National Mapping Program
Technical Instructions

Part 2
Specifications

Standards for
Digital Line Graphs

Department of the Interior
U.S. Geological Survey
National Mapping Division

CONTENTS

APPENDICES

TABLES

LIST OF PAGES

A complete and current copy of Part 2 of Standards for Digital Line Graphs consists of the pages (and most recent creation or revision dates) listed below.

2. SPECIFICATIONS

Specifications for DLG data will be described by considering the following subject areas: coordinate systems, cell size and extent, error definition, data quality and distribution format.

2.l COORDINATE SYSTEMS

The positional descriptions for DLG data elements are expressed in one of several coordinate systems, dependent upon the distribution format selected.

The DLG data in the standard distribution format are encoded using an internal file coordinate system to minimize storage requirements. The characteristics of this system are as follows:

- The coordinate system is Cartesian.
- The origin (x=0, y=0) is at the center of the cell. Some older files will have their origin below and to the left of the lower left corner of the cell.
- The x axis of the coordinate system is parallel to a theoretical straight line connecting the southwest and southeast corners of the cell, and the y axis is perpendicular to that line.
- One unit is equal to 0.00l inch at map scale.
- The coordinate domain is limited to the range -32768 to +32767.

The file header contains the parameters of a transformation which can be used to convert the internal file coordinates to the ground coordinate system in either Universal Transverse Mercator (UTM) for l:24,000- and l:l00,000-scale DLG's, or Albers Conical Equal Area for l:2,000,000-scale DLG's.

The DLG data in the optional distribution format are expressed in the units of the respective ground coordinate systems; that is, meters in the UTM or Albers Conical Equal Area systems.

The l:2,000,000-scale DLG data in the graphics distribution format are expressed in geographic coordinates (latitude and longitude). These values are expressed in degrees, minutes, and seconds.

2.2 CELL SIZE AND FILE EXTENT

In general the large-scale DLG's are stored and distributed in standard cells of 7.5-minutes of latitude by 7.5-minutes of longitude. Non-standard quadrangles which have a neatline extended to accommodate overedge information, (e.g. along national boundaries or in coastal areas) are collected as multiple 7.5-minute units.

Of the l:24,000-scale data collected from l5-minute quadrangles, the majority are digitized as four 7.5-minute units, and distributed in standard 7.5-minute cells. A few older data files, collected from l5-minute quadrangles, were digitized in single l5-minute units, and are distributed in this format. In Alaska, data digitized from l:24,000/l:25,000-scale source material are stored in cells varying from l0-minutes to l8-minutes of longitude, by 7.5-minutes of latitude, depending on the latitude of the cell. Alaskan data digitized from l:63,360-scale source material are stored in cells varying from 20-minutes to 36-minutes of longitude, by l5-minutes of latitude, depending on the latitude of the cell.

The intermediate-scale DLG's, covering the contiguous United States and Hawaii, are to be distributed in groups of files that make up a 30- x 30-minute area of coverage, each grouping representing the east or west half of a l:l00,000-scale source map. Each 30-minute area consists of a varying number of DLG files depending on the category and the feature density. The normal distribution group will be four l5-minute files per 30-minute area. If the feature density of an area is such that the file size would exceed the limitations of the processing software, then that 30-minute area would be covered by sixteen 7.5-minute files. In l986 the U.S. Geological Survey released a preliminary version of l:l00,000-scale

DLG's. These data were packaged differently than described above. The distribution cells for the "roads and trails" portion of the "transportation" overlay, and for the "hydrography" overlay, consist of sixteen 7.5-minute files. The "railroads" and "miscellaneous transportation" portions of the "transportation" overlay consist of single 30-minute files. In northern Florida and southern Georgia, the "railroads" and "miscellaneous transportation" data may be in sixteen 7.5-minute files.

The small-scale DLG's are distributed predominantly in multistate cells, which approximate the National Atlas sectional maps. The total number of l:2,000,000-scale DLG cells is twenty-one; fifteen for the conterminous United States, five for Alaska and one for Hawaii.

The data for each cell are encoded in multiple thematic categories. Normally, there is one file per category. However, due to software limitations at the time of digitizing, some categories with a large number of elements may be encoded in several files.

2.3 ERROR DEFINITION

DLG data may contain errors of three types: blunders, which should be removed prior to entry to the data base; systematic errors, occurring in a system-specific or a procedure-specific pattern; and accidental errors, which are of a purely random nature and are completely unpredictable. Although all three types may be reduced in magnitude by refinements in technique and precision, they never can be completely eliminated.

2.3.l Blunders

For DLG data, a blunder is an error of major proportions often exceeding 0.009 inch (3 times the standard error) in the x or y component directions. This is the maximum error permitted for DLG data, and as such is easily identifiable. Moreover, a blunder is an indication that the data collection process has deteriorated beyond the level of simple systematic or random errors. Every effort is made to eliminate identifiable blunders during processing and quality-control operations. However, despite design precautions, some blunders may remain.

2.3.2 Systematic Errors

Systematic errors are those errors that are introduced by procedures or systems and typically are predictable but not easily correctable. These types of errors cause a bias or artifact in the final product, but are generally not large enough to be classed as blunders. For DLG data, localized systematic errors could include artifacts which are typical of raster-digitized data. Unidentified and uncorrected systematic errors are included in and contaminate the accuracy statistics used to describe the final DLG.

2.3.3 Random Errors

Random errors are those errors considered to be observational in nature or a result of limitations in measuring precision. They are caused by both system and human limitations. Random errors generally conform to a normal error distribution.

2.3.4 → Standard Error

The standard error statistic is used to describe the horizontal accuracy of a DLG, encompassing both random and systematic errors introduced during production of the data. The standard error is computed in both x and y component directions.

Standard error (SE) for the x or y direction is defined as:

$$SE = \sqrt{\frac{\sum (S_i - S_t)^2}{n}}$$

where S_i = DLG x or y coordinate of a test point

S_t = true x or y coordinate of a test point

n = number of test points

The term S_t, "true" coordinate, refers to the "most probable" coordinate value, since values are normally derived from production map sources.

Accuracy is computed by comparison of the DLG coordinate with true coordinates derived with a higher order of accuracy. Test points should be well defined and well distributed and have "true" coordinates with accuracies greater then the DLG accuracy criteria. ←

2.4 DATA QUALITY

Five characteristics relating to digital data quality are included as sections of a quality report. The goal of this type of standard is to allow the user the freedom to evaluate the usefulness of the data for a given application, rather than applying a quantitative threshold towards each characteristic. The quality of Digital Line Graph data can be described in terms of the following five characteristics: lineage, positional accuracy, attribute accuracy, logical consistency, and completeness.

2.4.l Lineage

Lineage data generally provide information on the source of the data file, collection procedures, processing steps, reference systems, projection transformation parameters, data resolution, and coordinate domain.

DLG data carry some lineage information in the header record for each file. Format specifications designate specific fields for lineage data elements (see Appendices 2-A and 2-B). Additional lineage data are described in related NMD Technical Instructions, such as Procedure Manuals and Data Users Guides. The sources of lineage information and information about collection and revision procedures are available through the Assignment Management System (AMS) and are expected to be identified in the future with file specific metadata.

2.4.1.1 Date

One of the lineage elements of the DLG header record is a date. This element is identified as "Date of Original Source Material." Previously, the date element provided a way to collect the dates in the lower right-hand corner of printed maps. These dates indicated the version of the map used to produce the DLG. The first four bytes of the date field held the map edit date, represented on the

map in black. The last four bytes of the field held the date of any photoinspections or photorevisions, represented on the map in red or purple. The dates were followed by a "Collection Procedure Qualifier." Originally, there were four qualifiers: "D" for digital revision; "I" for photoinspection; "L" for limited revision; and "P" for photorevision.

