpi or three 1,600-bpi tapes.

To assist you in ordering, the Earth Science Information Center (ESIC) can furnish indexes, price lists, and order forms. Data Users Guides are included with each order.

For further information, contact the USGS, Earth Science Information Center, 507 National Center, Reston, VA 22092, or call 1-800-USA-MAPS.

DIGITAL LINE GRAPHS FROM 1:24,000-SCALE MAPS

This document describes the Digital Line Graphs (DLG's) prepared primarily from the 1:24,000 materials associated with the USGS Topographic Map Series. The series will eventually provide complete national coverage.

DATA CONTENT

The DLG data files derived from the 1:24,000-scale and other large-scale maps contain selected base categories of cartographic data in digital form; these data categories do not necessarily correspond to the traditional feature separates associated with the maps. The attribute coding scheme for these data has undergone several revisions since the start of the digital program. A major revision of these codes has been printed as Standards for Digital Line Graphs - Part 3, Attribute Coding, which is available for purchase from a USGS ESIC office (see the ordering information inside the front cover). Currently, DLG data entered in the National Digital Cartographic Data Base (NDCDB) are coded in accordance with the Standards for Digital Line Graphs. The implementation of the new coding standards will require the updating of existing files in the NDCDB in order to have a consistent product available for users. Software and procedures are being developed to convert existing data files to these codes during the next several years. Priority will be given to converting files retrieved in response to sales requests. In the meantime, a data base query will provide identification of the coding scheme used for any file in the NDCDB. This information will be supplied to customers when orders are submitted, and upon transmittal of data files. The following categories are included in current large-scale DLG files:

- Boundaries -- This category of data consists of (1) political boundaries that identify States, counties, cities, and other municipalities, and (2) administrative boundaries that identify areas such as National and State forests. Political and administrative boundaries are always collected as a single data set.
- Hydrography -- This category of data is currently being collected as combined hydrography consisting of all flowing water, standing water, and wetlands.

Prior to 1983, hydrographic data were differentiated into two components: streams and water bodies. Streams represent flowing water and were digitized as a network intended for hydrologic flow modeling. Streams included the banks of double-line rivers and centerline connectors placed through double-line rivers and lakes. Water bodies include standing water such as lakes and ponds. Wetlands and coastal hydrographic data were not collected.

- Public Land Survey System (PLSS) -- This category of data describes the rectangular system of land surveys that is administered by the U.S. Bureau of Land Management. PLSS data are only collected for areas falling solely, or in part, within the States that 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.

DIGITAL LINE GRAPHS FROM 1:24,000-SCALE MAPS

continued

- Transportation -- This category of data includes major transportation systems collected in three separate overlays labeled: (1) Roads and Trails, (2) Railroads, and (3) Pipelines, Transmission Lines, and Miscellaneous Transportation Features.

In the last quarter of 1985, new transportation attribute codes were implemented. The principal difference between the old and new coding schemes is that under the old transportation subcategory, certain miscellaneous transportation features were not collected and descriptive attribute codes were not used.

- Other Significant Manmade Structures -- This category of data includes miscellaneous cultural features not included in the other major data categories.

New attribute codes for Other Significant Manmade Structures were implemented in the last quarter of 1985. Very little data from this category currently reside in the NDCDB.

The attribute codes for the following base categories were newly defined in late 1985. Currently, there are very little data available in these categories.

- Hypsography -- This category of data consists of information on topographic relief (primarily contour data).
- Surface Cover -- 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.
- Non-Vegetative Surface Features -- 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 are found in the category of Hydrography.
- Survey Control and Markers -- This category of data consists of information about the points of established position and third-order or better elevations that are used as fixed references in positioning and correlating map features.

DIGITAL LINE GRAPHS FROM 1:2,000,000-SCALE MAPS

DATA CONTENT

The DLG data files derived from the 1:2,000,000-scale maps contain selected base categories of cartographic data in digital form. The data files are derived from the sectional maps of the 1970 National Atlas of the United States of America. The following categories are included in current 1:2,000,000-scale DLG files:

- Boundaries -- This category of data includes boundary information collected in two separate subcategories: (1) Political Boundaries and (2) Administrative Boundaries.
- Hydrography -- This category of data includes features collected in three separate subcategories: (1) Streams, (2) Water Bodies, and (3) Hypsography (Continental Divide only).
- Transportation -- This category of data includes major transportation systems collected in three separate subcategories: (1) Roads and Trails, (2) Railroads, and (3) Cultural Features (airports and Alaska pipeline).

DISTRIBUTION FORMATS

The 1:2,000,000-scale DLG data are available in three distribution formats: (1) standard, (2) optional, and (3) graphic.

The Standard distribution format was designed to minimize storage requirements. Explicit topological linkages are contained only in the line elements.

