National Mapping Program

USGS Digital Cartographic Data Standards

Digital Line Graphs From 1:24,000-Scale Maps

Geological Survey
Circular 895-C

US GeoData

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

By William R. Allder and Atef A. Elassal

USGS Digital Cartographic Data Standards

Edited by Robert B. McEwen, Richard E. Witmer, and Benjamin S. Ramey

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FOREWORD

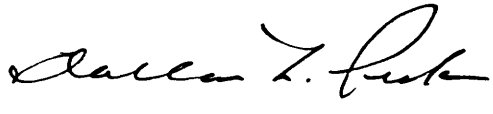
In recent years, the disciplines of cartography and geography have undergone a rapid and striking reorientation as the techniques for digital collection and manipulation of data have evolved from fledgling laboratory procedures into dominant and driving forces that now pervade the disciplines. Digital techniques have provided a variety of new and powerful capabilities to collect, manipulate, analyze, and display spatial data. However, this evolution also has introduced a number of new and complex problems. One of the most pressing problems, and one which is receiving particular attention at present, is the issue of digital cartographic data standards.

The U.S. Geological Survey (USGS) has been actively developing digital cartographic and geographic techniques for over a decade and has taken significant steps to develop and define in-house standards governing the various types of digital cartographic data that are being collected and archived in a national digital cartographic data base. The in-house standards are expressed in the form of specifications documents that were prepared to govern collection of the data and in the form of user guides that were prepared for distribution with the data.

In an effort to fulfill lead agency requirements for promulgation of Federal standards in the earth sciences, the documents have been assembled with explanatory text into this USGS Circular consisting of separately bound chapters. This Circular describes some of the pertinent issues relating to digital cartographic data standards, documents the digital cartographic data standards currently in use within the USGS National Mapping Division, and details USGS efforts to define national digital cartographic data standards.

Chapter A is an overview in which the major issues involved in developing digital cartographic data standards are discussed and the activities of the USGS related to digital cartographic data production and standards development are described in detail. Succeeding chapters comprise the pertinent documents that establish USGS in-house standards for the various types of digital cartographic data currently produced by the National Mapping Division--that is, digital elevation data, digital planimetric data, digital land use and land cover data, and digital geographic names data.

This compendium of relevant material is prepared to serve as a benchmark and to assist ongoing efforts to establish acceptable standards and conventions for both Federal agencies and the public.



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PREFACE

This Circular is the result of the efforts of numerous individuals who have contributed to the research, development, and preparation of various digital cartographic and geographic standards for the National Mapping Division of the U.S. Geological Survey. The individuals named as chapter authors represent both the originators of the various concepts as well as the writers who expanded and clarified these ideas. Their contributions, either to the concepts or the writing, are of such magnitude as to warrant crediting as authors.

Atef A. Elassal was largely responsible for the original data structures and computer file formats that are used for the digital line graphs and digital elevation models. The attribute coding scheme was first developed by members of the Digital Applications Team under the direction of Robert B. McEwen. The Geographic Names Information System was conceived and developed by Sam Stulberg and Roger L. Payne. The Geographic Information Retrieval and Analysis System was developed by Robin G. Fegeas, K. Eric Anderson, Stephen C. Guptill, Cheryl A. Hallam, and William B. Mitchell. The small-scale digital line graph data structure and attribute coding scheme was developed by Warren E. Schmidt and Michael A. Domaratz.

The Circular was compiled in part from various user guides and technical instructions of the National Mapping Division. These documents were originally prepared by several individuals; credit is acknowledged to G. Michael Callahan, A. Joan Szeide, William R. Allder, Vincent M. Caruso, Hugh W. Calkins, Donna Cedar-Southworth, and Cheryl A. Hallam. The compilation of the various guides, instructions, and other material into the Circular format was performed with major assistance by Clark H. Cramer, Eloise R. Byrd, and Cynthia L. Cunningham.

We acknowledge these substantial contributions that have led to this publication.

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

By William R. Allder and Atef A. Elassal

Abstract

The discipline of cartography is undergoing a number of profound changes that center on the emerging influence of digital manipulation and analysis of data for the preparation of cartographic materials and for use in geographic information systems. Operational requirements have led to the development by the USGS National Mapping Division of several documents that establish in-house digital cartographic standards.

In an effort to fulfill lead agency requirements for promulgation of Federal standards in the earth sciences, the documents have been edited and assembled with explanatory text into a USGS Circular. This Circular describes some of the pertinent issues relative to digital cartographic data standards, documents the digital cartographic data standards currently in use within the USGS, and details the efforts of the USGS related to the definition of national digital cartographic data standards. It consists of several chapters; the first is a general overview, and each succeeding chapter is made up from documents that establish in-house standards for one of the various types of digital cartographic data currently produced. This chapter, 895-C, describes the data format and structure together with current attribute codes used for digitizing USGS 1:24,000-scale maps.

INTRODUCTION

This document describes the digital line graphs (DLG's) prepared from the 7.5-minute, and in some cases 15-minute, materials associated with the USGS Topographic Map Series. The series will eventually provide complete national coverage. The data are collected from 7.5-minute source materials at 1:24,000 or 1:25,000 scale where possible; when 7.5-minute sources are not available, 15-minute sources at 1:48,000 or 1:62,500 scale are used.

The digital data are useful for the production of cartographic products, such as base maps, and the data are structured to support the analytical functions of geographic information systems. A typical use of base category digital cartographic data is to combine them with other geographically referenced data, enabling various automated spatial analyses to be conducted.

DATA CONTENT

The DLG data files derived from the 7.5- and 15-minute 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 graphic maps. One or more of the following categories may be included in current 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. Appendix H contains a list of quadrangles for which hydrographic data were collected as streams and water bodies, and Appendix I contains a list of the attribute codes used in these files.

- Public Land Survey System (PLSS) -- This category of data describes the rectangular system of land surveys which 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 which were formed from the public domain. The PLSS subdivides the public domain and represents property boundaries or references to property boundaries. These DLG data are not intended to be official or authoritative. They are presented as cartographic reference information. The only legal basis for determining land boundaries remains the original survey.

- Transportation -- This category of data includes major transportation systems differentiated into roads and trails, railroads, and pipeline and transmission lines. Data for all three are combined into a single data file, labeled transportation, for areas with sparse features. In areas with dense transportation features, the data are collected in three separate subcategories labeled: (1) roads and trails, (2) railroads, and (3) pipelines and transmission lines.

DATA STRUCTURE

The term digital line graph is employed by the USGS to describe a digital map data set in vector format in which the data are structured to one of the following levels.

1. Level 1 -- This is the simplest structure which maintains the original (raw) data in a standardized format, coded to prescribed standards, and edited for normal input errors. The main purpose of this level is to meet three needs: (1) to provide a source of digital data quickly; (2) to provide data to users who can complete the structuring process; and (3) to provide data for plotting or display systems of low or moderate cartographic quality.
2. Level 2 -- This structure is designed to support graphic display or plotting equipment of high cartographic quality. Level 2 DLG files contain extensive attribute codes that describe the graphic elements.
3. Level 3 -- The third structure is used for fully topologically structured data files designed to be integrated into geographic information systems. All topological relationships have been defined for level 3 DLG data.

These three levels do not easily aggregate in an upward direction. Data collected under criteria and specifications for level 1 or level 2 cannot

always be enhanced to level 3. To achieve this level, it is often easier and more cost effective to recapture the data in level 3 form. However, the reverse process of extracting level 2 from level 3 data, or level 1 from level 2, is more easily accomplished.

Current data collection from 7.5- and 15-minute maps is almost exclusively directed toward producing level 3 DLG data referred to as DLG-3. The DLG-3 concept is based on graph theory in which a two-dimensional diagram is expressed as a set of nodes (points in space) and links (line segments connecting nodes) in a manner that explicitly expresses logical relationships. Applied to a map, this concept is used to encode the digital data with the spatial relationships between map elements which are obvious when the map is examined visually. The spatial relationships include such concepts as adjacency and connectivity between features on the map. The abstraction of the map data according to the rules of graph theory preserves the spatial relationships inherent in the map graphic and creates a logical and consistent data file structure for computer processing. A digital file of cartographic or geographic data that maintains the spatial relationships inherent in the map is called a topologically structured data file. A topologically structured data file can support simple graphic applications, such as plotting streams and roads for base maps, as well as more advanced applications, such as computations involving areas and lines and their spatial relationships.

A DLG-3 file is composed of three separate, but related, elements: nodes, lines, and areas. Nodes define the location of the endpoints of every line, and a single node may mark the start or end of one or more lines. Intersections of lines are also marked by nodes and significant features on a line may also be marked by nodes.

A line is an ordered set of points that describes the position and shape of a linear feature on the map. Each line starts at a node and ends at a node and, thus, has both an explicit direction and a left-right connotation. Lines connect to each other at nodes, and a line does not cross itself or any other line. A line may describe the boundary between two map features, such as counties, or may define a map feature by itself, such as a road. A special line, called a degenerate line, is used to define features symbolized as points on a map. A degenerate line starts and ends at the same node, has zero length, and is totally enclosed inside one map area.

An area is a portion of the map bounded by lines and all portions of the map must be assigned to some area. For each area defined in a DLG-3 data file, an arbitrary point is chosen to represent the characteristics of the area; the point is not required to be inside the area it represents. Every data file will have at least two areas defined: one representing the area covered by the file and the other representing the area outside the coverage of the file. Additional areas will be defined as necessary to subdivide the area covered by the file.

ATTRIBUTE CODES

In addition to locational and topological information, DLG data elements may have explicitly encoded attributes. Attribute codes, also called feature codes or classification attributes, are used to describe the map information represented by a node, area, or line. For example, the attribute code for an area might identify a park, lake, or county; the attribute code for a line might identify a road, railroad, stream, shoreline, or boundary (fig. 1). The codes are based on the cartographic features symbolized on the USGS Topographic Map Series. This is the basic source material used to digitize and encode the data elements and therefore forms the overall classification strategy as contrasted to special purpose classifications of major features on the Earth which might be used for engineering or scientific applications. A listing of all the attribute codes currently assigned and used in the 7.5- and 15-minute DLG files is given in Appendix D, and a listing of attribute codes used to

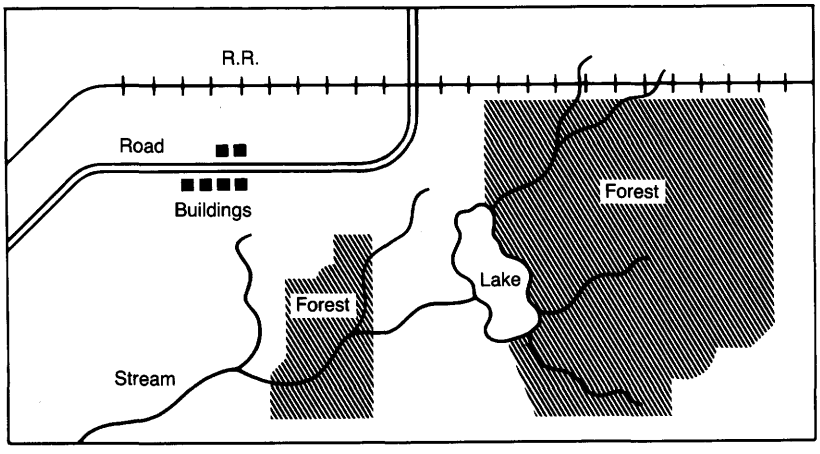

Figure 1.--Map elements showing roads, railroads, buildings, streams, and lake and forest areas.

describe hydrographic features in DLG's digitized prior to 1983 is given in Appendix I. Detailed information on how to apply and interpret the attribute coding system with the hydrography and Public Land Survey System categories is given in Chapter G of this Circular.

Each attribute code identifies the major category to which a data element belongs, as well as the specific nature of the element. Codes also may provide additional descriptive information. Most elements are uniquely described by a single attribute code. Others, however, may require two or more codes for a complete description. If multiple attributes are needed to describe an element, the order is not significant. Allowing for a variable number of attribute codes creates an open-ended structure to which information may be added at any time. It is not necessary for each element to have associated attributes; in general, attribute codes are not assigned to an element if the attributes can be derived based on relationships to adjacent elements. For example, a U.S. Public Land Survey section line is not assigned an attribute code because the line record carries a reference to the areas to the left and right that will be assigned attribute codes identifying the two different section numbers. The fact that the line is a section line is derivable.

A DLG attribute code is composed of two distinct numeric fields: a three-digit major code, which identifies the major category to which the element belongs, and a four-digit minor code, which specifically describes the element. In the digital file, the major and minor attributes are encoded in two integer fields of six digits, right justified with leading blanks (FORTRAN 2I6 format). In this document, major codes are presented as three digits, and minor codes are presented as four digits. Leading zeros are shown for clarity; for example: 050 0412.

MAJOR ATTRIBUTE CODES

The first two digits of the major code uniquely identify the category to which the described element belongs. Table 1 lists the major codes and the categories they represent.

The third digit of the major code is used to modify the minor code in two ways:

- If zero, the minor code represents a description or classification of the element.