In 1994, the NMD redefined the way dates are handled for both graphic maps and digital data products. This redefinition was originally documented in the Supplemental Technical Instruction (STI) 94-6, "Map Date for Primary Series Maps," dated 6/17/94. The criteria for redefining map dates was reissued in the current version of the Technical Criteria for Digital Revision and Product Generation, 1:24,0000-scale Digital Line Graphs and Quadrangle Maps, Miscellaneous Instruction and in STI 96-1, "Map Date for Primary Series Maps" (9/4/96).

→ Beginning in 1994, only one date is shown on new and revised graphic map products. This provides a better indicator of the currentness of map information. Likewise, the date element in the DLG header provides one date to indicate the date to which the data are current. The following paragraphs provide information on the date element for DLG products produced by digital revision and by map collection.

Replacement Mapping and Standard Update -- For DLGs revised using replacement mapping or standard update procedures, the date element contains only one date. The latest field check date, which indicates the date of currentness for all categories, is used for the date element.

Limited Update -- For DLGs revised using limited update procedures, the date element contains only one date. For each category, the date indicating the currentness of the data is used in the date element. The dates will vary from category to category depending on what type of source is used, the vintage of the source, and whether

or not the category is revised[1]. Dates may be based on the date of imagery used to inspect or revise the data, the date associated with ancillary sources used to inspect or revise the data, or the date of the original field check.

Collection from Maps -- The date element indicates, on a category by category basis, the date to which data in that category is current. The date element contains only one date per category. The collection procedure qualifiers "D", "I", "L", and "P" are no longer valid during collection. The date information is obtained from the credit notes and margin information using the following criteria:

- The currentness date for PLSS and Survey Control is used if it is specifically stated. Otherwise, the most recent field check or planetable surveys date is used.

- The currentness date for Boundaries is used if it is specifically stated on the map. If there is no boundary note, the most recent map edited date is used. If there is no map edited note, use the most recent purple photorevision date shown under the black map date. The collection procedure qualifier "P" is no longer used. If the date information cannot be determined using the above criteria, the map date is used.

- The currentness date for Hypsography is the date of the most recent compilation of topography for the entire quadrangle. If the topography was compiled from imagery, the currentness date is the date of that imagery. If there is a range of imagery dates for the most recent compilation, the oldest date is used. If the current topography was compiled by planetable surveys, the planetable surveys date is used. If the topography was compiled using a combination of imagery and planetable surveys, the older of the two dates is used.

[1] Refer to the Technical Criteria for Digital Revision and Product Generation, 1:24,000-Scale Digital Line Graphs and Quadrangle Maps, Miscellaneous Instruction for specific information on coding the date element by category and which categories are revised during limited update.

Use the following criteria for all remaining categories:

- If there is a field check date more recent than any date of imagery, the remaining categories use the field check date. If there is a range of field check dates, use the most recent field check date.

- If there is no field check date or if the field check date is not more recent than the latest revision imagery date, the remaining categories use the date of imagery. If there is a range of imagery dates, the oldest date of the range is used.

- If the map has a purple photorevised note, the date of the photorevision imagery is used for the remaining categories. If there have been multiple photorevisions, the date of the most recent photorevision imagery is used. If there is a range of imagery dates for the most recent photorevision, the oldest date is used. The collection procedure qualifier “P” is no longer used.

- If the map has either a photoinspection imagery date note or a red photoinspected map date, that date is used for the remaining categories. The collection procedure qualifier "I" is no longer used.

- If the date information for the remaining categories cannot be determined using the above criteria, the most recent date of imagery is used. If there is a range of imagery dates involved with the most recent compilation, the oldest date is used. ←

2.4.2 Positional Accuracy

DLG positional accuracy is based on the use of standard USGS graphic products as the fundamental source for initial loading of the NDCDB. These source graphics are normally compiled to meet National Map Accuracy Standards (see Appendix 2-E), where 90 percent of well-defined features are to be within 0.02 inches of

true mapped ground position. The DLG positional error shall be less than or equal to 0.003 inches standard error in both the x and y component directions, relative to the source that was digitized.

Positional consistency of DLG elements that span quadrangle edges may be altered using edge alignment routines that result in "snapping" together corresponding node and line elements that are located within 0.020 inches of each other. The maximum positional adjustment for any node and associated line element would be 0.010 inches.

2.4.3 Attribute Accuracy

DLG data represent the source graphic and, therefore, data for a given category will contain attribute codes that reflect the information portrayed on the source. All attribute codes of DLG data in the NDCDB will agree within 98.5 percent to attribute codes as described in Part 3 of this Standard: Attribute Coding.

2.4.4 Edge Matching

Edge matching ensures that features are matched in content, position and attribution along a common edge. Edge matching is conducted interactively at the time of original compilation and some revisions using source materials for verification. Edge align software automatically compares position and attribution, and aligns features that are within 0.020 inches of each other. Features that are out of tolerance and/or have different attributes are identified.

DLGs collected from source maps without revision are processed through the edge align software for all edges internal to the project area and for all edges external to the project area if adjoining DLG data exists. (For external edges see section 2.4.5, REASON FLAG #8, for exceptions.) For both internal and external edges, the level of edge matching achieved on the source graphics is maintained; do not investigate or correct mismatches.

Digitally revised DLGs are edge matched and aligned according to the instructions found in Part 1 of Miscellaneous Instruction, Technical Criteria for Digital Revision and Product Generation.

2.4.5 Edge Align Status and Reason Flags

Information in the header of the DLG-3 indicates the status of the file with respect to the edge matching described above. The four status flags contain the status of the West, North, East, and South edges of a DLG-3 as compared to the edges of the four adjoining DLG-3 files. Each of the four flags is followed by a status reason code that explains the status of the four edges respectively.

The possible status values for a DLG-3 entered into the NDCDB are:

(blank) = no reason code set, ("unchecked" for some earlier data sets)
0 = passed edge match check
l = alignment discontinuity
2 = attribute discontinuity
3 = attribute and alignment discontinuity

The possible reason codes are:

(blank) = no reason code set, ("unchecked" for some earlier data sets)
4 = adjacent data do not exist
5 = adjacent data unavailable
6 = temporal/source discontinuity
7 = mismatch valid
8 = paneling unauthorized
9 = processing software limitation

The following combinations of status flags and reason flags are currently valid for the processing software.

blank, blank blank, 4 blank, 5 blank,8
0,blank
l,6 l,7 1,9
2,6 2,7
3,6 3,7

The following is a brief explanation of the reason flags.

4 = adjacent data do not exist

This flag is used with a status flag of blank (unchecked). This combination exists primarily for file edges which are adjacent to areas unmapped within the series/scale of products being digitized, e.g. coastal and international boundary locations. This flag is also used for U.S. Public Land Survey System (PLSS) file edges which border areas of the country not having PLSS information.

5 = adjacent data unavailable

This flag is used with a status flag of blank (unchecked). It is appropriate for edges adjacent to areas having similar source material and data categories, but which have not been digitized and archived. A reason code with the value of 5 may be reset as the adjoining data cell becomes available for edge match verification.

6 = temporal/source discontinuity

This flag indicates a discontinuity in classification or alignment between features on adjacent DLGs which were either digitized as represented from map sources with different information, or which were compiled or revised from source of different dates. Mismatches may also occur due to changes in the standards and/or in the processing software.

7 = mismatch valid

This reason flag applies in the case of a linear graph element ending precisely on the neatline or having a reasonable attribute value change as it crosses the neatline. (e.g. A road changing from third to fourth class at the neatline.)

8 = paneling unauthorized

This flag is used with the edge status flag of blank and indicates that no authorization was in place for edge matching at the time the data were archived. Paneling is not authorized for (1) adjoining DLGs on different horizontal datums or (2) for Hypsography and Hydrography, when the adjoining DLG is on a different vertical datum or (3) for Hypsography, when the adjoining DLG has a different contour interval that is not a multiple of the adjoining contour interval or when one quad has metric contours while the other has English contours (4) when adjoining data have not been processed successfully to a level 3 DLG using software developed after 1986, such as all Unified Cartographic Line Graph Encoding System (UCLGES) data (pre-1987) and TRANCON data.