The Optional distribution format was designed for data interchange. These files are typically larger than those in the standard format but, for certain applications, can simplify processing requirements. Topological linkages are explicitly encoded between all line and node elements, and all line and area elements. This structure allows a polygon data structure to be easily created.

The Graphic distribution format was designed to be compatible with the GS-CAM (Geological Survey - Cartographic Automatic Mapping) software. This software provides for plotting line and point information using a variety of map projections, scales, and graphic symbologies.

The files in the graphic distribution format are derived from the topologically structured DLG data described above, and contain a subset of the line and attribute code information in the DLG files. No node or area information is stored in these files. These files are not topologically structured.

The small-scale (1:2,000,000-scale) DLG sectional U.S. coverage data is available on a CD-ROM for \$32.

DIGITAL LINE GRAPHS FROM 1:100,000-SCALE MAPS

DATA CONTENT

The DLG data files derived from the 1:100,000-scale maps contain selected base categories of cartographic data in digital form; these data categories do not necessarily correspond to the traditional feature separates associated with the maps. The following categories are included in current 1:100,000 DLG files:

- Hydrography -- This category of data describes combined hydrography consisting of all flowing water, standing water, and wetlands.
- Transportation -- This category of data includes major transportation systems collected in three separate subcategories labeled: (1) roads and trails, (2) railroads, and (3) pipelines, transmission lines, and miscellaneous transportation.
- Hypsography -- This category of data consists of information on topographic relief (primarily contour data), and supplementary spot elevations.
- Boundaries -- This category of data consists of (1) political boundaries that identify States, counties, cities, and other municipalities, and (2) administrative boundaries that identify areas such as National and State forests. Political and administrative boundaries are always collected as a single data set.
- Public Land Survey System (PLSS) -- This category of data describes the rectangular system of land surveys that is administered by the U.S. Bureau of Land Management. PLSS data are only collected for areas falling solely, or in part, within the States that 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.

The hypsography, boundary, and PLSS categories were authorized for production in late 1987. Currently there is very little data available in these categories.

The remaining categories: manmade features, survey control, vegetative surface cover, and nonvegetative features are projected to enter the production phase in 1990.

DIGITAL LINE GRAPHS

DISTRIBUTION FORMATS

The 1:24,000-scale and other large-scale DLG data are available in two distribution formats: (1) standard and (2) optional.

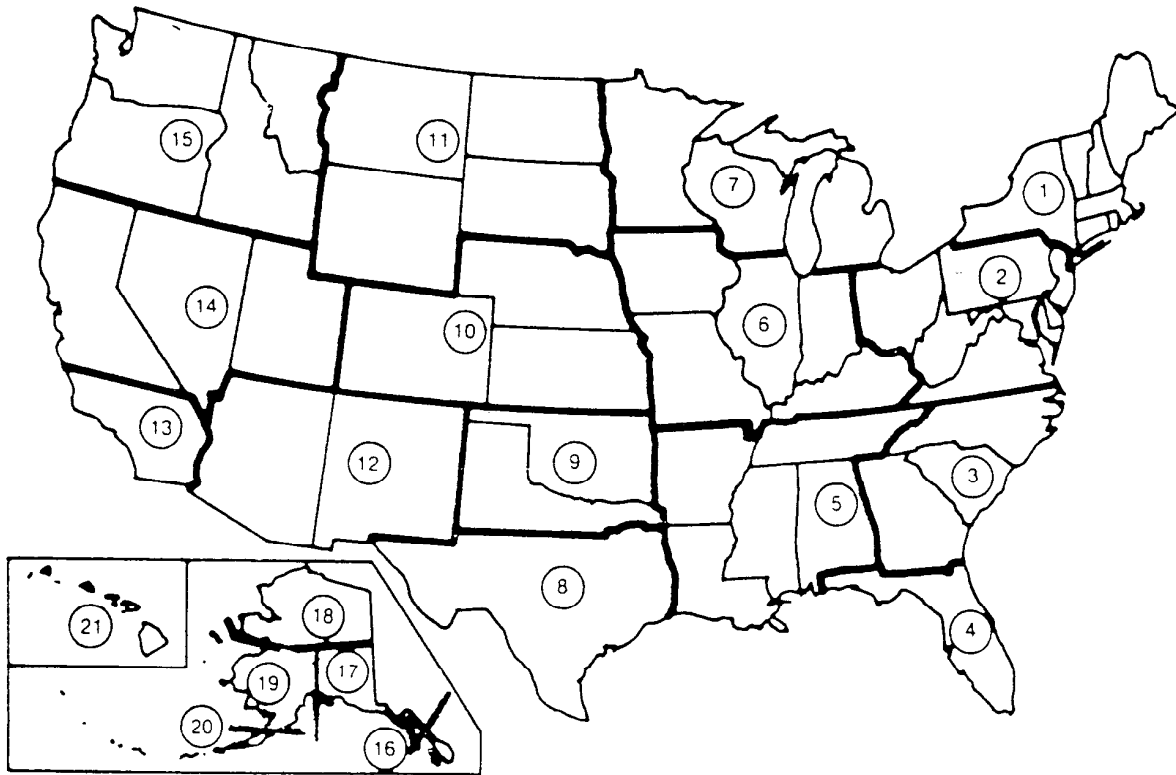
The **Standard** distribution format is intended to minimize storage requirements. Explicit topological linkages are contained only in the line elements (starting node, ending node, area to the left of direction of travel, area to the right of direction of travel).