Table 1.--Major codes used for DLG base categories

Major Code	Base Category
030*	Streams
040*	Water bodies
050*	Combined hydrography--streams, water bodies, and wetlands
090	Boundaries
100**	Transportation systems--roads and trails
110**	Transportation systems--railroads
130**	Transportation systems--pipelines and transmission lines
300	U.S. Public Land Survey System

* Prior to 1983, hydrographic features were digitized as two separate base categories: (1) 030-Streams, and (2) 040-Water bodies. Hydrographic features are currently digitized as a single base category: 050-Combined hydrography. See Appendix H for a list of quadrangles digitized using pre-1983 hydrographic attribute codes.

** Transportation systems have been assigned more than one major code so that their components may be readily separated for analytical applications. Data for all three of the transportation categories are collected as a single data file for areas with sparse features.

- If non-zero, the minor code which follows is a parameter requiring special interpretation according to instructions given in the codes for each category (see next section).

MINOR ATTRIBUTE CODES

The first digit of the minor code is normally zero. If non-zero, it is used as a modifier to provide additional information such as road access or railroad status.

The remaining three digits are normally used to indicate the cartographic interpretation to be applied to specific elements. The type of element described by a particular code usually can be determined from the range of value of the last three digits:

001 - 099 = nodes
100 - 199 = areas
200 - 299 = lines
300 - 399 = points (degenerate lines)
400 - 499 = codes which may be applied to any element type (nodes, lines, areas, or points)
601 - 699 = general descriptive codes

The last three digits (and occasionally all four digits) also may be used as a parameter code. Parameters are used when a minor code can legitimately assume a range of values such as a water elevation or a highway route number. The meaning of a parameter code is indicated by the (non-zero) third digit of the major code.

SAMPLE ATTRIBUTE CODES

Three samples using the DLG attribute codes follow and should be interpreted with reference to Appendix D.

Example A:

050 0412 The major code 050 indicates the combined hydrography category. The minor code 0412 identifies the feature as a perennial stream.

Example B:

100 1203 The major code 100 indicates the roads and trails category. The last three digits of the minor code identify the line feature as a primary route, hard surface (divided, width 25' or more). The first digit of the minor code is non-zero and modifies the minor code by indicating limited access.

Example C:

306 0033 The major code 306 indicates an Origin of Survey code for

the U.S. Public Land Survey System category. Because the last digit of the major code is non-zero, the minor code is a parameter. The minor code 0033 indicates that the area element is referenced to the Willamette Meridian.

SAMPLE DLG-3 STRUCTURE

A sample level 3 line graph (DLG-3) and its corresponding digital records are given in figure 2 and table 2. (These examples are simplified representations of the concepts used in the DLG-3 structure; they are not actual data files.)

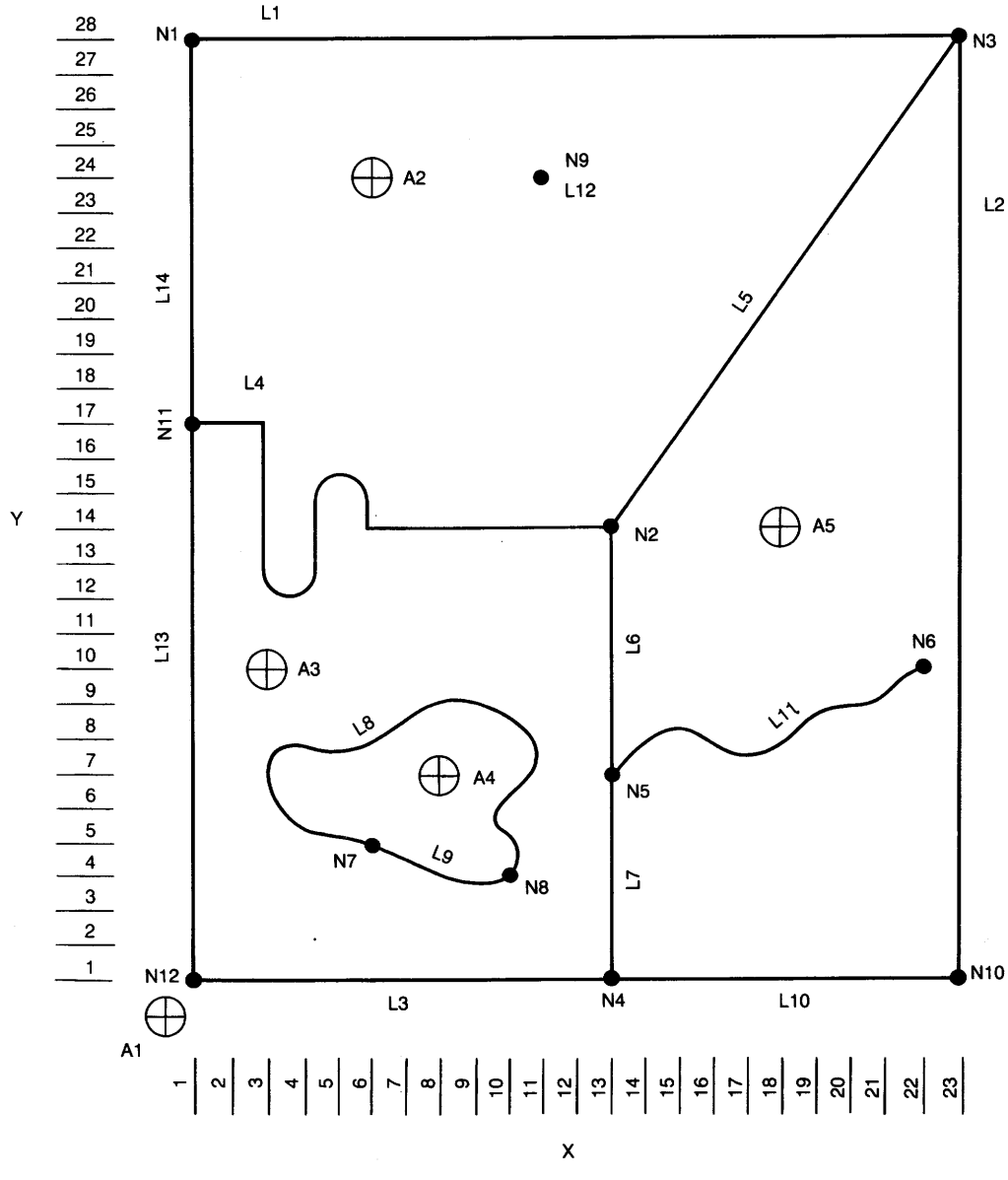

Figure 2.--Sample line graph.

Table 2.--Digital description of sample level 3 line graph (see fig. 2)

Nodes

Number	X Coordinate	Y Coordinate
N1	1	28
N2	13	14
N3	23	28
N4	13	1
N5	13	7
N6	22	10
N7	6	5
N8	10	4
N9	11	24
N10	23	1
N11	1	17
N12	1	1

Areas

Number	X Coordinate	Y Coordinate
A1	0	0
A2	6	24
A3	3	10
A4	8	7
A5	18	14

Lines

	Nodes		Area		Coordinates
Number	Starting	Ending	Left	Right	(Only first and last shown)
L1	1	3	1	2	X(1) Y(28) X(23) Y(28)
L2	3	10	1	5	X(23) Y(28) X(23) Y(1)
L3	4	12	1	3	X(13) Y(1) X(1) Y(1)
L4	11	2	2	3	X(1) Y(17) ... X(13) Y(14)
L5	2	3	2	5	X(13) Y(14) X(23) Y(28)
L6	2	5	5	3	X(13) Y(14) X (13) Y(7)
L7	5	4	5	3	X(13) Y(7) X(13) Y(1)
L8	8	7	4	3	X(10) Y(4) ... X(6) Y(5)
L9	7	8	4	3	X(6) Y(5) ... X(10) Y(4)
L10	4	10	5	1	X(13) Y(1) X(23) Y(1)
L11	5	6	5	5	X(13) Y(1) ... X(22) Y(10)
L12	9	9	2	2	X(11) Y(24) X(11) Y(24)
L13	12	11	1	3	X(1) Y(1) X(1) Y(17)
L14	11	1	1	2	X(1) Y(17) X(1) Y(28)

The level 3 line graph shown is composed of 12 nodes, 5 areas, and 14 lines. The 12 nodes are labeled N1 through N12. Each node is the starting or ending point for at least one line. Each element type is maintained as a separate list in the digital data, with pointers or linkages that express the topological relationships of connectivity and adjacency. The map can be completely described by considering the elements and their interrelationships.

The map represented by the line graph is divided into five distinct areas labeled A1 through A5. Area A1 represents all the area outside of the map border. There is one outside area for each DLG-3. It is always the first area encountered and has the attribute code 000 0000. In the example given in figure 2, the portion of the map inside the border is divided into four areas, each bounded (closed) by lines. Area A2 is bounded by lines L14, L1, L4, and L5. Area A3 is bounded by lines L3, L13, L4, L6, L7, L8, and L9. Area A4 is bounded by lines L8 and L9. Area A5 is bounded by lines L5, L6, L7, and L10 and L2.

As implemented in the standard DLG-3 data structure, line elements contain the only explicit topological references. Each line contains pointers to its bounding nodes (starting and ending) and the areas that it bounds (left and right of the line). This format minimizes redundant linkages to achieve efficient data encoding and storage.

The lines in figure 2 are labeled L1 through L14. The lines can be identified by their starting node number, ending node number, number of the area to the left of the direction of travel, number of the area to the right of the direction of travel, and string of coordinates describing the alignment of the line. In this example, only two coordinates are shown; however, in an actual file, an irregular line would have a variable number of coordinates. The direction of travel of the line is arbitrarily determined during the digitizing operation. In this example, L1 is encoded as proceeding clockwise around area A2. Thus line L1 starts at node N1, ends at node N3, has area A1 to the left of the direction of travel, and has area A2 to the right of the direction of travel. The coordinate string describing the alignment of the line will start with the same coordinate value as that of node N1 and will end with the same coordinate value as that of node N3. Because the area to the left of its direction of travel, A1, is different from the area to the right of its direction of travel, A2, the line is known to be a boundary between the two areas.

Lines L11 and L12 are examples of lines which lie within one area. In this example, line L11 starts at node N5, ends at node N6, has area A5 to the left of the direction of travel, and again has area A5 to the right of the direction of travel. The coordinate string for the line will start with the same coordinate value as that of node N5 and will end with the same coordinate value as that of node N6. Line L12 is an example of a degenerate line. The line starts at node N9, ends at node N9, and has area A2 as both the area to the left and right of the direction of travel. There are only two coordinates in the string defining the alignment of the line: both points have the same coordinate value as node N9; thus, the two points are the same and the line has zero length.

The line graph concept allows all of the points on the map to be described as a member of a line graph element (node, area, or line) with minimal redundancy. The relationships between the various elements are indicated by the structure.

GRAPH THEORY IN DLG DATA

There are two ways to implement the line graph concept in DLG files: the area case and the network case. These cases are differentiated by the nature of the information contained in the categories.

AREA CASE

Area line graphs are used to represent areal features such as political entities or water bodies in digital form. Area line graphs correspond directly to the general line graph case in that each closed area on the map is represented by a distinct area element. Data categories that are collected as area line graphs include:

- Boundaries,
- Combined Hydrography, and
- Public Land Survey System.

Line elements for boundaries and the Public Land Survey System are not normally assigned attributes. The characteristics of lines in these categories can be derived by examining the attributes of the area elements on each side of the line.

Figure 3 shows a window taken from the Dixie Mountain, Oregon, 7.5-minute quadrangle. Figure 4 shows the area line graph encoded for the Public Land Survey System of the same area. The nodes, areas, and lines are labeled.

Table 3 contains some of the digital data records extracted from the node, area, and line lists which describe this portion of the graph. (Note: Descriptions of DLG-3 formats are contained in

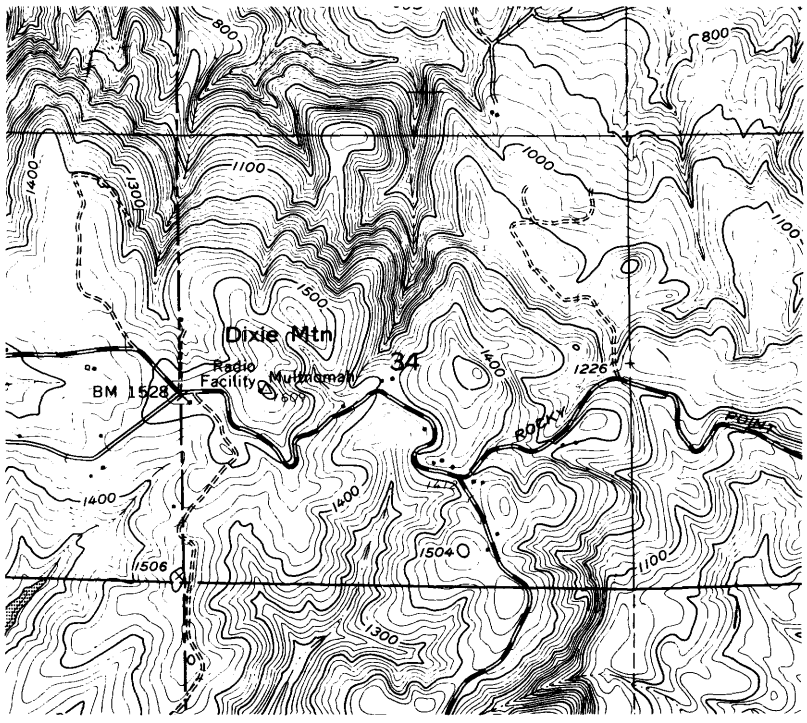

Figure 3.--Window from Dixie Mountain, Oregon, quadrangle published USGS 1:24,000-scale map.