9 = processing software limitations

This flag indicates data have been matched and automatically aligned using the processing software. Mismatches occur because one file has been segmented due to a processing software file size limitation. The edge align software is unable to distinguish between file segments that are intentionally devoid of data and file segments where data is missing in error. This flag is valid in situations where the mismatches are due only to software limitations.[1]

In the course of checking and aligning an edge it is possible to encounter more than one reason for a mismatch status, such as both valid and temporal/source discontinuities. In such cases the reason flag is to be set to indicate the "worst case", i.e. the reason indicating the most serious problem with the edge and which in most cases would require some degree of correction in the future. For the above example, the temporal/source discontinuity reason flag would be set in preference to the mismatch valid flag.

[1] Until this reason flag is added to PROSYS/PROSIX, use reason flag *7, mismatch valid*, to explain mismatches caused by software file size limitations.

2.4.6 Logical Consistency

Logical consistency describes topological fidelity internal to a file. Certain node-area-line relationships are collected or generated to satisfy topological requirements. Some of these requirements include: lines begin and end at nodes, lines connect to each other at nodes, lines do not extend through nodes, left and right areas are defined for each line element and are consistent throughout the files and the lines representing the limits of the file (neatline) are free of gaps.

2.4.7 Completeness

Completeness refers to the subset of features or objects represented in the DLG in relation to the domain, which is the source graphic. The DLG for a given category of data will contain at least the same level of content and detail shown on the source graphic.

2.5 DISTRIBUTION FORMATS

Digital Line Graph data originally were available in two distribution formats: (1) standard and (2) optional. A third format, DLG's from 1:2,000,000-scale maps had also been available as a "graphics" format.

In July 1996, the NMD abandoned the standard and graphic formats as deliverable products because they were seldom purchased by customers and they were not designed for widespread data usage, especially in Geographic Information System (GIS) applications. **The optional distribution format is currently the only DLG format available**.

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 the direction of travel for line elements, bounding lines for area elements, and bounded 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, because topological linkages are explicitly encoded for all line, node, and area elements, a polygon data structure can be easily created. These linkages facilitate GIS applications of DLG data as well as generation of graphic products.

The standard distribution format reflected design decisions intended to minimize storage requirements. Explicit topological linkages were contained only in the line elements (starting node, ending node, an area to the left of direction of travel, and an area to the right of the direction of travel).

The 1:2,000,000-scale graphic distribution format was designed for use with the GS-CAM plotting package. GS-CAM was a modified version

of the Cartographic Automatic Mapping (CAM) computer program. The graphic format file was organized by feature type, contained only minimal descriptive information about each line, and did not specify the relationship between lines. These files were not topologically structured and did not contain node or area elements.

The characteristics of the DLG distribution formats are compared in table 2.1. The format and record contents for the standard, optional, and graphic formats are summarized in Appendices 2-A, 2-B, and 2-C respectively. Appendices 2-A and 2-C are retained for historical purposes only.

Table 2-1
Comparison of DLG standard, optional, and graphic formats

	Standard	Optional	Graphic
Character set	ASCII	ASCII	ASCII
Logical record length	144 bytes	80 bytes	20 bytes
Physical record length (block size)	Variable in multiples of 144 bytes	Variable in multiples of 80 bytes	Variable in multiples of 20 bytes
Coordinate system	Internal file (thousandths of a map inch)	Ground planimetric: UTM-24K and 100K, Albers Conical Equal Area-2M	Geographic (latitude and longitude)
Topological linkages	Contained only in line elements	Contained in node, area, and line elements	None (only contains line elements)

Appendix 2-A

Standard DLG Distribution Format

THIS DISTRIBUTION FORMAT IS NO LONGER AVAILABLE

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

Logical record type	Content
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 strings.
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 DLG distribution 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
Node description (D.1)	for each
Attribute codes (F)	node within a
Text string (G)	data category
Area records	Repeated
Area description (D.1)	for each
Attribute codes (F)	area within a
Text string (G)	data category
Line records	
Line description (D.2)	Repeated
X,Y coordinates (E)	for each
Attribute codes (F)	line within a
Text string (G)	data category

3. Accuracy estimate
   Type H (one record) (not currently used)

Descriptions of the contents of records A-F are contained in the following tables. The tables also reflect the relationship between these record types and 144-byte logical records.

[Integer fields with a value of zero will have leading zeros suppressed.]
[Any field with the format of D24.15 which has a value of zero will be represented as "bbb0.0bbbbbbbbbbbbbbbbbb", the last four positions of the fractional portion being reserved for a decimal exponent. (b=blank)]

Logical Record Type A

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
A.1	1	Name of digital cartographic unit	ALPHA	A40	1	40	The Topographic Map Names Data Base name of the digital data cell, a comma and a space, followed by the State two-character designators (separated by hyphens).
---	---	Filler	---	---	41	41	1 space
A.1	2	Date of original source material	ALPHA	A10	42	51	If only one date is required, input date in bytes 42-45. If two dates are required, separate dates with a comma and space.
A.1	3	Collection procedure qualifier	ALPHA	A1	52	52	'P' for photorevision and 'I' for photoinspection are the only valid codes.
A.1	4	Scale of original source material	INTEGER*4	I8	53	60	Scale denominator of source material; for example, 24000, 100000, or 2000000.
(Data elements 5 through 23 of record A.1 apply to 1:24,000- and 1:100,000-scale files only. For 1:2,000,000-scale data files, bytes 61 - 144 of record A.1 are filler.)							
---	---	Filler	---		61	63	3 spaces
A.1	5	Sectional indicator (100K files)	ALPHA	A3	64	66	Codes S, F, or T for size of section, plus sequence number.

Logical Record Type A--continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
---	---	Filler	---	---	67	113	47 spaces
A.1	6	Largest primary contour interval	ALPHA	A4	114	117	Largest primary contour interval, followed by the interval unit (1=feet, 2=meters). Present only if two or more primary intervals exist. (selected categories)
A.1	7	Comma	ALPHA	A1	118	118	comma separator
A.1	8	Largest primary bathymetric contour interval	ALPHA	A4	119	122	Largest primary bathymetric interval, followed by the interval unit (1=feet, 2= meters, 3=fathoms). Present only if two or more primary intervals exist. (selected categories)
---	---	Filler	---	---	123	123	1 space
A.1	9	Smallest primary contour interval	ALPHA	A4	124	127	Smallest or only primary interval, followed by the interval unit as shown above. (selected categories)
A.1	10	Comma	ALPHA	A1	128	128	comma separator
A.1	11	Smallest primary bathymetric contour interval	ALPHA	A4	129	132	Smallest or only primary bathymetric interval, followed by the interval unit as shown above. (selected categories)
A.1	12-14	Coded flags	ALPHA	A1	133	135	3 flags for future use
A.1	15	Coded flag	ALPHA	A1	136	136	Database coded edge flag

Logical Record Type A--continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
A.1	16	EDGEWS	ALPHA	A1	137	137	Status flag for west edge, values are: b = unchecked, 0 = passed, 1 = alignment discontinuity, 2 = attribute discontinuity, 3 = attribute and alignment discontinuity.
A.1	17	EDGEWR	ALPHA	A1	138	138	Reason for EDGEWS, values are: b = no problem, 4 = adjacent data do not exist 5 = adjacent data unavailable, 6 = temporal/source discontinuity, 7 = mismatch valid, 8 = paneling unauthorized, 9 = processing software limitation
A.1	18	EDGENS	ALPHA	A1	139	139	Status flag for north edge, values = b,0,1,2, or 3 as above.
A.1	19	EDGENR	ALPHA	A1	140	140	Reason for EDGENS, values are b,4,5,6,7,8, or 9 as above.
A.1	20	EDGEES	ALPHA	A1	141	141	Status flag for east edge. Values are b,0,1,2, or 3 as above.
A.1	21	EDGEER	ALPHA	A1	142	142	Reason for EDGEES, values are b,4,5,6,7,8, or 9 as above.
A.1	22	EDGESS	ALPHA	A1	143	143	Status flag for south edge, values are b,0,1,2, or 3 as above.
A.1	23	EDGESR	ALPHA	A1	144	144	Reason for EDGESS, values are b,4,5,6,7,8, or 9 as above.