The **Optional** distribution format was designed to facilitate data usage. The topological relationships explicitly encoded include starting node, ending node, area to the left of direction of travel and area to the right of direction of travel for line elements, bounding lines for area elements, and bounding lines for node elements. These files are typically larger than those in the standard format but, for certain applications, can simplify processing requirements. For example, topological linkages are explicitly encoded for all line, node, and area elements, allowing a polygon data structure to be easily created. These linkages facilitate GIS applications of DLG data as well as generation of graphic products.

The characteristics of the standard and optional DLG formats are

Standard and optional DLG format

	Standard	Optional
Character set	8-bit ASCII	8-bit ASCII
Logical record length	144 bytes	80 bytes
Physical record length (blocksize)	Variable in multiples of 144 bytes.	Variable in multiples of 80 bytes.
Coordinate system	Internal file (thousandths of a map inch).	Ground planimetric (UTM).
Topological linkages	Contained only in line elements.	Contained in node, area, and line elements.



Multistate cells used for Digital Line Graphs from 1:2,000,000-scale maps.

INDEX MAP

- 1 NORTHEASTERN STATES
- 2 MIDDLE ATLANTIC STATES
- 3 SOUTHEASTERN STATES
- 4 FLORIDA
- 5 SOUTHERN MISSISSIPPI VALLEY STATES
- 6 CENTRAL MISSISSIPPI VALLEY STATES
- 7 NORTHERN GREAT LAKES STATES
- 8 SOUTHERN TEXAS
- 9 SOUTHERN PLAINS STATES
- 10 CENTRAL PLAINS STATES
- 11 NORTHERN PLAINS STATES
- 12 ARIZONA AND NEW MEXICO
- 13 SOUTHERN CALIFORNIA
- 14 CENTRAL PACIFIC STATES
- 15 NORTHWESTERN STATES
- 16 SOUTHEASTERN ALASKA
- 17 CENTRAL ALASKA
- 18 NORTHERN ALASKA
- 19 SOUTHWESTERN ALASKA
- 20 ALEUTIAN ISLANDS
- 21 HAWAIIAN ISLANDS

APPENDIX --Sample DLG Data File (Standard Distribution Format)
 (Each 144-character record is shown as two consecutive 72-character lines.)

GLEN ELLEN

1968 24000

3 1 10 -0.122033045000000D 09 0.380180450000000D 08 0.0
 0.0 0.0 0.0
 0.0 0.0 0.0
 0.0 0.0 0.0
 0.0 2 0.610000000000000D 00 0 4
 -0.122625000000000D 03 0.382500000000000D 02 -0.122625000000000D 03
 0.383750000000000D 02 -0.122500000000000D 03 0.383750000000000D 02
 -0.122500000000000D 03 0.382500000000000D 02
 0.609594407590000D 00 -0.288178569420000D-02 0.538248793410000D 06
 0.424037445560000D 07 4
 SW -8971-11376NW -8955 11375NE 8955 11376SE 8971-11376

1

BOUNDARIES (24&25)		795	16	795	7	530	20
N	1 -8971-11376	0	0				
N	2 -8955 11375	0	0				
N	3 8955 11376	0	0				
N	4 8971-11376	0	0				
N	5 -8966 3203	0	0				
N	6 2101 11374	0	0				
N	7 5832 11376	0	0				
N	8 7513 11376	0	0				
N	9 8956 7494	0	0				
N	10 8961 2884	0	0				
N	11 3469 10371	0	0				
N	12 5530 9112	0	0				
N	13 -3115-10127	0	0				
N	14 7520 11175	1	0				

90 1

APPENDIX --Standard DLG Distribution Format (Record Contents)

In the standard DLG distribution format, the topological linkages are contained only in the line elements. The files are physically comprised of standard 8-bit ASCII characters organized into fixed-length logical records of 144 characters. Nine distinct record types are defined.