Appendixes A and B, and a list of attribute codes is contained in Appendix D.)

In the Dixie Mountain example, each node and area element is described by two logical records: (1) a type D.1 record that describes the element, and (2) a type F record that lists the attribute codes associated with the element. The first record (type D.1) for each node and area element contains the following fields:

1. Type of record indicator (N or A).
2. Internal sequence identification number.
3. x-coordinate of node or representative area point.
4. y-coordinate of node or representative area point.
5. Number of attribute codes that describe the element.
6. Number of pairs of characters in the text string that describes the element.

The second record (type F) for each node and area element contains n attribute codes (expressed as major and minor code pairs), where n is the number specified in field 5 of the first (type D.1) record.

Each line element in the Dixie Mountain example (except for line number 140), is also described by two logical records: (1) a type D.2 line description record, and (2) a type E record that lists the x,y coordinate pairs that define the shape of the line. Line 140 is described by a type F (attribute code) record in addition to the type D.2 and type E records. The first record (type D.2) for each line element contains the following fields:

1. Type of record indicator (L).
2. Internal sequence identification number.
3. Internal sequence number of starting node.
4. Internal sequence number of ending node.
5. Internal sequence number of the area to the left of the line.
6. Internal sequence number of the area to the right of the line.
7. Number of x,y coordinate pairs that locate the line on the map.
8. Number of attribute codes that describe the line.
9. Number of pairs of characters in the text string that describes the line.

The second logical record (type F) for each line element contains n coordinate pairs, where n is the number specified in field 7 of the first (type D.2) record. In the Dixie Mountain example, all lines are straight and are, therefore, defined by only two coordinate pairs that are identical to the coordinates of the starting and ending nodes.

The lines in the Dixie Mountain example (except for line number 140) do not have type F (attribute code) records because the attributes of each line can be derived by noting the attributes of the left and right areas. For example, line number 63 is a township extremity line, symbolized on the published map as a double-weight line. This attribute of line 63 is not explicitly coded in the digital file but can be derived by noting that the township numbers of the areas to the left (area 28, 302 0003, Township 3 North) and to the right (area 40, 302 0002, Township 2 North) of the line are different.

The explicit attribute record attached to line number 140 contains an attribute

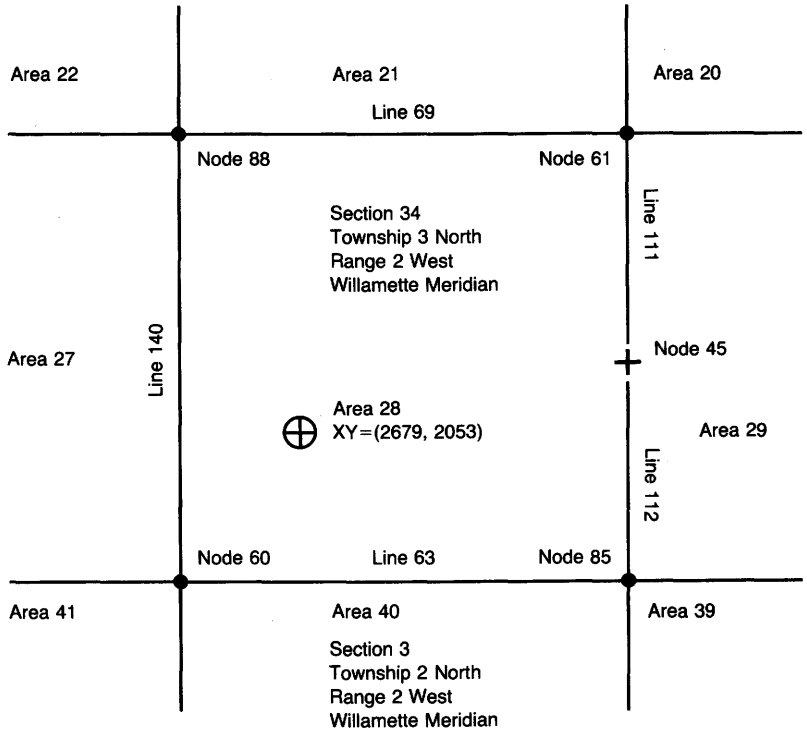

Figure 4.--Window from area line graph for Public Land Survey System, Dixie Mountain, Oregon, quadrangle.

Table 3.--Selected sample of standard format DLG-3 records for Dixie Mountain, Oregon, PLSS

```
N     45  3839  2202     2     0
   300    14   300    40
N     60  1241   943     2     0
   300     1   300    40
N     61  3829  3527     2     0
   300     1   300    40
N     85  3851   883     1     0
   300     1
N     88  1215  3552     1     0
   300     1
A     20  5092  4780     4     0
   306    33   302     3   305     2   301    26
A     21  2372  4731     4     0
   306    33   302     3   305     2   301    27
A     22  -166  4756     4     0
   306    33   302     3   305     2   301    28
A     27   -71  2265     4     0
   306    33   302     3   305     2   301    33
A     28  2679  2053     4     0
   306    33   302     3   305     2   301    34
A     29  5024  2067     4     0
   306    33   302     3   305     2   301    35
A     39  5248  -620     4     0
   306    33   302     2   305     2   301     2
A     40  2606  -596     4     0
   306    33   302     2   305     2   301     3
A     41    80  -577     4     0
   306    33   302     2   305     2   301     4
L     63    60    85    28    40     2     0     0
  1241   943  3851   883
L     69    61    88    28    21     2     0     0
  3829  3527  1215  3522
L    111    61    45    29    28     2     0     0
  3829  3527  3839  2202
L    112    45    85    29    28     2     0     0
  3839  2202  3851   883
L    140    88    60    28    27     2     1     0
  1215  3552  1241   943
   309     9
```

code (309 0009) that indicates coincidence with a boundary, in this case the political boundary dividing Multnomah and Washington counties. The corresponding line in the boundaries file will be coded as coincident with Public Land Survey System (090 0030). This coding is intended to facilitate the integration of different categories of DLG data.

The topological pointers contained in the DLG-3 line elements enable a user to manipulate the data based on the spatial relationships. For example, many applications require areal data to be expressed as closed strings of x,y coordinate pairs. The following procedure could be used to create a perimeter string of the section referenced in figure 4 as area 28. Area 28 has four attributes: Township 3 North (302 0003), Range 2 West (305 0002), Section 34 (301 0034), Willamette Meridian (306 0033).

1. Identify the corresponding area element (area 28) in the data file by comparison with the attribute code lists.
2. Identify all line elements which bound area 28 by examining the line records for their area left and area right topological pointers. (Lines 63, 69, 111, 112, 140).
3. Extract the x,y coordinates for the first line encountered (line 63). Line 63 ends at node 85, so find another line which begins or ends at node 85. Line 112 ends at node 85, so its coordinates must be extracted in the reverse of the order in which they are stored. Now search at node 45, the beginning node of line 112 and proceed as described above until the lines in question are exhausted and the beginning node (node 60) is reached. (Note: This simplified procedure will not suffice for more complex graphs which include, for example, island polygons.)

NETWORK CASE

Network line graphs are used to represent linear features such as roads or

streams in digital form. The network case differs from the area case in that, irrespective of the number of closed areas forming the graph, only two area elements are encoded: (1) the area outside the graph, termed the outside area; and (2) the area within the graph, termed the background area. All lines except the graph boundary are considered to be contained within the background area. The major topological relationship expressed by network data is that of connectivity. Data encoded in network line graph form are suitable for various forms of network analysis, such as minimum path computations. Data categories that are collected as network line graphs include:

- Roads and trails,
- Railroads, and
- Pipelines and transmission lines.

Figure 5 shows a window taken astride the western edge of the network line graph of roads and trails for the Fairdealing, Kentucky, 7.5-minute quadrangle. The window was placed astride the edge of the quadrangle to demonstrate the methodology used to encode data at the map neatline. Although the intersecting lines of the road network divide the graph into a number of areas, only two area elements are encoded, the background area and the outside area. Figure 6 shows the same area on the published map, and table 4 lists some of the digital data records for this portion of the graph.

Note that all line segments within the graph boundary are, by definition, contained in the background area. Area 2 is identified as being to the left and to the right of each line. Only the three lines which form part of the graph boundary, or map neatline (lines 644, 645, and

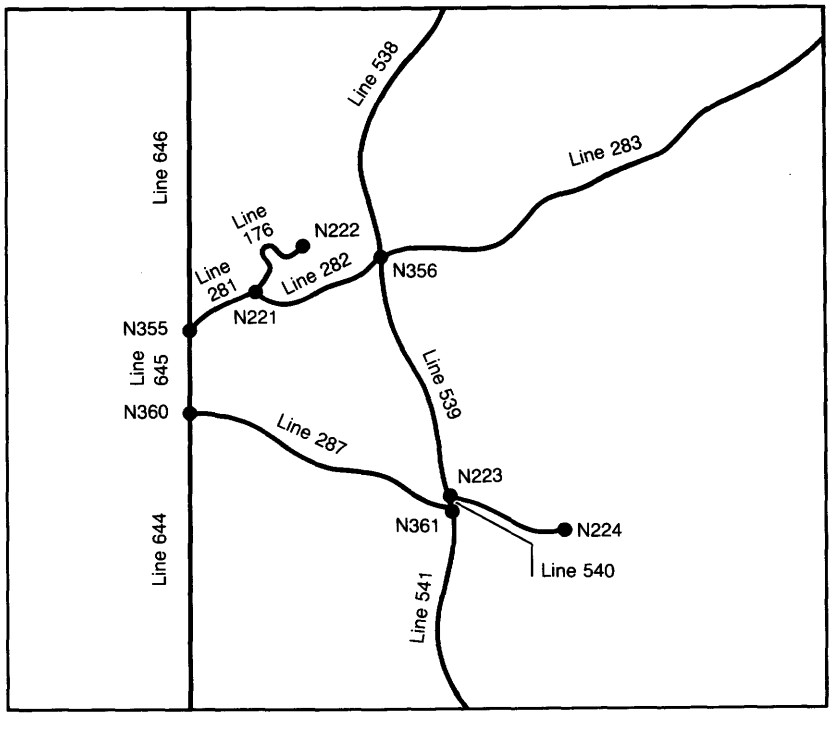

Figure 5.--Window from network line graph of roads and trails for the Fairdealing, Kentucky, quadrangle.

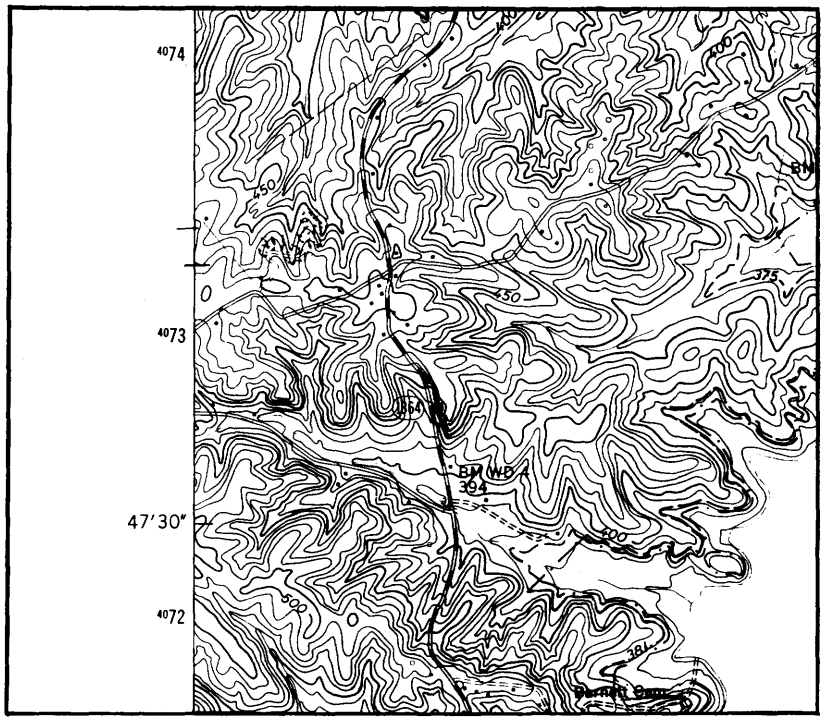

Figure 6.--Window from Fairdealing, Kentucky, quadrangle published USGS 1:24,000-scale map.