Logical Record Type A--continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
A.2	1	DLG level code	INTEGER*2	I6	1	6	Code=3, DLG-3
A.2	2	Code defining ground planimetric reference system	INTEGER*2	I6	7	12	Code=1, UTM (24K and 100K) Code=3, Albers Conical Equal Area (2M)
A.2	3	Code defining zone in ground planimetric reference system	INTEGER*2	I6	13	18	Code for appropriate UTM zone (24K and 100K files) Code=9999 (2M files)
A.2	4	Map projection parameters	REAL*8	5D24.15	19	138	This field contains the first 5 of 15 map projection parameters (see Appendix 2-4).
---	---	Filler	---	---	139	144	6 spaces
A.3	1	Map projection parameters	REAL*8	6D24.15	1	144	This record contains projection parameters 6 thru 11 (see Appendix 2-4).
A.4	1	Map projection parameters	REAL*8	4D24.15	1	96	This field contains the last 4 projection parameters (see Appendix 2-4).
A.4	2	Code defining units of measure for ground planimetric coordinates throughout the file	INTEGER*2	I6	97	102	Code=2, meters

Logical Record Type A--continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
A.4	3	Resolution	REAL*8	D24.15	103	126	The true ground distance corresponding to one unit (0.001 inch at map scale) in the file internal reference system. Scale — Resolution 1:24,000 — 0.61 M 1:25,000 — 0.635 M 1:48,000 — 1.22 M 1:62,500 — 1.587 M 1:63,360 — 1.61 M 1:100,000 — 2.54 M 1:250,000 — 6.35 M 1:2,000,000 — 50.80 M
A.4	4	Accuracy code of planimetric data	INTEGER*2	I6	127	132	Code=0, unknown accuracy
A.4	5	Number (n) of sides in the polygon which defines the coverage of the cell	INTEGER*2	I6	133	138	n=4
A.4	6	Horizontal Datum	INTEGER*2	I3	139	141	Horizontal Datum of DLG 'b' or 0 = NAD 27 1 = NAD 83 2 = Puerto Rico 3 = Old Hawaiian 4 = Local (Astro)
A.4	7	Vertical Datum	INTEGER*2	I3	142	144	Vertical Datum of DLG 'b' or 0 = NGVD 29 1 = NAVD 88 2 = Local Mean Sea Level

Logical Record Type A--continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
A.5 A.6	1	A (4,2) array containing geographic coordinates of the registration points for the DLG. In quadrangle-based mapping, these points form a geographic square/rectangle which contain the domain of the DLG.	REAL*8	3(2D24.15) 2D24.15	1 1	144 48	The four registration points usually coincide with an area defined by one of the standard map formats of the National Mapping Program. Coordinates are in geographic longitude and latitude in units of degrees and decimal degrees and are expressed in the order: SW, NW, NE, SE.
---	---	Filler	---	---	49	144	96 spaces

Logical Record Type B

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
B.1	1	Parameters (A1, A2, A3, A4) of file-to-ground projection transformation; the explicit form of the transformation is: X=A1x+A2y+A3 Y=A1y-A2x+A4 where: x,y are coordinates in file internal reference system; X,Y are coordinates in map projection reference system	REAL*8	4D24.15	1	96	X,Y coordinates resulting from this transformation will be in ground units in the appropriate projection defined by the data elements in records A.2 through A.4.
B.1	2	Number (m) of registration points	INTEGER*2	I6	97	102	m=4
---	---	Filler	---	---	103	144	42 spaces

Logical Record Type B--continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
B.2	1	A (4,3) array containing identifications and coordinates of registration points. Coordinates are expressed in the file internal reference system.	ALPHA/ INTEGER*2	4(A2, 2I6)	1	56	The corners of a four-sided polygon are used as registration points. The identification sequence is SW, NW, NE, SE. The array is stored by row. Coordinates in the file internal reference system are expressed in units of thousandths of an inch and fall in the range -32768 to +32767. These coordinates correspond to the geographic coordinates contained in records A.5 and A.6.
---	---	Filler	---	---	57	144	88 spaces

Logical Record Type C

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
C.1	1	Number (q) of categories in the DLG file	INTEGER*4	I6	1	6	q=1
---	---	Filler	---	---	7	144	138 spaces
C.2[1] to C.N	1	A (q,7) array containing category name as well as maximum and actual number of node, area, and line elements in the category	ALPHA/ INTEGER*2	q (A20,6I6)	1 (57	56 112)	This array is stored by row. The first element is the category name consisting of 20 alphanumeric characters, the first four of which are unique. Elements 2 and 3 contain the maximum and actual number of nodes in the category, elements 4 and 5 the maximum and actual number of areas, and elements 6 and 7 the maximum and actual number of line segments. (Note: for 24K and 100K files, the maximum number of nodes or areas in a category is 25,960 and the maximum number of lines is 25,938. For 2M files, the maximum number of any element type within a category is 4,770. This field is used only during initial processing of data.
---	---	Filler	---	---	---	144	32 or 88 spaces

[1]The number of categories "q" is given in record C.1. There are 56 bytes of data per category, and thus a maximum of two categories can be described on a 144-character record. The space filler will vary in size depending on the value of "q".

Note that the actual number of elements will equal the highest ID number used because the files are packed and the element numbers are compressed.

Logical Record Type D

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
D.1	1	Type of element code	ALPHA	A2	1	2	Code ='Nb' for Node element, 'Ab' for Area element.
D.1	2	Element's internal identification number	INTEGER*2	I6	3	8	Number is positive and sequential from 1-n within each element type.
D.1	3	X,Y file coordinate of node point or representative point for the area element	INTEGER*2	2I6	9	20	The representative area point is usually, but not always, contained within the area it represents.
D.1	4	Number (t) of attribute codes which are attached to the node or area element (t>=0)	INTEGER*2	I6	21	26	Absence of attribute codes is indicated by t=0.
D.1	5	Number (k) of pairs of text characters which are attached to the node or area element (k>=0)	INTEGER*2	I6	27	32	k=0. Not currently used.
---	---	Filler	---	---	33	144	112 spaces
D.2	1	Code indicating a line segment graph element	ALPHA	A2	1	2	Code='Lb' for line segment.
D.2	2	Line segment's internal identification number	INTEGER*2	I6	3	8	Number is positive and sequential from 1-n within each category and element type.