<u>Logical record type</u>	<u>Content</u>
A	Header record containing DLG identification information.
B	Header record containing projection information and registration points.
C	Header record identifying data categories contained in this DLG and indicating the number of nodes, areas, and lines in each category.
D.1	A node or an area record.
D.2	A line record.
E	Record containing x,y coordinate string.
F	Record containing attribute codes.
G	Record containing text string (not currently used).
H	Accuracy estimate (not currently used).

The actual sequence of records in a standard distribution DLG file is as follows:

1. Header records

- Type A (one record)
- Type B (one record)
- Type C (one record)

2. Data records

Node records	}	Repeated for each node within a data category	}	Repeated for each data category
Node description (D.1)				
Attribute codes (F)				
Text string (G)				
Area records	}	Repeated for each area within a data category		
Area description (D.1)				
Attribute codes (F)				
Text string (G)				
Line records	}	Repeated for each line within a data category		
Line description (D.2)				
x,y coordinates (E)				
Attribute codes (F)				
Text string (G)				

3. Accuracy estimate

- Type H (one record) (not currently used)

APPENDIX --Sample DLG Data File (Optional Distribution Format)
 (Each 80-character record is shown as a single line.)

USGS-NMD DLG DATA - CHARACTER FORMAT - 09-29-82 VERSION
 GLEN ELLEN 1968 24000

	3	1	10	2	0.61000000000D+00	4	0	4	1
	-0.122033045000000D+09		0.380180450000000D+08			0.0			
	0.0		0.0			0.0			
	0.0		0.0			0.0			
	0.0		0.0			0.0			
	0.0		0.0			0.0			
	0.10000000000D+01		0.0		0.0	0.0			
SW	38.250000	-122.625000			532812.91	4233413.86			
NW	38.375000	-122.625000			532757.10	4247282.79			
NE	38.375000	-122.500000			543674.93	4247335.01			
SE	38.250000	-122.500000			543750.25	4233465.56			
BOUNDARIES (24&25)		0	16	16	010	7	7	010	20 20 1
N 1	532812.91	4233413.86			2	0	0		
	1	-10							
N 2	532757.10	4247282.79			2	0	0		
	-2	3							
N 3	543674.93	4247335.01			2	0	0		
	-6	7							
N 4	543750.25	4233465.56			2	0	0		
	-9	10							
N 5	532773.94	4242301.15			3	0	0		
	-1	2 12							
N 6	539496.77	4247314.04			3	0	0		
	-3	4 17							
N 7	541771.16	4247326.01			3	0	0		
	-4	5 -19							
N 8	542795.89	4247330.85			3	0	0		
	-5	6 -14							
N 9	543686.72	4244968.57			3	0	0		
	-7	8 -15							
N 10	543703.06	4242158.35			3	0	0		
	-8	9 -20							
N 11	540333.59	4246706.56			3	0	0		
	-16	-17 18							
N 12	541593.59	4245945.02			3	0	0		
	-18	19 20							
N 13	536379.09	4234192.12			2	0	0		
	11	-11							
N 14	542800.74	4247208.34			2	1	0		
	14	15							
	90	1							
N 15	537351.64	4243171.97			2	1	0		
	-12	13							
	90	1							
N 16	538780.02	4243415.25			2	1	0		
	-13	16							
	90	1							

APPENDIX --Optional DLG Distribution Format (Record Contents)

In the optional DLG distribution format, topological linkages are explicitly encoded for node and area elements as well as for line elements. The files are physically comprised of 8-bit ASCII characters organized into fixed-length logical records of 80 characters (bytes). Bytes 1-72 of each record may contain DLG data, and bytes 73-80 may contain a record sequence number.

The 11 distinct record types used in the optional DLG distribution format may be categorized as header and data records.

Four types of records are considered header records:

- File identification and description records
- Accuracy records (not currently used)
- Control-point identification records
- Data-category identification records

Seven types of records are considered data records:

- Node and area identification records
- Node-to-line linkage records
- Area-to-line linkage records
- Line identification records (also contains line-to-node and line-to-area linkages)
- Coordinate string records
- Attribute code records
- Text records (not currently used)

The actual sequence of records in an optional distribution format DLG file is as follows:

1. Header records

Ten file identification and description records
Accuracy records (not currently used)
Control point identification records
(one per control-point)
Data category identification records
(one per data category in the file)

2. Data records

Node identification record	}	Repeated for each node within a data category	}	Repeated for each data category
Node-to-line linkage record(s)				
Attribute code record(s)				
Text record(s)				
Area identification record	}	Repeated for each area within a data category		
Area-to-line linkage record(s)				
Attribute code record(s)				
Text record(s)				
Line identification records	}	Repeated for each line within a data category		
Coordinate string record(s)				
Attribute code record(s)				
Text record(s)				