646), have distinct left and right area identifiers; they are bounded on one side by the outside area and on the other by the background area.

Each node and area record is described by type D.1 (description) and type F (attribute code) logical records as was the case in the Dixie Mountain (area case) example. Note that area 2, which represents the background area, carries no attribute record. This is always the case with the background area in a network line graph.

Each line segment in the Fairdealing example is described by type D.2 (line description), type E (coordinate list), and type F (attribute code) logical records as appropriate. The line segments that represent the roads and trails in this file are not straight (except for line 540) and are, therefore, described by more than two coordinate pairs. Line number 282, for example, begins at node 356, ends at node 221, and is described by 14 pairs of coordinates.

Preservation of the topological relationship of connectivity is illustrated by the four line segments (lines 538, 539, 540, and 541) that are all part of a single State road. Each line carries two attribute codes:

100	0206 -	secondary route, hard surface, unrestricted access, and
104	1364 -	State route 1364

These segments can be joined at nodes to form a coherent description of route 1364.

DISTRIBUTION FORMATS

The 7.5- and 15-minute DLG data are available in two distribution formats: (1) standard and (2) optional.

Table 4.--Selected sample of standard format DLG-3 records for Fairdealing, Kentucky, roads and trails

(Leading zeros are not used in this table, and each 144-character record is shown as two consecutive 72-character lines.)

```
N    221 -8784 -2449     1     0
   100    1
N    222 -8509 -2211     1     0
   100   51
N    223 -7658 -3666     1     0
   100    1
N    224 -7080 -3862     1     0
   100   51
N    355 -9148 -2667     1     0
   100   50
N    356 -8008 -2328     1     0
   100    1
N    360 -9147 -3161     1     0
   100   50
N    361 -7641 -3733     1     0
   100    1
A      1 -9525 -1872     1     0
     0    0
A      2   447   268     0     0
L    176   222   221     2     2    16     1     0
 -8509 -2211 -8525 -2228 -8548 -2243 -8547 -2245 -8624 -2236 -8660 -2222
 -8678 -2212 -8700 -2215 -8719 -2236 -8715 -2268 -8684 -2288 -8672 -2311
 -8683 -2343 -8708 -2373 -8763 -2423 -8784 -2449
   100   208
L    177   224   223     2     2      8     1     0
 -7080 -3862 -7129 -3885 -7160 -3885 -7271 -3832 -7440 -3721 -7526 -3680
 -7595 -3661 -7658 -3666
   100   208
L    281 355     221     2     2      8     1     0
 -9148 -2667 -9128 -2646 -9056 -2598 -9005 -2556 -8957 -2519 -8829 -2455
 -8805 -2448 -8784 -2449
   100   207
L    282   356   221     2     2     14     1     0
 -8008 -2328 -8071 -2367 -8124 -2391 -8199 -2442 -8246 -2466 -8386 -2513
 -8497 -2553 -8555 -2566 -8620 -2589 -8647 -2588 -8667 -2574 -8727 -2497
 -8758 -2461 -8784 -2449
   100   207
```

Table 4.--Selected sample of standard format DLG-3 records for Fairdealing, Kentucky, roads and trails--continued

```
L    283   357   356     2    2     36     1     0

 -5363  -966 -5377  -974 -5449 -1045 -5510 -1099 -5711 -1239 -5773 -1279
 -5921 -1356 -6043 -1390 -6089 -1411 -6130 -1440 -6168 -1484 -6199 -1527
 -6326 -1651 -6380 -1706 -6467 -1729 -6541 -1757 -6615 -1790 -6674 -1829
 -6781 -1874 -6843 -1895 -6940 -1908 -6987 -1925 -7036 -1935 -7070 -1956
 -7100 -1989 -7126 -2075 -7308 -2259 -7434 -2282 -7501 -2302 -7574 -2302
 -7741 -2284 -7883 -2264 -7912 -2266 -7947 -2283 -7979 -2310 -8008 -2328
   100   207

L    287   361   360     2     2    20     1     0

 -7641 -3733 -7690 -3725 -7722 -3712 -7855 -3634 -8010 -3530 -8081 -3508
 -8130 -3487 -8262 -3466 -8353 -3441 -8433 -3428 -8465 -3414 -8499 -3391
 -8585 -3323 -8636 -3302 -8708 -3238 -8756 -3215 -8831 -3200 -8894 -3182
 -8941 -3164 -9147 -3161
   100   207

L    538   213   356     2     2    32     2     0

 -7048   815 -7123   645 -7193   524 -7303   264 -7379   112 -7424     7
 -7450   -67 -7479  -127 -7521  -268 -7556  -434 -7591  -613 -7609  -739
 -7634  -846 -7659  -923 -7709 -1000 -7763 -1066 -7825 -1102 -7873 -1140
 -7933 -1194 -8001 -1271 -8064 -1349 -8118 -1426 -8151 -1526 -8166 -1606
 -8174 -1700 -8170 -1809 -8159 -1880 -8131 -1961 -8103 -2025 -8058 -2101
 -8038 -2156 -8008 -2328
   100   206   104  1364

L    539   356   223     2     2    15     2     0

 -8008 -2328 -8008 -2373 -8018 -2428 -8018 -2593 -8015 -2651 -8007 -2685
 -7921 -2808 -7885 -2852 -7864 -2885 -7849 -2901 -7819 -2953 -7799 -3010
 -7776 -3095 -7720 -3396 -7658 -3666

   100   206   104  1364

L    540   223   361     2     2     2     2     0

 -7658 -3666 -7641 -3733

   100   206   104  1364

L    541   361   295     2     2    14     2     0

 -7641 -3733 -7628 -3821 -7620 -3930 -7622 -3997 -7639 -4061 -7702 -4251
 -7751 -4334 -7766 -4392 -7774 -4448 -7773 -4501 -7761 -4557 -7699 -4646
 -7681 -4665 -7647 -4716

   100   206   104  1364

L    644   528   360     1     2     2     0     0

 -9151 -4962 -9147 -3161

L    645   360   355     1     2     2     0     0

 -9147 -3161 -9148 -2667

L    646   355   566     1     2     2     0     0

 -9148 -2667 -9146   617
```

The standard distribution format is a direct character representation of the binary archival DLG and, as such, reflects design decisions intended to minimize storage requirements. For example, explicit topological linkages are contained only in the line elements.

The optional distribution format was designed strictly for data interchange. 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.

The characteristics of the standard and optional DLG formats are summarized below:

	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	ground planimetric (usually UTM)
Topological linkages	contained only in line elements	contained in node, area, and line elements

These formats are described in detail in Appendixes A and B.

SOURCE MATERIALS

The DLG data files described in this document are derived from USGS topographic maps published as 7.5-minute quadrangles at 1:24,000 or 1:25,000 scale. Where 7.5-minute coverage is not available, the following sources are used, in order of preference:

1. Advance manuscripts for 7.5-minute maps,
2. Archival compilation materials for 15-minute quadrangles, if available at a larger scale than the published map, such as 1:48,000 scale, or
3. Published 15-minute quadrangles at 1:62,500 scale

The scale of the source materials used to generate a DLG is contained in the file header. The scale is also reflected in the resolution field, which states the ground length in meters of the smallest data collection unit (0.001 inch) for each scale.

Source scale	Resolution
1:24,000	0.61 meter
1:25,000	0.63 meter
1:48,000	1.22 meters
1:62,500	1.58 meters

CELL SIZE AND FILE EXTENT

The DLG's are stored and distributed in standard cells of 7.5 minutes of latitude by 7.5-minutes of longitude. Data collected from 15-minute quadrangles are partitioned into four 7.5-minute units.

Non-standard cells are collected in coastal areas where map format is sometimes extended to conform to the shoreline. Such cells are readily identified by examining the geographic coordinate limits contained in the file header.

COORDINATE SYSTEMS

The positional descriptions for DLG data elements are expressed in one of two coordinate systems, dependent upon the distribution format selected. These are described as follows as the standard distribution format and the optional distribution format.

STANDARD DISTRIBUTION FORMAT

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:

1. The coordinate system is Cartesian.
2. The origin (x=0, y=0) is either:

a. To the left and below the lower left corner of the cell or
b. At the center of the cell (fig. 7).

3. The x-axis of the coordinate system is parallel to a straight line connecting the southwest and southeast corners of the cell, that is, the southwest and southeast corners of the cell have identical y coordinates in the internal file coordinate system.
4. One unit is equal to 0.001-inch at map scale.
5. The coordinate domain is limited to the range -32767 to +32767.

The file header contains the parameters of an transformation which can be used to convert the internal file coordinates to the ground planimetric (usually UTM) coordinate system. An example of this transformation is given in Appendix E.

OPTIONAL DISTRIBUTION FORMAT

The DLG data in the optional distribution format are expressed in the units of the ground coordinate system (usually meters in the UTM coordinate system).

DATA VALIDATION

The DLG data do not currently carry quantified map accuracy statements. The following procedures, however, are used to validate the data files before they are released for distribution:

File fidelity and completeness -- The data are manually digitized using equipment with a resolution of 0.001 inch and an absolute accuracy of from 0.003 to 0.005 inch. The positional accuracy of the data and completeness of the file are checked by visually comparing proof plots with the original stable base source material. These proof plots are generated using automated drafting machines with a resolution of 0.001 inch and an absolute accuracy of from 0.003 to 0.005 inch.

Attribute accuracy -- DLG attribute codes are checked by software against a table of valid codes to ensure that each attribute in a file is valid for the category and element type to which it is assigned. Validating the codes for correct application is currently a manual process involving the correlation of formatted listings with proof plots.

Topological fidelity -- The topological structure of each DLG file is

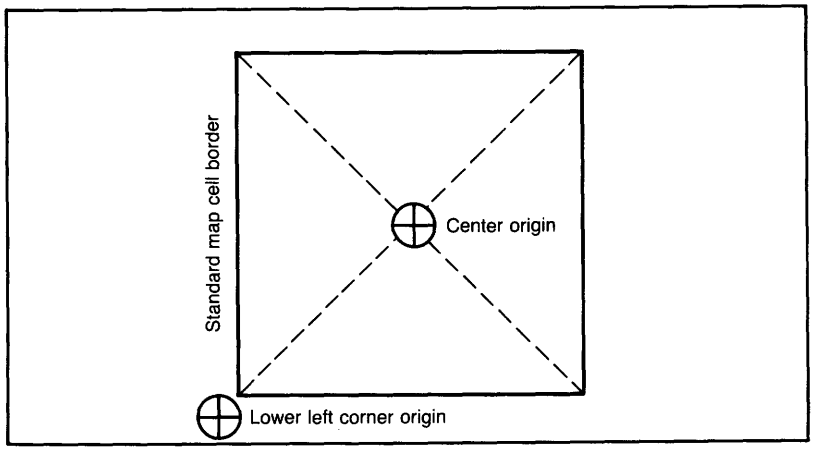

Figure 7.--Location of origin of file reference coordinates.

fully validated by software. There are no extraneous intersections; that is, a line does not join or cross another line, or itself, except at a node. No line extends through a node. Polygon (area) adjacency is also validated; that is, area left and right topological attributes of lines are consistent throughout the file.

Validation of DLG data is performed for each category within a file. The data are not digitally edge matched to adjacent cells. There is currently no attempt, other than the coding of coincident features, to provide fully integrated data layers (usually termed vertical integration).

APPENDIXES

APPENDIX A.--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.

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 string
F	Record containing attribute codes
G	Record containing text string (text record is rarely used)
H	Accuracy estimate (record H is not currently used for any DLG file)

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
     - 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)

   (Repeated for each 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.