Logical Record Type D--continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
D.2	3	Internal identification number of starting node	INTEGER*2	I6	9	14	Number refers to data element 2 in record D.1.
D.2	4	Internal identification number of ending node	INTEGER*2	I6	15	20	Number refers to data element 2 in record D.1.
D.2	5	Internal identification number of left area	INTEGER*2	I6	21	26	Number refers to data element 2 in record D.1.
D.2	6	Internal identification number of right area	INTEGER*2	I6	27	32	Number refers to data element 2 in record D.1.
D.2	7	Number (v) of coordinate pairs which define the line segment.	INTEGER*2	I6	33	38	The value of v is from 2 to 3000 (for 24K and 100K files) and from 2 to 1500 for 2M files.
D.2	8	Number (t) of attribute codes which are attached to the line segment (t>=0)	INTEGER*2	I6	39	44	Absence of classification attribute codes is indicated by t=0.
D.2	9	Number (k) of pairs of text characters which are attached to the line segment (k>=0)	INTEGER*2	I6	45	50	k=0. Not currently used.
	---	Filler	---	---	51	144	94 spaces

Logical Record Type E

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
E.1 to[2] E.n	1	A (v,2) array containing an ordered sequence of coordinate pairs which define the image presentation of a line element	INTEGER*2	v(2I6)	1		Coordinates are expressed in internal file reference system, in units of thousandths of an inch. The array is stored by row.
---	---	Filler	---	---	---	144	0 to 132 spaces

[2]The number of coordinate pairs, "v", is given in record D.2. There will be v(2I6) coordinate pairs of which a maximum of 12 pairs will fit on a 144-character ASCII record. The space filler will vary in size depending on the value of "v." If "v" is an integer multiple of 12, there will be no spaces as filler at the end of the record.

Logical Record Type F

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
F.1[3] to F.n	1	A (t,2) array containing major and minor attribute codes for a graph element	INTEGER*2	t(2I6)	1		The array is stored by row with the first column containing the major attribute code, and the second column containing the minor attribute code.
---	---	Filler	---	---	---	144	0 to 132 spaces

[3]The number of feature (attribute) codes, "t" is given in the D.1 and D.2 records. The F record is an array of t(2I6) codes of which a maximum of 12(2I6) will fit on a 144-character ASCII record. The space filler will vary depending on the value of "t". If "t" is an integer multiple of 12 there will be no spaces as filler at the end of the record.

Appendix 2-B

Optional DLG Distribution Format

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

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

The following are considered header records:

- File identification and description records (variable record formats)
- Accuracy/miscellaneous records (not currently used)
- Control-point identification records
- Data-category identification records

The following are considered data records:

- Node and area identification records
- Node-to-area linkage records*
- Node-to-line linkage records
- Area-to-line linkage records
- Area-to-node linkage records*
- Line identification records
- Coordinate string records (lines)
- Coordinate string records (areas)*
- Attribute code records
- Text records (not currently used)

*Data distributed in optional format from the NDCDB will not contain these data records.

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
   - Node-to-area linkage record(s)*
   - Node-to-line linkage record(s)
   - Attribute code record(s)
   - Text record(s)

   } Repeated for each node within a data category

   Area identification record
   - Area-to-node linkage record(s)*
   - Area-to-line linkage record(s)
   - Coordinate string record(s)*
   - Attribute code record(s)
   - Text record(s)

   } Repeated for each area within a data category

   Line identification record
   - Coordinate string record(s)
   - Attribute code record(s)
   - Text record(s)

   } Repeated for each line within a data category

*Data distributed in optional format from the NDCDB will not contain these records.

Descriptions of the contents of the various types of records in an optional distribution format DLG are contained in the following tables.

FILE IDENTIFICATION AND DESCRIPTION RECORDS

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte*	Comment
1	1	Banner	ALPHA	A72	1	72	"***DLG-OPTIONAL FORMAT PRODUCED BY USGS PROSYS RELEASE x.x.x *** "
2	1	Name of digital cartographic unit	ALPHA	A40	1	40	The authorized cell name followed by a comma, space, and the State two-character designator(s), separated by hyphens. Abbreviations for other countries, such as Canada and Mexico, shall not be represented in the DLG header.
---	---	Filler	---	---	41	41	1 space
2	2	Date of original source material	ALPHA	A10	42	51	Only one date is now allowed, input date in bytes 42-45. If two dates are used, dates are separated with a comma and space.
2	3	Collection procedure qualifier	ALPHA	A1	52	52	No longer required. 'P' for photorevision, 'I' for photoinspection, 'L' for limited revision, and 'D' for digital revision were once valid codes.
2	4	Scale of original source material	INTEGER*4	I8	53	60	Scale denominator of source material; for example, 24000, 100000, or 2000000.

(Record 2, data element 5 and Record 3, data elements 1 through 18 apply to 24K and 100K data files only. These fields contain filler in 2M data files.)

---	---	Filler	---	---	61	63	3 spaces

*The logical record length for the optional distribution format is 80 bytes, with 8 spaces of blank fill in bytes 73-80 of each record which may be used for a record sequence number.

FILE IDENTIFICATION AND DESCRIPTION RECORDS-continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
2	5	Sectional indicator (100K files)	ALPHA	---	64	66	Codes S, F, or T for size of section, plus sequence number.
---	---	Filler	---	---	67	72	6 spaces
---	---	Filler	---	---	1	41	41 spaces
3	1	Largest primary contour interval	ALPHA	A4	42	45	Largest primary contour interval, followed by the interval unit (1=feet, 2=meters). Present only if two or more primary intervals exist. (selected categories)
3	2	Comma	ALPHA	A1	46	46	comma separator
3	3	Largest primary bathymetric contour interval	ALPHA	A4	47	50	Largest primary bathy-metric interval, followed by the interval unit (1=feet, 2=meters, 3=fathoms). Present only if two or more primary intervals exist. (selected categories)
---	---	Filler	---	--	51	51	1 space

FILE IDENTIFICATION AND DESCRIPTION RECORDS

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
3	4	Smallest primary contour interval	ALPHA	A4	52	55	Smallest or only primary contour interval, followed by the interval unit as described above (selected categories).
3	5	Comma	ALPHA	A1	56	56	comma separator
3	6	Smallest primary bathymetric contour interval	ALPHA	A4	57	60	Smallest or only primary bathymetric contour interval, followed by the interval unit as described above (selected categories).
3	7-9	Coded Flags	ALPHA	A1	61	63	3 flags for future use
3	10	Coded Flag	ALPHA	A1	64	64	Database coded edge flag for internal NMD use.
3	11	EDGEWS	ALPHA	A1	65	65	Status flag for west edge, values are: b=unchecked, 0=passed, 1=alignment discontinuity, 2=attribute discontinuity, 3=attribute and alignment discontinuity.
3	12	EDGEWR	ALPHA	A1	66	66	Reason for EDGEWS, values are: b=no problem, 4= adjacent data do not exist, 5=adjacent data unavailable, 6=temporal/source discontinuity, 7=mismatch valid, 8=paneling unauthorized, 9=processing software limitations.

FILE IDENTIFICATION AND DESCRIPTION RECORDS

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
3	13	EDGENS	ALPHA	A1	67	67	Status flag for north edge, values are b,0,1,2, or 3 as above.
3	14	EDGENR	ALPHA	A1	68	68	Reason for EDGENS, values are b,4,5,6,7,8, or 9 as above.
3	15	EDGEES	ALPHA	A1	69	69	Status flag for east edge, values are b,0,1,2, or 3 as above.
3	16	EDGEER	ALPHA	A1	70	70	Reason for EDGEES, values are b,4,5,6,7,8, or 9 as above.
3	17	EDGESS	ALPHA	A1	71	71	Status flag for south edge, values are b,0,1,2, or 3 as above.
3	18	EDGESR	ALPHA	A1	72	72	Reason for EDGESS, values are b,4,5,6,7,8, or 9 as above.
4	1	DLG level code	INTEGER*2	I6	1	6	* Code=3 DLG-3 Code=2 DLG-2
4	2	Code defining ground planimetric reference system	INTEGER*2	I6	7	12	*[1]Code=1 UTM (24K and 100K), Code=3 Albers Conical Equal Area (2M files)
4	3	Code defining zone in ground planimetric reference system	INTEGER*2	I6	13	18	*[1]Code for appropriate UTM zone (24K or 100K files), Code=9999 for 2M files

[1]See General Purpose Transformation Package software documentation for additional information.

* Listed values reflect current NMD standard.

