DIGITAL HYDROGRAPHIC, LAND USE/LAND COVER, AND HYDROLOGIC UNIT BOUNDARY FILES FOR THE DEATH VALLEY REGION OF SOUTHERN NEVADA AND SOUTHEASTERN CALIFORNIA PROCESSED FROM U.S. GEOLOGICAL SURVEY 1:100,000- AND 1:250,000-SCALE DIGITAL DATA FILES

by A. Keith Turner, Frank A. D'Agnese, and Claudia C. Faunt

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
hectares (ha)	2.47	acre
kilometer (km)	0.6214	mile
meter (m)	3.281	foot
millimeter (mm)	0.03937	inch

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Digital Hydrographic, Land Use/Land Cover, and Hydrologic Unit Boundary Files for the Death Valley Region of Southern Nevada and Southeastern California Processed from U.S. Geological Survey 1:100,000- and 1:250,000-Scale Digital Data Files

By A. Keith Turner, Frank A. D'Agnese, *and* Claudia C. Faunt

Abstract

Digital hydrographic and land-use/land-cover data have been compiled into a digital geographic data base for an approximately 100,000-square-kilometer area of the Southern Great Basin, the Death Valley region of southern Nevada and southeastern California, located between lat 35°N., long 115°W. and lat 38°N., long 118°W. The digital geographic data base was compiled from U.S. Geological Survey digital cartographic and geographic data files distributed by the USGS Earth Science Information Center containing information concerning surface hydrographic features, land-use and land-cover conditions, and hydrologic basin boundaries.

ARC/INFO standard translation utilities were used to convert these digital data source files into six thematic ARC/INFO map coverages representing the Death Valley region. Minor map feature discrepancies, due to differences among the original source maps, were revealed along map quadrangle boundaries when the data were merged across the Death Valley region. These discrepancies were resolved by referring to large-scale and newer maps.

Surface hydrographic features were defined from data sources that utilized the Digital Line Graph format and contained information derived from 1:100,000-scale map sources. Four ARC/INFO map coverage themes were developed: hydrographic data area features (lakes, salt flats, playas, and reservoirs), hydrographic data line features (streams, rivers, ditches, and canals), hydrographic data point label features (stream origins and locations of inflow and outflow to [and from] water bodies), and hydrographic data degenerate line features (springs, wells, and windmills).

Two additional ARC/INFO map coverages, representing land-use/land-cover conditions and boundaries of the standard USGS-defined hydrologic units, were developed from data sources that utilized the Geographic Information Retrieval and Analysis System format and contained information derived from 1:250,000-scale map sources.

Each coverage is provided as an individual file in ARC EXPORT uncompressed ASCII format. These files are available from the USGS, Denver, Internet repository via 'anonymous ftp' at ympbserv1.cr.usgs.gov.

INTRODUCTION

Yucca Mountain, Nevada, is being studied as a potential site for construction of a repository for the permanent storage of high-level radioactive waste. The United States Geological Survey (USGS), in cooperation with the Department of Energy (DOE), is evaluating the site as part of the DOE Yucca Mountain Project. Because of the potential for radionuclides to be transported by ground water from the repository to the accessible environment, these evaluations include studies to define the regional hydrologic regime in the vicinity of Yucca Mountain. The compilation of regional hydrographic and land-use/land-cover information is part of these studies.

These studies encompass approximately 100,000 square kilometers of Nevada and California between lat 35°N., long 115°W. and lat 38°N., long 118°W. This region includes the Nevada Test Site at Yucca Mountain and adjacent parts of southern Nevada and eastern California (fig. 1) and encompasses the Death Valley regional ground-water system (Bedinger and others, 1989). The hydrographic and