APPENDIX A.--Standard DLG Distribution Format (Record Contents)--continued

[Integer fields with a value of zero will have leading zeros suppressed. For example, an I6 field would be "bbbbb0". (b = blank)]
[Any field with the format of D24.15 which has a value of zero will be represented as "bbb0.0bbbbbbbbbbbbbbbbbb". (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 name of the map will be used when practical.
---	---	Filler	---	---	41	41	1 space
A.1	2	Date of original source materials	ALPHA	A10	42	51	Year of original source material, followed by latest photorevision date if applicable, for example, 1956, 1965.
---	---	Filler	---	---	52	52	1 space
A.1	3	Scale of original source material	INTEGER*4	I8	53	60	Scale denominator of source material, for example, 62500.
---	---	Filler	---	---	61	144	84 spaces
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, Universal Transverse Mercator (UTM)
A.2	3	Code defining zone in ground planimetric reference system	INTEGER*2	I6	13	18	Codes for UTM coordinate zones are given in Appendix C.
A.2	4	Map projection parameters	REAL*8	5D24.15	19	138	This field contains the first 5 of 15 map projection parameters. Parameters for the UTM projection are given in Appendix C.
---	---	Filler	---	---	139	144	6 spaces

Logical Record Type A--continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
A.3	1	Map projection parameters	REAL*8	6D24.15	1	144	This record contains projection parameters 6 thru 11. Parameters for the UTM projection are given in Appendix C.
A.4	1	Map projection parameters	REAL* 8	4D24.15	1	96	This field contains the last 4 projection parameters. Parameters for the UTM projection are given in Appendix C.
A.4	2	Code defining units of measure for ground planimetric coordinates throughout the file	INTEGER*2	I6	97	102	Code=2, meters
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. This value corresponds to the scale of the source document as follows: Scale — Resolution 1:24,000 — 0.61 M 1:25,000 — 0.63 M 1:48,000 — 1.22 M 1:62,500 — 1.58 M
A.4	4	Accuracy code of planimetric data	INTEGER*2	I6	127	132	Code=0, unknown accuracy

Logical Record Type A--continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
A.4	5	Number (n) of sides in the polygon which defines the coverage of the cell	INTEGER*2	I6	133	138	n=4
---	---	Filler	---	---	139	144	6 spaces
A.5	1	A (4,2) array containing geographic coordinates of the polygon which contains the domain of the DLG file	REAL*8	3(2D24.15)	1	144	The four-sided polygon will 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 espressed in the order=SW, NW, NE, SE.
A.6				2D24.15	1	48	
---	---	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 meters in UTM zone defined by data element 3 of record A.2.
B.1	2	Number (m) of registration points	INTEGER*2	I6	97	102	m=4
---	---	Filler	---	---	103	144	42 spaces
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	$1 \leq q \leq 32$. Up to 32 categories can be represented in a given file. The value will usually be between 1 and 5.
---	---	Filler	---	---	7	144	138 spaces
C.2[1] to C.N	1	A (q,7) array containing category names as well as maximum and actual number of node, area, and line elements in each 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. Columns 2 and 3 of the array contain maximum and actual number of nodes in the category. Columns 4 and 5 contain maximum and actual number of areas in the category. Columns 6 and 7 are the maximum and actual number of line segments. (Note: the maximum number of any element type within a category is 4,770. This field is used only during initial processing of data).
---	---	Filler	---	---	---	---	32 or 88 spaces

[1]The number of categories "q" is given in record C.1. There will be 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."

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	Unique within each category and 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 classification attributes which are attached to the node or area element ($t \geq 0$)	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 ($k \geq 0$)	INTEGER*2	I6	27	32	k=0. There are no text attributes for 7.5- and 15-minute DLG data.
---	---	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	This number is unique within each category and element type.
D.2	3	Internal identification number of starting node	INTEGER*2	I6	9	14	Number refers to data element 2 in record D.1.

Logical Record Type D--continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
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	$1500 \geq v \geq 2$
D.2	8	Number (t) of classification attributes which are attached to the line segment ($t \geq 0$)	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 ($k \geq 0$)	INTEGER*2	I6	45	50	k=0. There are no text attributes for 7.5- and 15-minute DLG data.
	---	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	---	---	---	---	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" equals 12 or 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 classification codes for a graph element	INTEGER* 2	t(2I6)	1		The array is stored by row with the first column containing the major classification attribute, and the second column containing the minor classification attribute.
---	---	Filler	---	---	---	---	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 12 or an integer multiple of 12 there will be no spaces as filler at the end of the record.

APPENDIX B.--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 contain DLG data, and bytes 73-80 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 Node-to-line linkage record(s) Attribute code record(s) Text record(s)	Repeated for each node within a data category	Repeated for each data category
Area identification record Area-to-line linkage record(s) Attribute code record(s) Text record(s)	Repeated for each area within a data category	
Line identification records Coordinate string record(s) Attribute code record(s) Text record(s)	Repeated for each line within a data category	

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	Descriptive text.
2	1	Name of Digital Cartographic Unit	ALPHA	A40	1	40	The name of the map will be used when practical.
---	---	Filler	---	---	41	41	1 space
2	2	Date of original source material	ALPHA	A10	42	51	Year of original source material followed by latest photorevision date if applicable, for example, 1956, 1965.
---		Filler	---	---	52	52	1 space
2	3	Scale of original source material	INTEGER*4	I8	53	60	Scale denominator of source material, for example, 62500
---		Filler	---	---	61	72	12 spaces
3		Filler	---	---	1	72	72 spaces. This record is not currently used.
4	1	DLG level code	INTEGER*2	I6	1	6	Code=3, DLG-3
4	2	Code defining ground planimetric reference system	INTEGER*2	I6	7	12	Code=1, UTM
4	3	Code defining zone in ground planimetric reference system	INTEGER*2	I6	13	18	Codes for UTM coordinate zones are given in appendix C.

FILE IDENTIFICATION AND DESCRIPTION RECORDS--continued

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	Code=2, meters
4	5	Resolution	REAL*4	D18.11	25	42	The true ground distance corresponding to one unit (0.001 inch at map scale) in the file internal coordinate system used in data collection. This value corresponds to the scale of the source document as follows: Scale / Resolution 1:24,000 0.61M 1:25,000 0.63M 1:48,000 1.22M 1:62,500 1.58M
4	6	Number of file-to-map transformation parameters	INTEGER*2	I6	43	48	Usually 4.
4	7	Number of accuracy/ miscellaneous records	INTEGER*2	I6	49	54	Currently=0, none included
4	8	Number (n) of sides in the polygon which define the coverage of the cell. Number (n) also defines the number of control-points	INTEGER*2	I6	55	60	Usually 4.

APPENDIX B.--Optional DLG Distribution Format (Record Contents)--continued

FILE IDENTIFICATION AND DESCRIPTION RECORDS--continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
4	9	Number (q) of categories (overlays) in the DLG file	INTEGER*2	I6	61	66	$1 \leq q \leq 32$. Up to 32 categories can be represented in a given file. The value will usually be between 1 and 5.
---	---	Filler	---	---	67	72	6 spaces
5-9	1	Projection parameters for map transformation	REAL*8	3D24.15	1	72	Three parameters on each of 5 records. Parameters for the UTM projection are given in Appendix C.
10	1	Internal file-to-map projection transformation parameters	REAL*4	4D18.11	1	72	A transformation of this type is not required, since coordinates are expressed in a ground planimetric coordinate system (usually UTM). These parameters are however, valid for transformation as described in record B.1, data element 1, of the standard format.

APPENDIX B.--Optional DLG Distribution Format (Record Contents)--continued

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	A2	1	2	"SW," "NW," "NE," or "SE" for four quadrangle corners.
		Filler			3	6	4 spaces
	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	Internal file x	REAL*4	F12.2	37	48	In units in the appropriate zone of the ground planimetric coordinate system.
	5	Internal file y	REAL*4	F12.2	49	60	In units in the appropriate zone of the ground planimetric coordinate system.
---	---	Filler	---	---	61	72	12 spaces

APPENDIX B.--Optional DLG Distribution Format (Record Contents)--continued

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.
	2	Attribute format codes	INTEGER*2	I4	21	24	Blank or zero (0) indicates default (2I6) attribute formatting in major-minor pairs.
	3	Number of nodes referenced in file	INTEGER*2	I6	25	30	Number of nodes referenced in file as start and end nodes of lines.
	4	Actual number of nodes in file	INTEGER*2	I6	31	36	Only if some or all node records were excluded from the file, would 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	Flag=0, node-to-area linkage records not present.[1]
	6	Presence of node-to-line linkage records	INTEGER*2	I1	39	39	Flag=1, node-to-line linkage records are included.[1]
	---	Filler	---	---	40	40	1 zero or space
	7	Number of areas referenced in file	INTEGER*2	I6	41	46	Number of areas referenced in file as areas left and areas right of lines.

[1]The flags for lists present or absent are the current default values, and are the only current values used.

DATA CATEGORY IDENTIFICATION RECORDS--continued

Record Number	Data Element	Contents	Type (Fortran Notation)	Format	Starting Byte	Ending Byte	Comment
	8	Actual number of areas in file	INTEGER*2	I6	47	52	Only if some or all area records were excluded from the file would the number be different from the data element 7.
	---	Filler	---	---	53	53	1 space
	9	Presence of area-to-node linkage records	INTEGER*2	I1	54	54	Flag=0, area-to-node linkage records not present.[1]
	10	Presence of area-to-line linkage records	INTEGER*2	I1	55	55	Flag=1, area-to-line linkage records are included.[1]
	11	Presence of area-coordinate lists	INTEGER*2	I1	56	56	Flag=0, area-coordinate lists not present.[1]
	12	Number of lines referenced in file	INTEGER*2	I6	57	62	Number of lines referenced in area-to-line and node-to-line records.
	13	Actual number of lines in file	INTEGER*2	I6	63	68	Only if some lines were excluded from the file would this number be different from data element 12.
	---	Filler	---	---	69	71	3 spaces
	14	Presence of line-coordinate lists	INTEGER*2	I1	72	72	Flag=1, line-coordinate lists are included.[1]

[1]The flags for lists present or absent are the current default values, and are the only current values used.

APPENDIX B.--Optional DLG Distribution Format (Record Contents)--continued

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	This value is unique within each category and element type.
	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 in a node list (for areas)	INTEGER*2	I6	31	36	Blank or zero (0). These lists are not currently included.
	5	Number of elements in line segment list	INTEGER*2	I6	37	42	Number of line segments that intersect at the node, or bound the area.
	6	Number of x,y or lat-long points in area-coordinate list	INTEGER*2	I6	43	48	Blank or zero (0). These lists are not currently included.
	7	Number of attributes listed	INTEGER*2	I6	49	54	Number of attributes listed.
	8	Number of text characters listed	INTEGER*2	I6	55	60	Zero (0). There are no text attributes for 7.5- and 15-minute DLG data.
	9	Number of islands within area	INTEGER*2	I6	61	66	Area records only, 6 spaces for node records.
---	---	Filler	---	---	67	72	6 spaces

NODE-TO-LINE LINKAGE RECORDS

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

AREA-TO-LINE LINKAGE RECORDS

FORTRAN format (1216), for each area: The list consists of line segment internal ID numbers (which appear in bytes 2-6 of the line identification records) and, for those areas with islands (indicated by bytes 61-66 of the area's first record), zero (0) elements marking the beginning of islands. Line segments with this area to the right are included as positive ID numbers. Line segments 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). A zero (0) element is inserted in the list before each island sublist.

APPENDIX B.--Optional DLG Distribution Format (Record Contents)--continued

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	This number is unique within each category and element type.
	3	Starting node		I6	7	12	Internal ID number. This refers to data element 2 of the node identification record.
	4	Ending node		I6	13	18	Internal ID number. This refers to data element 2 of the node identification record.
	5	Left area		I6	19	24	Internal ID number. This refers to data element 2 of the area identification record.
	6	Right area		I6	25	30	Internal ID number. This refers to data element 2 of the area identification record.
	---	Filler		---	31	42	12 spaces
	7	Number of x,y coordinates listed		I6	43	48	Number of coordinate pairs listed.
	8	Number of attributes listed		I6	49	54	Number of attributes (or two element attribute pairs) listed.
	9	Number of text characters listed		I6	55	60	Zero (0). There are no text data associated with 7.5- and 15-minute DLG data.

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). The file-to-map projection parameters in Header record 10 are set to (1.0,0.0,0.0,0.0) for real map projection coordinates (the transformation formulas still apply).

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.

APPENDIX C.--Map Projection Parameters
Universal Transverse Mercator (UTM)

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).

When the ground planimetric coordinate system of a DLG is the Universal Transverse Mercator system, as in the case for all DLG's digitized from 1:24,000-scale maps, only the first two of the 15 parameter fields are used:

1.	Longitude of any point in UTM zone.	Normally placed at the center of the DLG cell.
2.	Latitude of any point in UTM zone.	

3-15. Not used (=0).

A transformation to or from UTM using GCTP can be controlled by specifying the UTM zone or by supplying the geographic coordinate in parameters 1 and 2, from which the UTM zone is computed by GCTP. In a 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 "bb0.500300362500000D 08" encoded in FORTRAN D24.15 format.