FILE IDENTIFICATION AND DESCRIPTION RECORDS							
Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
4	4	Code defining units of measure for ground planimetric coordinates throughout the file	INTEGER*2	I6	19	24	* [1]Code=2, meters
4	5	Resolution	REAL*4	D18.11	25	42	The true ground distance corresponding to 0.001 inch at map scale. Scale — Resolutions 1:24,000 — 0.61 M 1:25,000 — 0.635 M 1:48,000 — 1.22 M 1:62,500 — 1.587 M 1:63,360 — 1.61 M 1:100,000 — 2.54 M 1:250,000 — 6.35 M 1:2,000,000 — 50.80 M
4	6	Number of file-to-map transformation parameters	INTEGER*2	I6	43	48	number=4
4	7	Number of accuracy/ miscellaneous records	INTEGER*2	I6	49	54	Currently=0, none included
4	8	Number (n) of control points	INTEGER*2	I6	55	60	n=4 These points are usually, but not always, a definition of the file coverage.

[1]See General Purpose Transformation Package software documentation for additional information.

* Listed values reflect current NMD standard.

FILE IDENTIFICATION AND DESCRIPTION RECORDS

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
4	9	Number (q) of categories in the DLG file	INTEGER*2	I6	61	66	* q=1
4	10	Horizontal Datum	INTEGER*2	I3	67	69	Horizontal Datum of DLG 'b' or 0 = NAD 27 1 = NAD 83 2 = Puerto Rico 3 = Old Hawaiian 4 = Local (Astro)
4	11	Vertical Datum	INTEGER*2	I3	70	72	Vertical Datum of DLG 'b' or 0 = NGVD 29 1 = NAVD 88 2 = Local Mean Sea Level
5-9	1	Projection parameters for map transformation	REAL*8	3D24.15	1	72	Three parameters on each of 5 records (see Appendix 2-4).
10	1	Internal file-to-map projection transformation parameters	REAL*4	4D18.11	1	72	X, Y coordinates resulting from this transformation will be expressed in the appropriate ground planimetric coordinate system. If the x, y coordinates are already in the ground coordinate system, the projection parameters will be: A1=1.0, A2=0.0, A3=0.0, and A4=0.0.

* Listed values reflect current NMD standard.

CONTROL POINT IDENTIFICATION RECORDS

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
1-n	1	Control-point label	ALPHA	A6	1	6	"SW," "NW," "NE," or "SE" for four quadrangle corners. Field is padded with trailing blanks.
	2	Latitude	REAL*4	F12.6	7	18	In degrees and decimal degrees.
	3	Longitude	REAL*4	F12.6	19	30	In degrees and decimal degrees.
		Filler			31	36	6 spaces
	4	X coordinate	REAL*4	F12.2	37	48	In units in the appropriate zone of the ground planimetric coordinate system.
	5	Y coordinate	REAL*4	F12.2	49	60	In units in the appropriate zone of the ground planimetric coordinate system.
---	---	Filler	---	---	61	72	12 spaces

DATA CATEGORY IDENTIFICATION RECORDS

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
1-q	1	Category name	ALPHA	A20	1	20	The first 4 characters are unique to USGS/NMD data.
	2	Attribute format codes	INTEGER*2	I4	21	24	Blank or zero (0) indicates default (2I6) attribute formatting in major-minor pairs.
	3	Highest node identification number.	INTEGER*2	I6	25	30	Number of nodes referenced in the file.
	4	Actual number of nodes in file	INTEGER*2	I6	31	36	Only if the DCF is not packed, and the element ID numbers not compressed, will this number be different from data element 3.
	---	Filler	---	---	37	37	1 space
	5	Presence of node-to-area linkage records	INTEGER*2	I1	38	38	*0=node-area list not included, 1=node-area list included.
	6	Presence of node-to-line linkage records	INTEGER*2	I1	39	39	0=node-line list not included, *1=node-line list included.
	---	Filler	---	---	40	40	1 zero or space

* Values marked are values from data distributed from the NDCDB.

DATA CATEGORY IDENTIFICATION RECORDS--continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
1-q	7	Highest area ID number.	INTEGER*2	I6	41	46	Number of areas referenced in the file.
	8	Actual number of areas in file	INTEGER*2	I6	47	52	Only if the DCF is not packed, and the element ID numbers not compressed, will this number be different from data element 7.
	---	Filler	---	---	53	53	1 space
	9	Presence of area-to-node linkage records	INTEGER*2	I1	54	54	*0=area-node list not included, 1=area-node list included.
	10	Presence of area-to-line linkage records	INTEGER*2	I1	55	55	0=area-line list not included, *1=area-line list included.
	11	Presence of area-coordinate lists	INTEGER*2	I1	56	56	*0=area coordinates not included, 1=area coordinates included
	12	Highest line identification number	INTEGER*2	I6	57	62	Number of lines referenced in the file.

* Values marked are values for data distributed from the NDCDB.

DATA CATEGORY IDENTIFICATION RECORDS--continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
1-q	13	Actual number of lines in file	INTEGER*2	I6	63	68	Only if the DCF is not packed, and the element ID numbers not compressed, will this number be different from data element 12.
	---	Filler	---	---	69	71	3 spaces
	14	Presence of line-coordinate lists	INTEGER*2	I1	72	72	0=line coordinates not included, *1=line coordinate list included.

* Values marked are values for data distributed from the NDCDB.

NODE AND AREA IDENTIFICATION RECORDS

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
	1	Record type	ALPHA	A1	1	1	"N" or "A"
	2	Element internal ID number	INTEGER*2	I5	2	6	Number is positive and sequential from 1-n within each element type, where n is the highest element ID number.
	3	Coordinates of node point or representative point for area	REAL*4	2F12.2	7	30	The area point is usually, but not always within the polygon it represents.
	4	Number of elements in an area list (for nodes), or a node list (for areas)	INTEGER*2	I6	31	36	
	5	Number of elements in line list	INTEGER*2	I6	37	42	Number of line segments that intersect at the node or, for areas, line segments plus number of islands.
	6	Number of x,y or lat-long points in area-coordinate list	INTEGER*2	I6	43	48	For area records only, blank for node records.
	7	Number of attribute code pairs listed	INTEGER*2	I6	49	54	
	8	Number of text characters listed	INTEGER*2	I6	55	60	Zero (0). There are no text attributes for DLG data.
	9	Number of islands within area	INTEGER*2	I6	61	66	For area records only, blank for node records.
---	---	Filler	---	---	67	72	6 spaces

NODE-TO-AREA LINKAGE RECORDS

FORTRAN FORMAT (12I6), for each node: The list consists of area internal ID numbers (which appear in bytes 2-6 of the area identification records) of all the areas that are adjacent to that node. There is no logical order to the list.

NODE-TO-LINE LINKAGE RECORDS

FORTRAN FORMAT (12I6), for each node: The list consists of line internal ID numbers (which appear in bytes 2-6 of the line identification records) of all the lines that connect to that node. The lines that begin at this node are included in the list as positive ID numbers. The lines which terminate at this node are included as negative ID numbers. There is no logical order to the list.

AREA-TO-NODE LINKAGE RECORDS

FORTRAN FORMAT (12I6) for each area: The list consists of node internal ID numbers (which appear in bytes 2-6 of the node identification records) of all nodes that are adjacent to that area. For those areas with islands, the number zero, used as a delimiter, marking the beginning of each island sublist. The format of this list is the same as the Area-Line list below.

AREA-TO-LINE LINKAGE RECORDS

FORTRAN format (12I6), for each area: The list consists of line internal ID numbers (which appear in bytes 2-6 of the line identification records) of all lines that bound that area and lines which are adjacent to an area. For those areas with islands (indicated by bytes 61-66 of the area's first record), the number zero, used as a delimiter, marking the beginning of islands. Lines with this area to the right are included as positive ID numbers. Lines with this area to the left are included as negative ID numbers. The list is ordered clockwise around the perimeter of the area and counterclockwise around each island, if any (counterclockwise around an island of an area is still a clockwise direction in reference to the area itself). The number zero is inserted in the list before each island sublist. Lines that do not contribute to the effective boundary of the area (those having both their area left and area right assigned to the same area) are not considered bounding lines. Therefore, these lines, while still present in the file, will not be referenced in the area-to-line linkage records.

LINE IDENTIFICATION RECORDS

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
	1	Record type		A1	1	1	"L"
	2	Element internal ID number		I5	2	6	Number is positive and sequential from 1-n within each element type, where n is the highest element ID number.
	3	Starting node		I6	7	12	Internal ID number. Refers to data element 2 of the node identification record.
	4	Ending node		I6	13	18	Internal ID number. Refers to data element 2 of the node identification record.
	5	Left area		I6	19	24	Internal ID number. Refers to data element 2 of the area identification record.
	6	Right area		I6	25	30	Internal ID number. Refers to data element 2 of the area identification record.
	---	Filler		---	31	42	12 spaces
	7	Number of x,y coordinate pairs listed		I6	43	48	Number of coordinate pairs listed.
	8	Number of attribute code pairs listed		I6	49	54	
	9	Number of text characters listed		I6	55	60	Zero (0). There are no text attributes for DLG data.

LINE COORDINATE STRING RECORDS

FORTRAN format (3(2F12.2)): The coordinates are in appropriate units in the designated ground planimetric coordinate system (usually meters in UTM), or in internal file units.

CODE RECORDS

As major-minor code attribute pairs, FORTRAN format (6(2I6)): Within each pair, the first integer is the major code and the second integer is the minor code. Each major and minor code is a one-to-four-digit integer, right justified within the six-byte field.

AREA COORDINATE STRING RECORDS

FORTRAN FORMAT (3(2F12.2)): The last data element in the area identification record contains the number of islands within the area. If this number is greater than zero, the following convention applies to the Area Coordinate list:

> The coordinates of the outside boundary of the area are listed first. The first coordinate of the outside boundary is repeated to signal the closure of this ring. Next, the coordinates of one of the islands are listed. The first coordinate of this boundary is repeated, again signaling the end of this ring. Next, the first coordinate of the outside boundary is listed as a ring delimiter. This process is repeated until the coordinates of the boundaries of all the islands are listed. The coordinates in this list are ordered so that the area being referenced is always to the right of the boundary described by the sequence of coordinates. Therefore, the list is ordered clockwise around the perimeter of the area and counterclockwise around each island, if any. The common coordinates between adjacent ring lines are only listed once, except for the beginning and ending of a ring.

EXAMPLE 1: (A diagram illustrating this example may be found following the text.)

Area line list (for area 41): 10, 11, -12, 0, 14, -15, 0, -18, 0, -82, -84, 21

Area node list (for area 41): 30, 31, 32, 0, 33, 34, 0, 35, 0, 36, 77, 76

Area coordinate list explanation:

- Outside ring coordinates:
  (20, 50), (40, 60), (60, 50), (70, 40), (60, 20), (40, 10), (30, 10), (20, 30), (10, 40), (20, 50) starting point
  [( ] [ )] of outside ring

  L10 L11 L12 separate rings)

- 1st island ring coordinates:
  (25, 45), (28, 39), (34, 43), (34, 48), (30, 50), (25, 45), (20, 50) ring closes itself — first coordinate in outside ring
  [( ]) delimiter

  L14 L15

- next island ring coordinates:
  (30, 30), (30, 20), (40, 20), (40, 30), (30, 30), (20, 50) ring delimiter
  [ ]

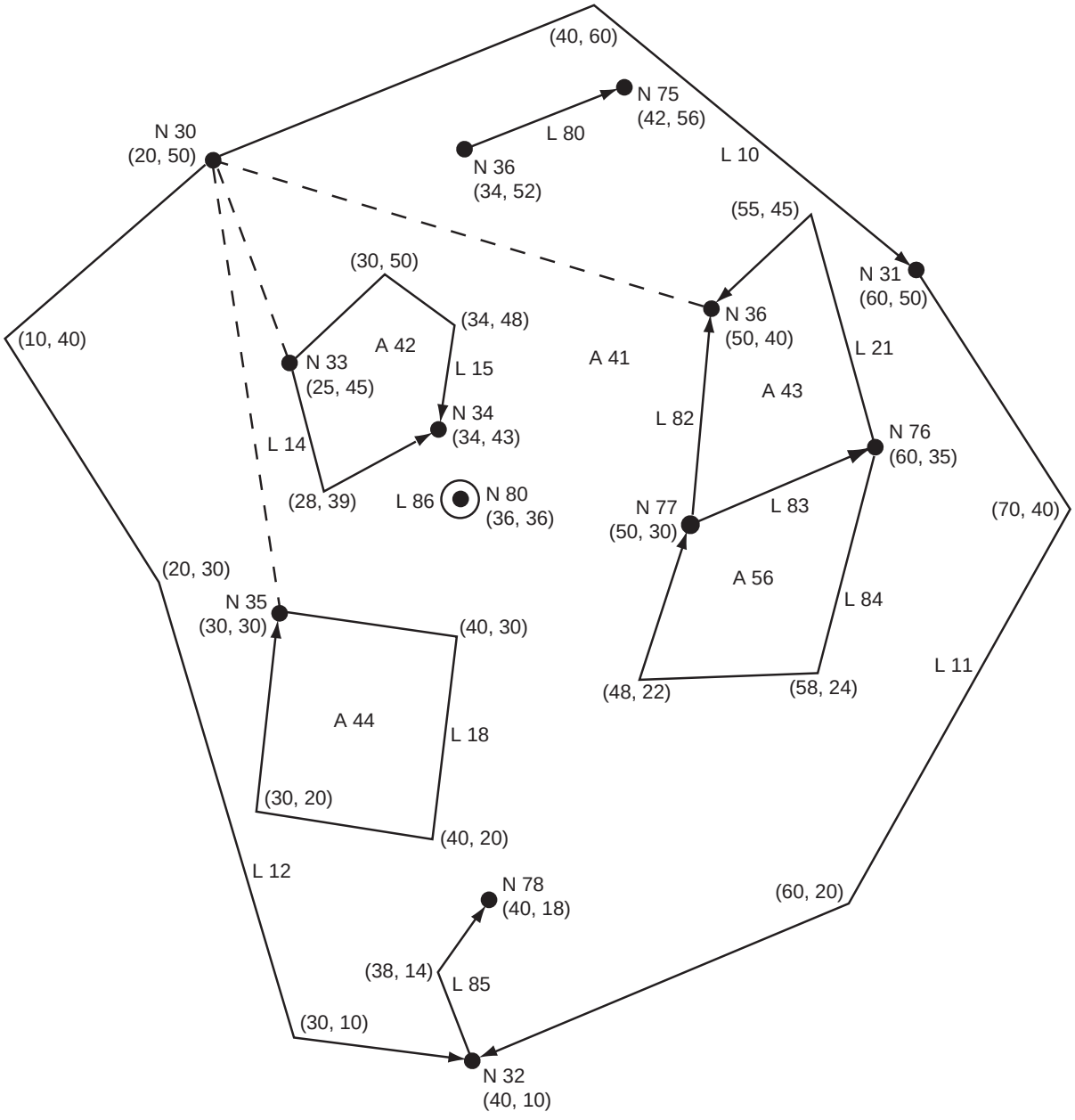
  L18

- last island ring coordinates:
  (50, 40), (50, 30), (48, 22), (58, 24) (60, 35), (55, 45), (50, 40), (20, 50) ring delimiter must be present at end of list if islands are present.
  [( ] [ )]

  L82 L84 L21

Note: Since lines 80, 85, and 86 have area 41 as both their area left and area right, they are not considered "boundaries" of area 41. Therefore, they are not used to build the area line list, area node list, or area coordinate list for this area.