APPENDIX C.--Map Projection Parameters
Universal Transverse Mercator (UTM)--continued

Codes for UTM Coordinate Zones

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
102- 96	14
96- 90	15
90- 84	16
84- 78	17
78- 72	18
72- 66	19
66- 60	20

Valid Minor Codes for the Coincident Feature Parameter

Code	Base Category
	Hydrography;
0003	Streams, rivers, irrigation channels or canals, ditches
0004	Lakes, ponds, reservoirs, springs, wells, glaciers, and snowfields
0005	Combined Hydrography
0009	Boundaries
	Transportation Systems
0010	Roads and trails
0011	Railroads
0030	Public Land Survey System

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Combined Hydrography	Feature identification	Nodes	050	0001	Upper origin of stream
				0002	Upper origin of stream at water body
				0003	Sink
				0004	Stream entering water body
				0005	Stream exiting water body
		Areas	000	0000	Area outside graph
			050	0100	Alkali flat
				0101	Reservoir
				0102	Covered reservoir
				0103	Glacier or permanent snowfield
				0104	Salt evaporator
				0105	Inundation area
				0106	Fish hatchery or farm
				0107	Industrial water impoundment
				0108	Area to be submerged
				0109	Sewage disposal pond or filtration beds
				0110	Tailings pond
				0111	Marsh, wetland, swamp, bog
				0112	Mangrove area
				0113	Rice field
				0114	Cranberry bog
				0115	Flats (tidal, mud, sand, gravel)
				0116	Bays, estuaries, gulfs, oceans, seas
		Lines		0200	Shoreline
				0201	Manmade shoreline
				0202	Closure line, (water-water)
				0203	Indefinite shoreline
				0204	Apparent limit
				0205	Outline of a Carolina bay

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Combined Hydrography (cont'd.)	Feature identification	Points (Degenerate Lines)	050	0300	Spring
				0301	Non-flowing well
				0302	Flowing well
				0303	Riser
				0304	Geyser
				0305	Windmill
		Multiple Element Types	050	0000	Feature added by photorevision methods
				0400	Rapids
				0401	Falls
				0402	Gravel pit or quarry filled with water
				0403	Gaging station
				0404	Pumping station
				0405	Water intake
				0406	Dam or weir
				0407	Canal lock or sluice gate
				0408	Spillway
				0409	Gate (flood, tidal, head, check)
				0410	Exposed rock
				0411	Crevasse
				0412	Stream
				0413	Braided stream
				0414	Ditch or canal
				0415	Aqueduct
				0416	Flume
				0417	Penstock
				0418	Siphon
				0419	Channel in water area
				0420	Wash or ephemeral drain
				0421	Lake or pond
				0422	Coral reef

APPENDIX D.--DLG Attribute Codes--continued

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Combined Hydrography (cont'd.)	Descriptive	Multiple Element Types	050	0601	Underground
				0602	Overpassing
				0603	Elevated
				0604	Tunnel
				0605	Right bank
				0606	Left bank
				0607	Under construction
				0608	Salt
				0609	Unsurveyed
				0610	Intermittent
				0611	Abandoned
				0612	Submerged
				0613	Wooded
				0614	Dry
				0615	Mineral or hot (sulphur, alkali, etc.)
				0616	Navigable transportation
				0617	Underpassing
				0618	Earthen construction
	Parameter	Multiple Element Types	05N	----	Water surface elevation N=1 for feet, 2 for meters, 6 for feet below datum, and 7 for meters below datum. Elevation value in four spaces, right justified.
			055	----	River mile, value in four spaces, right justified
			058	0000	Best estimate of classification and/or position
			059	00--	Coincident feature (enter first two digits of major code for category of coincident feature in blanks, right justified.

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Boundaries	Feature identification	Nodes	090	0001	Boundary, monumented point on boundary
				0002	Boundary, turning point
		Areas			(all within United States unless otherwise indicated)
			000	0000	Area outside graph
			090	0100	Boundary, civil township, district, precinct, barrio
				0101	Boundary, incorporated city, village, town, borough or hamlet
				0103	Boundary, national park, monument, lakeshore, parkway, battlefield or rec. area
				0104	Boundary, national forest or grassland
				0105	Boundary, national wildlife refuge, game preserve, or fish hatchery
				0106	Boundary, national scenic waterways or wilderness area
				0107	Boundary, Indian reservation
				0108	Boundary, military reservation
				0109	Boundary, non-military government reservation
				0110	Boundary, Federal prison
				0113	Boundary, land grant
				0130	Boundary, State park, rec. area, or State lake
				0131	Boundary, State wildlife refuge/game preserve
				0132	Boundary, State forest
				0133	Boundary, State prison
				0134	Boundary, county game preserve
				0150	Boundary, large city, county, or private park
				0151	Boundary, small park
				0197	Boundary, Canada
				0198	Boundary, Mexico
				0199	Boundary, area outside a national boundary

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Boundaries (cont'd.)	Feature identification	Lines	090	0200	Boundary, approximate boundary
				0201	Boundary, indefinite boundary (shown by normal symbolization at 1/2 specified line weight for county boundary and higher rank)
				0202	Boundary, disputed boundary
				0203	Boundary, historical line
		Points (Degenerate Lines)	090	0301	Reference monuments for turning points
	Parameter	Multiple Element Types	091	00--	Boundary, enter State FIPS code in two digits right justified
			092	0---	Boundary, enter county or county equivalent FIPS code in three digits right justified
			095	----	Boundary, monument number, one to four digits, right justified
			098	0000	Best estimate of classification and/or position
			099	00--	Boundary, coincident feature (enter first two digits of major code for category of coincident feature in blanks, right justified)
Transportation, Roads	Feature identification	Nodes	100	0001	Road intersection
				0002	Road intersection (grade separation, no interchange)
				0003	Road intersection (grade separation with interchange)
				0004	Road intersection (grade separation, partial interchange)
				0005	Road-railroad intersection
				0006	Road-railroad intersection (grade separation)
				0007	Road-stream intersection (fixed bridge/culvert)
				0008	Road-stream intersection (movable bridge)

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Transportation, Roads (cont'd.)	Feature identification	Nodes (cont'd.)	100	0009	Road-trail intersection
				0010	Trail-trail intersection
				0011	Bridge abutment
				0012	Tunnel portal
				0013	Road-transmission line intersection
				0014	Road-pipeline intersection
				0015	Ferry landing
				0016	Change in road classification/status
				0017	Structure over road
				0018	Ford
				0019	Low water bridge
				0020	Toll gate
				0021	Traffic circle
				0022	Cul-de-sac
				0023	Gate
				0024	Road-canal intersection (where canal is a transportation feature)
				0030	Foot or bicycle bridge over road
				0050	Point on road
				0051	End of road/trail
				0060	Port of entry
				0061	U.S. Customs
		Areas	000	0000	Area outside graph
		Lines	100	N201	Primary route, hard surface (undivided)
				N202	Primary route, hard surface (divided, 25' or less)
				N203	Primary route, hard surface (divided, 25' or more)
				N204	Primary route, hard surface (one-way traffic)
				N205	Secondary route, hard surface (one-way traffic)
				N206	Secondary route, hard surface
				N207	Improved light duty
				N208	Unimproved dirt
				N209	Trail

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Transportation, Roads (cont'd.)	Feature identification	Lines (cont'd.)	100	N210	4-wheel-drive vehicle trail
				N211	Urban streets
				N212	Foot trail
				N213	Bridle trail
				N214	Pack trail
				N215	Historical trail
				N216	Bicycle trail
				N217	Primary route, hard surface (interchange road)
				N218	Secondary route, hard surface (interchange road)
				N219	Improved light duty interchange road
				N220	Secondary route, divided
				N222	Road or street, class 3, divided by centerline
				N223	Road or street, class 3, divided, lanes separated
				N240	Ferry crossing
				N241	Road through parking area
				N250	Perimeter of parking area
				N293	Road or trail subject to inundation
				N294	Road or trail on dam
				N295	Road or trail on bridge
				N296	Road or trail on levee
				N297	Road or trail tunnel under ground
				N298	Road or trail tunnel under water
				N299	Road or trail under construction
					N=0 for unrestricted access, N=1 for limited access, N=2 for toll road, N=3 for privately operated or controlled public access, N=4 for proposed road, N=5 for abandoned road
		Points (Degenerate Lines)	100	0301	Roadside or wayside park
				0302	Rest area
				0303	Overlook
				0304	Weigh station
				0305	Service facility

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Transportation, Roads (cont'd.)	Feature identification	Multiple Element Types	100	0000	Feature added by photorevision methods
	Parameter	Multiple Element Types	101	00--	Number of lanes, right justified
			102	0---	Interstate route number, right justified
			103	0---	U.S. route number, right justified
			104	----	State route number, right justified
			105	----	Reservation, park, or military route number, right justified
			106	----	County route number, right justified
			108	0000	Best estimate of classification and/or position
			109	0---	Coincident feature or symbol (enter first two digits of major code for category of coincident feature in blanks, right justified)
Transportation, Railroads	Feature identification	Nodes	110	0001	Railroad intersection
				0002	Railroad intersection (grade separation)
				0003	Siding junction
				0004	Station
				0005	Railroad-road intersection
				0006	Railroad-road intersection (grade separation)
				0007	Railroad-stream intersection (fixed bridge/culvert)
				0008	Railroad-stream intersection (movable bridge)
				0009	Railroad-trail intersection
				0010	Bridge abutment
				0011	Tunnel portal
				0012	Railroad-transmission line intersection
				0013	Railroad-pipeline intersection
				0014	Ferry landing

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Transportation, Railroads (cont'd.)	Feature identification	Nodes (cont'd.)	110	0015	Change in railroad classification/ status
				0016	Structure over railroad
				0017	Turntable
				0018	Turntable and roundhouse
				0019	Point within yard
				0049	Crossover
				0050	Point on railroad
				0051	End of railroad
		Areas	000	0000	Area outside graph
		Lines	110	N201	Single track standard gage
				N202	Double track, standard gage
				N203	3-track, standard gage
				N204	4-track, standard gage
				N205	5 or more tracks, standard gage
				N206	Siding, standard gage
				N211	Single track, narrow gage
				N212	Double track, narrow gage
				N213	3-track, narrow gage
				N214	4-track, narrow gage
				N215	5 or more tracks, narrow gage
				N216	Siding, narrow gage
				N220	Carline or surface rapid transit
				N221	Elevated rapid transit
				N230	Industrial or mine railroad
				N240	Ferry crossing
				N241	Railroad through yard
				N250	Perimeter of yard
				N294	Railroad on pier
				N295	Railroad on bridge
				N296	Railroad on levee
				N297	Railroad tunnel under ground
				N298	Railroad tunnel underwater
				N299	Railroad in snowshed
					N=0 for normal use, N=1 for under construction, N=2 for abandoned, N=3 for dismantled

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Transportation Railroads (cont'd.)	Feature identification	Points (Degenerate Lines)	NONE		
		Multiple Element Types	110	0000	Feature added by photorevision methods
	Parameter	Multiple Element Types	118	0000	Best estimate of classification and/or position
			119	00--	Coincident feature or symbol (enter first two digits of major code for category of coincident feature, right justified).
Pipelines, Transmission Lines	Feature identification	Nodes	130	0001	Transmission line intersection
				0002	Pipeline intersection
				0003	Transmission line - pipeline intersection
				0004	Transmission line - road intersection
				0005	Pipeline - road intersection
				0006	Transmission line - railroad intersection
				0007	Pipeline - stream intersection
				0008	Transmission line - stream intersection
				0009	Pipeline - stream intersection
				0010	Transmission line - telephone/ telegraph line intersection
				0011	Pipeline - bank/shore intersection
				0012	Transmission line - telephone/ telegraph line intersection
				0013	Pipeline - telephone/telegraph line intersection
				0014	Pumping station
				0015	Substation
				0016	Steel tower
				0020	Change in classification/status
				0030	Angle point on transmission line
				0031	Angle point on pipeline

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Pipelines, Transmission Lines (cont'd.)	Feature identification	Nodes (cont'd.)	130	0032	Point on transmission line
				0033	Point on pipeline
				0034	End of transmission line
				0035	End of pipeline
				0036	End of transmission line at power station or substation
				0037	End of pipeline at refinery/oil-gas field
		Areas	000	0000	Area outside graph
		Lines	130	0201	Single or double pole powerline
				0202	Steel tower powerline
				0203	Single or double pole powerline extended over water
				0204	Steel tower powerline extended over water
				0205	Single or double pole powerline extended into urban area
				0206	Steel tower powerline extended into urban area
				0211	Pipeline (under ground)
				0212	Pipeline (above ground)
				0213	Pipeline (under water)
				0214	Pipeline (above water)
				0215	Pipeline, through siphon
				0216	Pipeline, through flume
				0217	Pipeline extended into urban area
				0221	Telephone or telegraph line
		Points	NONE		
		Multiple Element Types	130	0000	Feature added by photorevision methods

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Pipelines, Transmission Lines (cont'd.)	Parameter	Multiple Element Types	138	0000	Best estimate of classification and/or position
			139	00--	Coincident feature or symbol (enter first two digits of major code for category of coincident feature, right justified).
			139	01--	Assumed position next to parallel feature or symbol (enter first two digits of major code for category of parallel feature, right justified).
U.S. Public Land Survey Data	Feature identification	Nodes	300	0001	U.S. Public Land Survey section corner
				0002	Point on section line (no corner)
				0003	Closing corner
				0004	Meander corner
				0005	Auxiliary meander corner
				0006	Special meander corner
				0007	Witness corner
				0008	Witness point
				0009	Angle point
				0010	Location monument (includes amended monument and mineral monument)
				0011	Reference mark
				0012	Quarter-section corner
				0013	Tract corner
				0014	Land grant corner
				0015	Arbitrary section corner
				0040	Identification procedure, corner identified in field
				0041	Identification procedure, corner with horizontal coordinates
				0042	Identification procedure, corner with elevation value

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
U.S. Public Land Survey Data (cont'd.)	Parameters	Areas	000	0000	Area outside graph
					Select one parameter code from each of the following A, B, C, and D lists and/or consult list E
					A. Section number or Land Grant no.
			301	0---	Insert 0 in the first space for numeric section identifier, 1 for numeric portion of alphanumeric identifier, or 2 for alphabetic part of alphanumeric identifier. In the last three spaces, insert section number or numeric representation of alphabetic character (01-26), right justified.
			307	----	Insert 0 in the first space for numeric grant identifier, 1 for numeric portion of alphanumeric identifier, 2 for alphabetic portion of alphanumeric identifier, or 3 for alphabetic identifier. In the last three spaces, insert grant number or numeric representation of alphabetic character (01-26), right justified.
					B. Township number(s)
			30-	----	Insert 2 for north of the baseline or 3 for south of the baseline in first space. In the second space, insert a 0 for full township 2 for 1/4 township, 4 for 1/2 township, or 6 for 3/4 township. Insert township number in the last three spaces, right justified.

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
U.S. Public Land Survey Data (cont'd.)	Parameters	Areas (cont'd.)	30-	----	C. Range number(s)
			30-	----	Insert 4 for east of the principal meridian or 5 for west of the principal meridian in the first space. In the second space, insert a 0 for a full range, for 1/4 range, 4 for 1/2 range, 6 for 3/4 range, 8 for duplicate to the north or east of the original township, or 9 for triplicate to the north or east of the original township. Insert range number in last three spaces, right justified.
					D. Origin of survey
			306	00--	Insert code number from following list.
				0001	1st Principal Meridian
				0002	2nd Principal Meridian
				0003	3rd Principal Meridian
				0004	4th Principal Meridian (IL)
				0046	4th Principal Meridian (MN&WI)
				0005	5th Principal Meridian
				0006	6th Principal Meridian
				0007	Black Hills
				0008	Boise
				0009	Chickasaw
				0010	Choctaw
				0011	Cimarron
				0012	Copper River
				0013	Fiarbanks
				0014	Gila and Salt River
				0015	Humboldt
				0016	Huntsville
				0017	Indiana

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
U.S. Public Land Survey Data (cont'd.)	Parameters (cont'd.)	Areas (cont'd.)	306		D. Origin of survey (cont'd.)
				0018	Louisiana
				0019	Michigan
				0020	Principal
				0021	Mount Diablo
				0022	Navajo
				0023	New Mexico Principal
				0024	St. Helena
				0025	St. Stephens
				0026	Salt Lake
				0027	San Bernard
				0028	Seward
				0029	Tallahasee
				0030	Uintah
				0031	Ute
			306	00--	Insert code number from following list.
				0032	Washington
				0033	Willamette
				0034	Wind River
				0035	Ohio River Survey
				0036	Between the Miamis
				0037	Muskingum River
				0038	Ohio River Base
				0039	First Scioto River
				0040	Second Scioto River
				0041	Third Scioto River
				0042	Ellicott's Line (note 1)
				0043	Twelve-Mile Square
				0044	Kateel River

1. Ellicott's Line is the name given to the Ohio-Pennsylvania boundary. No townships are referenced to Ellicott's Line--it is included for compatibility with the BLM.

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
U.S. Public Land Survey Data (cont'd.)	Parameters (cont'd.)	Areas (cont'd.)	306		D. Origin of survey (cont'd.)
				0045	Umiat
				0046	Fourth Principal
				0047	West of the Great Miami
				0048	U.S. Military Survey
				0099	Not Public Land Survey (note 2)
					E. If the area has not been surveyed as part of the U.S.Public Land Survey System, the following codes should be used.
			300	0100	Indian lands
				0101	Homestead entries
				0102	Donation land claims
				0103	Land grants; civil colonies
				0104	Private extension of public land survey
				0105	Area of public and private survey overlap
				0106	Overlapping land grants
				0107	Military reservation
				0198	Water
				0199	Unsurveyed area
	Feature identification	Lines	300	0201	Approximate position (within 200 feet)
				0202	Protracted position
				0203	Arbitrary closure line
				0204	Base line

2. This code is included for compatibility with the BLM. It refers to area in the original 13 States, Texas, or a territory. The PLSS data category is not digitized in these areas.

APPENDIX D.--DLG Attribute Codes--continued

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
U.S. Public Land Survey Data (cont'd.)	Feature identification	Points (Degenerate lines)	0300		E. If the area has not been surveyed as part of the U.S.Public Land Survey System, the following codes should be used--continued.
				0300	Location monument
				0301	Isolated found section corner
				0302	Witness corner (off surveyed line)
	Parameter	Multiple Element Types			In addition to the parameter codes used for designating the section, township,and range numbers, the following codes may be used.
			308	0000	Best estimate of classification and/or position
			309	00--	Coincident feature or symbol (enter first two digits of major code for category of coincident feature in blanks, right justified).

APPENDIX E.--Coordinate Conversion

This Appendix illustrates the procedure for converting the internal file coordinates of the standard DLG format to the ground planimetric UTM reference coordinates. The formulas for this conversion, representing a simple offset, rotation, and scale, are as follows:

$$X = A1x + A2y + A3, \text{ and}$$

$$Y = A1y - A2x + A4,$$

where X and Y are the ground planimetric coordinate values and x and y are the internal file coordinates.

The parameters for these formulas (A1, A2, A3, and A4) are contained in Header Record B, as double-precision floating-point numbers.

This example converts four coordinate pairs from internal file coordinates to ground planimetric UTM zone 10 coordinate values. The parameters are as follows:

A1 =.60959440759
A2 = -.0028817856942
A3 = 538248.79341
A4 = 4240374.4556

The internal file coordinates to be converted are as follows:

	x	y
1st pair	-8971	-11376
2nd pair	-8955	11375
3rd pair	8955	11376
4th pair	8971	-11376

The calculations to determine the ground planimetric coordinates for the first pair are as follows:

X = (0.60959440759) (-8971) + (-0.0028817856942) (-11376)
+(538248.79341)
=532812.91

Y = (0.60959440759) (-11376) - (-0.0028817856942) (-8971)
+(4240374.4556)
=4233413.86

The resulting X,Y coordinate values for the four pairs are as follows:

	X	Y
1st pair	532,812.91	4,233,413.86
2nd pair	532,757.10	4,247,282.79
3rd pair	543,674.93	4,247,335.01
4th pair	543,750.25	4,233,465.56

APPENDIX F.--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                     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 F.--Sample DLG Data File
(Standard Distribution Format)--continued

(Each 144-character record is shown as two consecutive 72-character lines.)

```
N     15 -1450  4596     1     0
    90     1
N     16   895  4984     1     0
    90     1
A      1    22   253     1     0
     0     0
A      2 -4738  7527     2     0
    91     6    92    97
A      3  8325 10166     2     0
    91     6    92    97
A      4  4728 10834     3     0
    91     6    92    97    90   113
A      5  6463  8917     3     0
    91     6    92    97    90   113
A      6   161 -1378     3     0
    91     6    92    97    90   113
A      7 -3058-10280     4     0
    91     6    92    97    90   113    90   130
L      1     1     5     1     6     2     0     0
 -8971-11376 -8966  3203
L      2     5     2     1     2     2     0     0
 -8966  3203 -8955 11375
L      3     2     6     1     2     2     0     0
 -8955 11375  2101 11374
```

APPENDIX F.--Sample DLG Data File
(Standard Distribution Format)--continued

(Each 144-character record is shown as two consecutive 72-character lines.)

```
L       4       6       7       1       2       4       0       0
  2101 11374  5832 11376
L       5       7       8       1       2       5       2       0
  5832 11376  7513 11376
L       6       8       3       1       3       2       0       0
  7513 11376  8955 11376
L       7       3       9       1       3       2       0       0
  8955 11376  8956  7494
L       8       9      10       1       5       2       0       0
  8956  7494  8961  2884
L       9      10       4       1       6       2       0       0
  8961  2884  8971-11376
L      10       4       1       1       6       2       0       0
  8971-11376 -8971-11376
L      11      13      13       7       6       6       0       0
 -3115-10127 -3189-10286 -2985-10432 -2890-10296 -2943-10236 -3115-10127
L      12       5      15       2       6       4       2       0
 -8966  3203 -5538   798 -1933  5820 -1450  4596
     99     30     90    203
L      13      15      16       2       6       2       2       0
 -1450  4596   895  4984
     99     30     90    203
L      14      14       8       5       3       2       2       0
  7520 11175  7513 11376
     99     30     90    203
```

APPENDIX F.--Sample DLG Data File
(Standard Distribution Format)--continued

(Each 144-character record is shown as two consecutive
72-character lines.)

```
L     15    14     9     3     5     5     2     0

  7520 11175  7532 10014  7228  9681  7318  8896  8956  7494

    99    30    90   203

L     16    16    11     2     6   116     2     0

   895  4984   403  5222   275  5186   261  5244   247  5272   188  5344
   166  5364   146  5388   117  5441   107  5501   110  5561   104  5591
   106  5621   122  5681   144  5769   169  5829   199  5882   236  5931
   257  5952   313  5979   336  5999   350  6028   362  6087   362  6147
   352  6208   350  6238   355  6268   372  6295   415  6339   427  6367
   487  6471   496  6500   482  6682   491  6742   496  6803   510  6891
   512  6921   507  6955   507  6984   516  7015   530  7040   553  7062
   629  7111   656  7124   686  7132   741  7160   800  7179   858  7205
   921  7210   982  7223  1011  7236  1026  7261  1068  7309  1119  7386
  1181  7491  1228  7529  1254  7543  1285  7548  1316  7558  1339  7577

...etc....
```

APPENDIX G.--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 G.--Sample DLG Data File
(Optional Distribution Format)--continued

(Each 80-character record is shown as a single line.)

```
A    1   538261.48  4240528.75          10      0      1      0      0
   -10     -9     -8     -7     -6     -5     -4     -3     -2     -1
     0      0
A    2   535338.84  4244949.22           6      0      2      0      0
   -12      2      3     17    -16    -13
    91      6     92     97
A    3   543294.37  4246595.58           4      0      2      0      0
   -15     14      6      7
    91      6     92     97
A    4   541099.73  4246992.43           4      0      3      0      0
   -17      4    -19    -18
    91      6     92     97     90    113
A    5   542162.91  4245828.83           6      0      3      0      0
    19      5    -14     15      8    -20
    91      6     92     97     90    113
A    6   538350.91  4239534.90          10      0      3      0      1
    10      1     12     13     16     18     20      9      0     11
    91      6     92     97     90    113
A    7   536414.28  4234099.01           1      0      4      0      0
   -11
    91      6     92     97     90    113     90    130
L    1      1      5      1      6                  2      0      0
   532812.91  4233413.86   532773.94  4242301.15
L    2      5      2      1      2                  2      0      0
   532773.94  4242301.15   532757.10  4247282.79
L    3      2      6      1      2                  2      0      0
   532757.10  4247282.79   539496.77  4247314.04
L    4      6      7      1      4                  2      0      0
   539496.77  4247314.04   541771.16  4247326.01
L    5      7      8      1      5                  2      0      0
   541771.16  4247326.01   542795.89  4247330.85
L    6      8      3      1      3                  2      0      0
   542795.89  4247330.85   543674.93  4247335.01
L    7      3      9      1      3                  2      0      0
   543674.93  4247335.01   543686.72  4244968.57
L    8      9     10      1      5                  2      0      0
   543686.72  4244968.57   543703.06  4242158.35
L    9     10      4      1      6                  2      0      0
   543703.06  4242158.35   543750.25  4233465.56
L   10      4      1      1      6                  2      0      0
   543750.25  4233465.56   532812.91  4233413.86
L   11     13     13      7      6                  6      0      0
   536379.09  4234192.12   536334.44  4234094.98   536459.22  4234006.56
   536516.74  4234089.74   536484.26  4234126.17   536379.09  4234192.12
L   12      5     15      2      6                  4      2      0
   532773.94  4242301.15   534870.56  4240844.95   537053.68  4243916.72
   537351.64  4243171.97
    99     30     90    203
L   13     15     16      2      6                  2      2      0
   537351.64  4243171.97   538780.02  4243415.25
    99     30     90    203
```

APPENDIX G.--Sample DLG Data File
(Optional Distribution Format)--continued

(Each 80-character record is shown as a single line.)

```
L   14    14     8     5     3                2     2     0
   542800.74  4247208.34   542795.89  4247330.85
    99    30    90   203
L   15    14     9     3     5                5     2     0
   542800.74  4247208.34   542811.40  4246500.64   542627.04  4246296.77
   542684.17  4245818.50   543686.72  4244968.57
    99    30    90   203

L   16    16    11     2     6              116     2     0
   538780.02  4243415.25   538479.41  4243558.92   538401.49  4243536.60
   538392.79  4243571.92   538384.17  4243588.95   538348.00  4243632.67
   538334.53  4243644.80   538322.27  4243659.37   538304.44  4243691.60
   538298.17  4243728.14   538299.82  4243764.73   538296.08  4243783.00
   538297.21  4243801.29   538306.79  4243837.91   538319.95  4243891.62
   538335.02  4243928.27   538353.15  4243960.66   538375.57  4243990.64
   538388.31  4244003.50   538422.37  4244020.12   538436.33  4244032.38
   538444.78  4244050.10   538451.93  4244086.10   538451.75  4244122.68
   538445.48  4244159.83   538444.17  4244178.11   538447.14  4244196.42
   538457.42  4244212.92   538483.51  4244239.87   538490.74  4244256.97
   538527.02  4244320.54   538532.42  4244338.25   538523.36  4244449.15
   538528.68  4244485.76   538531.55  4244522.96   538539.83  4244576.64
   538540.96  4244594.93   538537.81  4244615.65   538537.73  4244633.32
   538543.13  4244652.25   538551.59  4244667.53   538565.55  4244681.00
   538611.74  4244711.09   538628.16  4244719.10   538646.42  4244724.06
   538679.87  4244741.29   538715.78  4244753.04   538751.06  4244769.06
   538789.45  4244772.29   538826.60  4244780.39   538844.24  4244788.39
   538853.31  4244803.68   538878.78  4244833.06   538909.64  4244880.14
   538947.14  4244944.33   538975.68  4244967.63   538991.49  4244976.24
   539010.37  4244979.38   539029.24  4244985.56   539043.21  4244997.21
.... etc.....
```