Complete area coordinate list:
(20, 50), (40, 60), (60, 50), (70, 40), (60, 20), (40, 10), (30, 10), (20, 30), (10, 40), (20, 50),
(25, 45), (28, 39), (34, 43), (34, 48), (30, 50), (25, 45), (20, 50),
(30, 30), (30, 20), (40, 20), (40, 30), (30, 30), (20, 50),
(50, 40), (50, 30), (48, 22), (58, 24), (60, 35), (55, 45), (50, 40), (20, 50)


(40, 60)
N 75
(42, 56)
L 80
N 30
(20, 50)
N 36
(34, 52)
L 10
(55, 45)
N 31
(60, 50)
(30, 50)
(34, 48)
A 42
(10, 40)
N 33
(25, 45)
L 15
A 41
N 36
(50, 40)
L 21
A 43
N 34
(34, 43)
L 82
N 76
(60, 35)
L 14
(28, 39)
L 86
N 80
(36, 36)
N 77
(50, 30)
L 83
(70, 40)
(20, 30)
A 56
N 35
(30, 30)
(40, 30)
L 84
L 11
(48, 22)
(58, 24)
A 44
L 18
(30, 20)
(40, 20)
L 12
N 78
(40, 18)
(60, 20)
(38, 14)
L 85
(30, 10)
N 32
(40, 10)

Appendix 2-C

1:2,000,000-Scale Graphics DLG Format

THIS DISTRIBUTION FORMAT IS NO LONGER AVAILABLE

The simplified graphics format that can be used with the GS-CAM plotting package is described below. In this format, each line record from the DLG format has been reformatted into two record types: one line identifier record and multiple latitude-longitude records (one for each coordinate pair). If a line record has more than one feature code associated with it in the DLG format, that line record appears in the graphics format files multiple times (once for each feature code). The graphics format files are organized by feature type.

Record 1: Line identifier record

	Field Position	Field Length	Fortran Format
1. Line identifier	1-7	7	I7
2. Rank (last two digits of feature code (unique within category)	8-9	2	I2
3. Number of points in the line (NP) (latitude and longitude)	10-15	6	I6
4. First five digits of feature code	16-20	5	I5

Record 2: Latitude-longitude record (repeated NP times)

1. Latitude (DDMMSSI)	1-7	7	3I2, A1
2. Longitude (DDDMMSSI)	8-15	8	I3, 2I2, A1
3. Sequence count	16-20	5	I5

Appendix 2-D

Map Projection Parameters

The standard and optional DLG distribution formats include 15 fields reserved for map projection parameters. These parameters are typically used as input for a coordinate transformation package such as the USGS General Cartographic Transformation Package (GCTP).

The ground coordinate system for large- and intermediate-scale DLG's is the Universal Transverse Mercator (UTM) projection system. The UTM coordinate system uses only the first two of the 15 parameter fields:

1. Longitude of the center of the DLG cell.
2. Latitude of the center of the DLG cell.
3. - 15. Not used.

A transformation to or from UTM using GCTP can be controlled by specifying the UTM zone or by supplying the geographic coordinates of any point in the zone (from which the UTM zone is computed by GCTP) in parameters 1 and 2. The DLG header, however, requires both the zone and the coordinates of the center point of the DLG. The codes for UTM coordinate zones are as follows:

West longitude (degrees)	Zone
180 - 174	1
174 - 168	2
168 - 162	3
162 - 156	4
156 - 150	5
150 - 144	6
144 - 138	7
138 - 132	8
132 - 126	9
126 - 120	10
120 - 114	11
114 - 108	12
108 - 102	13

West longitude (degrees)	Zone
102 - 96	14
96 - 90	15
90 - 84	16
84 - 78	17
78 - 72	18
72 - 66	19
66 - 60	20

The ground coordinate system for all 1:2,000,000-scale DLG's is the Albers Conical Equal Area projection. This projection uses the first eight parameter fields as follows:

1. Semimajor axis of ellipsoid (default is Clarke 1866)
2. Eccentricity squared of ellipsoid
3. Latitude of first standard parallel
4. Latitude of second standard parallel
5. Longitude of central meridian
6. Latitude of projection origin
7. False easting at central meridian
8. False northing at origin
9. - 15. Not used

A transformation to or from Albers Conical Equal Area projection coordinates using GCTP can be controlled by specifying the parameters stated below:

For all maps:

Spheroid parameters: Clarke 1866

False easting: 0.0

False northing: 0.0

For conterminous United States:

First standard parallel: 29.5° North
Second standard parallel: 45.5° North
Longitude of central meridian: 96° West
Latitude of projection origin: 23° North

For Hawaii:

First standard parallel: 8° North
Second standard parallel: 18° North
Longitude of central meridian: 157° West
Latitude of projection origin: 3° North

For Alaska:

First standard parallel: 55° North
Second standard parallel: 65° North
Longitude of central meridian: 154° West
Latitude of projection origin: 50° North

In any scale DLG file, the parameters are encoded as packed, degrees-minutes-seconds (DMS) as follows:

degrees * 1000000 + minutes * 1000 + seconds

Example: If degrees = +50, minutes = 30, and seconds = 36.25, then the parameter value is 50030036.25 stored as a REAL*8 variable, and "bbb0.500300362500000D 08" encoded in FORTRAN D24.15 format.

Appendix 2-E

U. S. National Map Accuracy Standards

With a view to the utmost economy and expedition in producing maps which fulfill not only the broad needs for standard or principal maps, but also the reasonable particular needs of individual agencies, standards of accuracy for published maps are defined as follows:

1. Horizontal accuracy. For maps on publication scales larger than 1:20,000, not more than 10 percent of the points tested shall be in error by more than 1/30 inch, measured on the publication scale; for maps on publication scales of 1:20,000 or smaller, 1/50 inch. These limits of accuracy shall apply in all cases to positions of well-defined points only. Well-defined points are those that are easily visible or recoverable on the ground, such as the following: monuments or markers, such as bench marks, property boundary monuments; intersections of roads, railroads, etc.; corners of large buildings or structures (or center points of small buildings); etc. In general what is well defined will also be determined by what is plottable on the scale of the map within 1/100 inch. Thus while the intersection of two road or property lines meeting at right angles would come within a sensible interpretation, identification of the intersection of such lines meeting at an acute angle would obviously not be practicable within 1/100 inch. Similarly, features not identifiable upon the ground within close limits are not to be considered as test points within the limits quoted, even though their positions may be scaled closely upon the map. In this class would come timber lines, soil boundaries, etc.

2. Vertical accuracy, as applied to contour maps on all publication scales, shall be such that not more than 10 percent of the elevations tested shall be in error more than one-half the contour interval. In checking elevations taken from the map, the apparent vertical error may be decreased by assuming a horizontal displacement within the permissible horizontal error for a map of that scale.

3. The accuracy of any map may be tested by comparing the positions of points whose locations or elevations are shown upon it with corresponding positions as determined by surveys of a higher accuracy. Tests shall be made by the producing agency, which shall also determine which of its maps are to be tested, and the extent of such testing.

4. Published maps meeting these accuracy requirements shall note this fact on their legends, as follows: "This map complies with National Map Accuracy Standards."

5. Published maps whose errors exceed those previously stated shall omit from their legends all mention of standard accuracy.

6. When a published map is a considerable enlargement of a map drawing (manuscript) or of a published map, that fact shall be stated in the legend. For example, "This map is an enlargement of a 1:20,000-scale map drawing," or "This map is an enlargement of a 1:24,000-scale published map."

7. To facilitate ready interchange and use of basic information for map construction among all Federal mapmaking agencies, manuscript maps and published maps, wherever economically feasible and consistent with the uses to which the map is to be put, shall conform to latitude and longitude boundaries, being 15 minutes of latitude and longitude, or 7.5 minutes, or 3-3/4 minutes in size.

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