APPENDIX H.--Quadrangles Digitized Using Pre-1983 Hydrographic Attribute Codes

ALABAMA	
Albertville	AL
Arab	AL
Bridgeport	AL, TN
Columbus City	AL
Flat Rock	AL
Grant	AL
Grove Oak	AL
Guntersville Dam	AL
Henagar	AL
Hollywood	AL
Huntersville	AL
Langston	AL
Lim Rock	AL
Mt. Carmel	AL
New Home	AL, TN, GA
Rogersville	AL
Scottsboro	AL
Stevenson	AL
Swearengin	AL
CALIFORNIA	
Weitchpec	CA
GEORGIA	
New Home	AL, TN, GA
ILLINOIS	
Belvidere NE	WI, IL
Belvidere NW	IL, WI
Belvidere North	IL
Belvidere South	IL
Caledonia	IL
Capron	IL, WI
Cherry Valley	IL
Garden Prairie	IL
Little Cypress	IL, KY
Riley	IL
KANSAS	
Charleston	KS
Cimarron	KS
Cimarron NE	KS
Cimarron NW	KS
Copeland	KS
Copeland NE	KS
Copeland NW	KS
Copeland SE	KS
Dodge City NW	KS
Dodge City SW	KS
Ensign SW	KS
Fowler	KS
Haggard	KS
Horse Thief Canyon SW	KS
Ingalls	KS
Kalvesta	KS
Kalvesta SW	KS
Meade NE	KS
Meade NW	KS
Montezuma	KS
Montezuma NW	KS
Montezuma SE	KS
Pierceville	KS
Pierceville NE	KS
Pierceville SW	KS
Plains NE	KS
Plains NW	KS
Scott City 4 SE	KS
Scott City 4 SW	KS
KENTUCKY	
Briensburg	KY
Grand Rivers	KY
Hamlin	KY, TN
Little Cypress	IL, KY
Mont	KY
OREGON	
Acty Mountain	OR
Acty Mtn. NW	OR
Adel	OR
Alger Lake	OR
Antelope Butte	OR
Beatys Butte	OR
Beatys Butte NW	OR
Blizzard Gap	OR
Bluejoint Lake East	OR
Calderwood Reservoir	OR
Campbell Lake	OR
Chimney Rock	OR
Coleman Lake	OR

APPENDIX H.--Quadrangles Digitized Using Pre-1983 Hydrographic Attribute Codes--continued

OREGON--continued

Collins Rim	OR
Coyote Gap	OR
Coyote Gape SE	OR
Crane Creek	OR
Crane Mountain	OR
Crook Peak	OR
Crooked Creek Valley	OR
Crump Lake	OR
Drake Peak	OR
Drake Peak NE	OR
Fish Fin Rim	OR
Flagstaff Lake	OR
Flook Lake	OR
Guano Lake	OR
Hart Lake	OR
Hawks Mountain	OR
Horse Prairie	OR
Jacobs Reservoir	OR
Lakeview NE	OR
Little Honey Creek	OR
Lone Grave Butte	OR
Mahogany Butte	OR
May Lake	OR
Mud Lake Reservoir	OR
Murphy Waterholes	OR
Piute Reservoir	OR
Plush	OR
Priday Reservoir	OR
Rocky Canyon	OR
Sage Hen Butte	OR
Sage Hen Flats	OR
Sixmile Draw	OR
Surveyors Lake	OR
Swede Knoll	OR
Valley Falls	OR
Warner Peak	OR

TENNESSEE

Big Spring	TN
Birchwood	TN
Bridgeport	AL, TN
Calhoun	TN
Charleston	TN
Daisy	TN
Fairmount	TN
Grasshopper Creek	TN
Ketner Gap	TN
New Home	AL, TN, GA
Ooltewah	TN
Sequatchie	TN
Snow Hill	TN
Soddy	TN
South Pittsburg	TN
Ten Mile	TN

TEXAS

Bangs East	TX
Bangs West	TX
Blanket	TX
Blanket Springs	TX
Bowser	TX
Brookesmith	TX
Brownwood	TX
Burkett	TX
Byrds	TX
Cross Cut	TX
Democrat	TX
Elm Grove	TX
Indian Creek	TX
Lake Brownwood	TX
May	TX
Mercers Gap	TX
Mercury	TX
Owens	TX
Pioneer	TX
Rising Star	TX
Sipe Springs	TX
Star Mountain	TX
Thrifty	TX
Trickham	TX
Zephyr	TX

VERMONT

Brandon	VT
Bread Loaf	VT
Bristol	VT
Chittenden	VT
East Middlebury	VT
Hancock	VT
Lincoln	VT
Mount Carmel	VT
Mount Ellen	VT
Pico Peak	VT

APPENDIX H.--Quadrangles Digitized Using Pre-1983 Hydrographic Attribute Codes--continued

VERMONT--continued	
Rochester	VT
South Mtn.	VT
Waitsfield	VT
Warren	VT

WISCONSIN	
Belvidere NE	WI, IL
Belvidere NW	IL, WI
Capron	IL, WI

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Rivers and Streams	Feature identification	Nodes	030	0001	River/stream, upper origin
				0002	River/stream, upper origin of stream at water body
				0003	River/stream, stream junction
				0004	River/stream, stream intersection with bank/shore or estuary
				0005	River/stream, sink (stream goes underground or channel is not evident)
				0006	River/stream, change in stream classification/status
				0007	River/stream, point on stream or centerline
				0008	River/stream, stream-canal intersection
				0009	River/stream, canal-canal intersection
				0010	River/stream, end of canal
				0011	River/stream, canal-shoreline interesection
				0012	River/stream, canal over canal
				0013	River/stream, canal over stream
				0020	River/stream, stream road intersection
				0021	River/stream, stream railroad intersection
				0022	River/stream, stream trail intersection
				0023	River/stream, stream transmission line intersection
				0024	River/stream, stream pipeline intersection
				0025	River/stream, aqueduct over stream
				0026	River/stream, aqueduct over aqueduct
				0027	River/stream, stream tunnel intersection
				0028	River/stream, stream dam intersection
				0029	River/stream, spillway
				0030	River/stream, flood gate or gate

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Rivers and Streams (cont'd.)	Feature identification	Nodes (cont'd.)	030	0031	River/stream, tide gate
				0032	River/stream, falls
				0033	River/stream, end of rapids
				0034	River/stream, river mile mark
				0035	River/stream, tunnel portal
				0036	River/stream, end of siphon
				0037	River/stream, end of flume
				0038	River/stream, end of penstock
				0050	River/stream, point on bank/shore+
				0051	River/stream, shore/bank dam intersection
				0052	River/stream, gaging station
				0053	River/stream, pumping station
				0054	River/stream, small dam or weir
				0055	River/stream, water intake
		Areas	000	0000	Area outside graph
		Lines	030	0226	River/stream, penstock
				0227	River/stream, irrigation ditch
				0228	River/stream, irrigation canal
				0229	River/stream, abandoned canal
				0230	River/stream, canal on levee
				0250	River/stream, right bank, intermittent stream
				0251	River/stream, left bank, intermittent stream
				0252	River/stream, right bank, perennial stream
				0253	River/stream, left bank, perennial stream
				0254	River/stream, right bank, braided stream
				0255	River/stream, left bank, braided stream
				0256	River/stream, right bank, unsurveyed stream

APPENDIX I.--Pre-1983 Hydrographic Attribute Codes--continued

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Rivers and Streams (cont'd.)	Feature identification	Lines (cont'd.)	030	0257	River/stream, left bank, unsurveyed stream
				0258	River/stream, right bank, sand wash
				0259	River/stream, left bank, sand wash
				0260	River/stream, right bank, submerged stream
				0261	River/stream, left bank, submerged stream
				0270	River/stream, shore of island
				0271	River/stream, shore of backwater
				0272	River/stream, bank along levee
				0273	River/stream, apparent shoreline (outer limits of vegetation)
				0274	River/stream, shoreline along pier, wharf, or jetty
				0280	River/stream, rapids
				0293	River/stream, canal centerline extended into lake or pond
				0294	River/stream, stream centerline - indefinite location
				0295	River/stream, stream centerline extended into marsh or swamp
				0296	River/stream, stream centerline extended into river
				0297	River/stream, stream centerline extended into lake or pond
				0298	River/stream, stream centerline extended underground
				0299	River/stream, closing line (water-water)
		Points (Degenerate Lines)		0350	Single point feature, river/stream, small island or exposed rock
				0352	Single point feature, river/stream, spillway
				0353	Single point feature, river/stream, flood gate or gate
				0354	Single point feature, river/stream, tide gate

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Rivers and Streams (cont'd.)	Feature identification	Points (Degenerate Lines) (cont'd.)	030	0355	Single point feature, river/stream, river mile mark
				0356	Single point feature, river/stream, gaging station
				0357	Single point feature, river/stream, pumping station
				0358	Single point feature, river/stream, water intake
		Multiple Element Types	030	0000	Feature added by photorevision methods
	Parameter	Multiple Element Types	03N	____	Elevation of water surface (right justified) N=1 for feet, N=2 for meters, N=6 for feet below datum
			03N	____	Water depth (right justified) N=3 for feet, N=4 for meters
			035	____	River mile (right justified)
			038	0000	Best estimate of classification and/or position
			039	00__	Coincident feature or symbol (enter first two digits of major code for category of coincident feature in blanks, right justified).
Water Bodies	Feature identification	Nodes	040	0001	Water body, point on shoreline
				0002	Water body, shoreline road intersection
				0003	Water body, shoreline railroad intersection
				0004	Water body, shoreline transmission line intersection
				0005	Water body, shoreline pipeline intersection

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Water Bodies (cont'd.)	Feature identification	Areas	000	0000	Area outside graph
			040	0100	Water body, perennial lake or pond
				0101	Water body, perennial salt lake or pond
				0102	Water body, intermittent lake or pond
				0103	Water body, intermittent salt lake or pond
				0104	Water body, dry lake or pond
				0105	Water body, alkali flat
				0106	Water body, reservoir
				0107	Water body, intermittent reservoir
				0110	Water body, glacier or snow field
				0111	Water body, crevasse area
				0120	Water body, salt evaporator
				0122	Water body, fish hatchery
				0123	Water body, area subject to controlled flooding for agriculture
				0124	Water body, industrial water impoundment
				0125	Water body, area to be submerged
				0126	Water body, fish farm or crawfish farm
				0127	Water body, sewage disposal pond
				0128	Water body, large water intake
				0129	Water body, tailings pond
				0130	Water body, wooded lake
				0150	Water body, island
				0199	Water body, area not in water body
				0200	Water body, shoreline
				0201	Water body, indefinite shoreline
				0202	Water body, shoreline along wall
				0203	Water body, shoreline along wharf, pier, or jetty
				0204	Water body, shoreline along dam
				0205	Water body, shoreline along causeway
				0210	Water body, edge of glacier or snowfield
				0211	Water body, edge of crevasse area
				0299	Water body, closure line (water-water)

DATA CATEGORY	TYPE OF CODE	APPLICATION	MAJOR CODE	MINOR CODE	DESCRIPTION
Water Bodies (cont'd.)	Feature identification	Lines (cont'd.)	040	0300	Single point feature, water body, spring
				0301	Single point feature, water body, nonflowing well
				0302	Single point feature, water body, flowing well
				0350	Single point feature, water body, small island or exposed rock
				0351	Single point featrue, water body, small perennial pond
				0352	Single point feature, water body, small intermittent pond
				0353	Single point feature, water body, riser or glory hold
				0354	Single point feature, water body, brine or salt well
				0355	Single point feature, water body, sulphur well
				0356	Single point feature, water body, geyser
		Multiple Element Types	040	0000	Feature added by photorevision method
	Parameter	Multiple Element Types	04N	----	Water surface elevation (right justified) N=1 for feet, N=2 for meters, N=6 for feet below datum
			04N	----	Water depth (right justified) N=3 for feet, N=4 for meters
			048	0000	Best estimate of classification and/or position
			049	00--	Coincident feature or symbol (enter first two digits of major code for category of coincident feature in blanks, right justified)

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