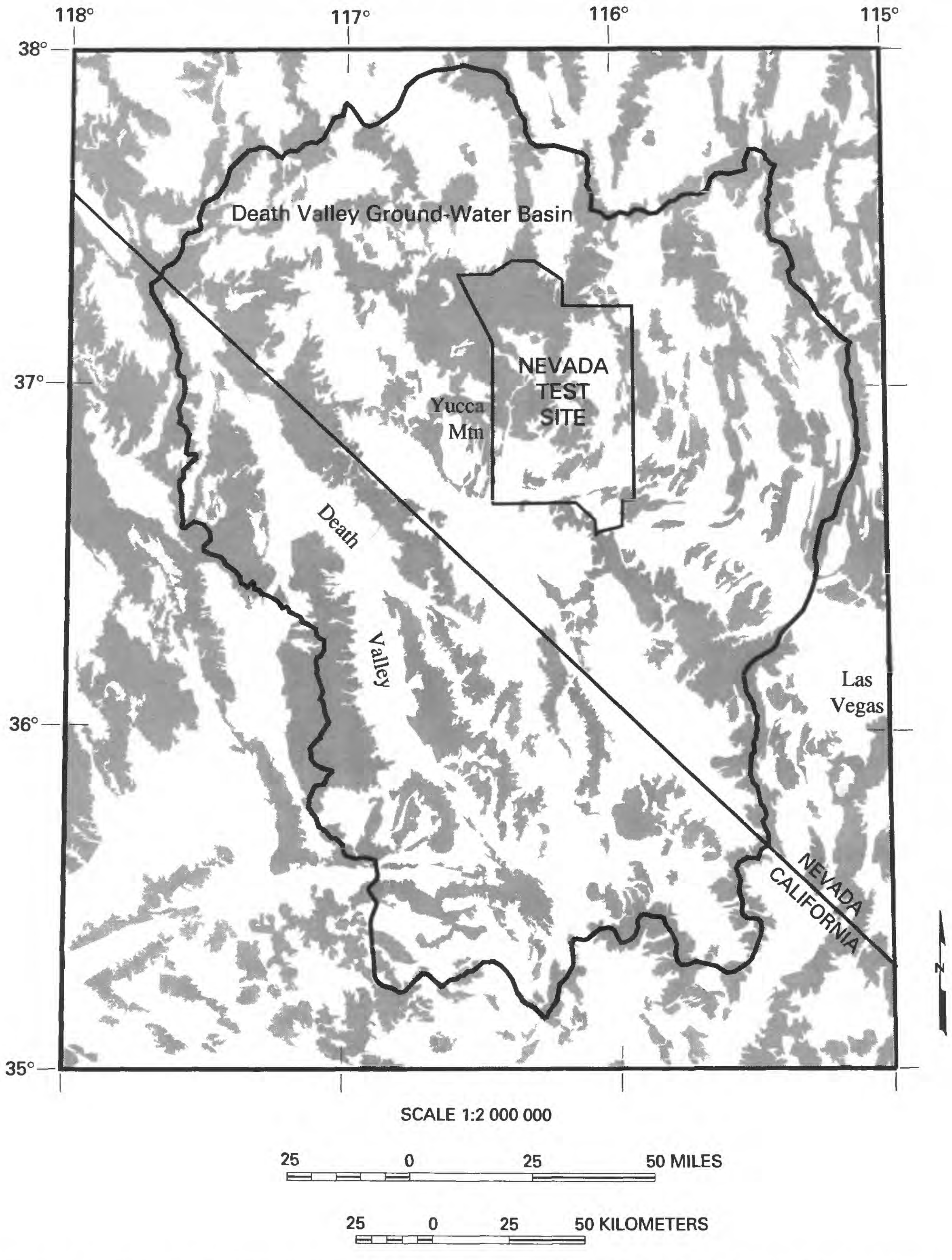

Figure 1. Area of study including location of Yucca Mountain, the Death Valley regional ground-water system, and the Nevada Test Site.

land-use/land-cover data were required by regional ground-water numerical modeling studies using Geographic Information System (GIS) methods.

Because digital maps are often useful for applications other than that for which they were originally intended, and because the area covered by these files corresponds to a region under continuing investigation by several groups, these digital files are being released by the USGS. This documentation is intended to allow others to judge the appropriateness of these data for their proposed uses and allow trained persons with similar hardware and software to replicate these digital maps from the source materials. This report assumes that the user has a rudimentary knowledge of general map and cartographic concepts, UNIX operating system, ARC/INFO GIS software, file management concepts, and data archiving systems.

The digital files described in this report are available from the USGS, Denver, Internet repository via 'anonymous ftp' at ympbserv1.cr.usgs.gov.

DATA SOURCES

Digital cartographic and geographic data files distributed by the Earth Science Information Center (ESIC) of the USGS may be grouped into four basic types. The first of these, called a Digital Line Graph (DLG), includes mapped line information in digital form representing planimetric-base categories such as transportation, hydrography, and political boundaries. The second data-file type, called a Digital Elevation Model (DEM), consists of a sampled array of elevations for ground positions at regularly spaced intervals. The third data-file type is Land-Use/Land-Cover (LU/LC) digital data, which provides information on nine major classes of land use or land cover, such as urban, agricultural, or forest, as well as associated map data such as political units, census county subdivisions, hydrologic units, and government land ownership. The fourth type, the Geographic Names Information System, provides primary information for known places, features, and areas in the United States identified by a proper name (U.S. Geological Survey, 1985, 1986).

The digital cartographic and geographic data files discussed here were developed from two of these basic data types, DLG and LU/LC digital data, for selected quadrangles in the Death Valley region. These digital cartographic and geographic data files were obtained from ESIC on 9-track magnetic computer tape. Detailed descriptions of the digital file formats for these data, along with other supporting documentation concerning data sources, data accuracies, and similar information, are described in Data Users Guides (U.S. Geological Survey, 1985, 1986).

Digital Line Graph Data Files

All DLG data developed by the USGS using 1:100,000-scale maps and currently released by ESIC are in the fully topologically structured DLG-3 format (U.S. Geological Survey, 1985). The DLG-3 concept is based on graph theory that allows the digital encoding of spatial relationships between map elements, such as adjacency and connectivity, in addition to basic graphical information. These relationships are defined as "topology," and the process produces a "topologically structured data file" that can support simple graphical applications, such as plotting streams, as well as more advanced applications, such as computations of areas of lakes, when these data are evaluated by GIS.

A DLG-3 file defines topology by three separate, but related, elements: nodes, lines, and areas (U.S. Geological Survey, 1985, p. 3). Nodes define the end points of lines. A single node may identify the start or end of one or several lines. Line intersections are marked by nodes because at intersections the linear features are subdivided into segments.

In the DLG-3 format, a line is defined by an ordered set of coordinate points that describes the position and shape of the linear feature on the map. Each line starts at a node and ends at a node and, thus, has an explicit direction and a left-right connotation. A special line, called a degenerate line, is used to define map features symbolized as points. A degenerate line starts and ends at the same node, has only two coordinate pairs, has zero length, and is totally enclosed within one map area (U.S. Geological Survey, 1985, p. 3).

The DLG-3 data structure defines an area as a portion of a map bounded by lines. All portions of the map must be assigned to some area. Every DLG-3 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 are defined as necessary to represent the mapped information.

DLG-3 data files are available in two distribution formats: (1) standard, and (2) optional. The DLG-3 Optional format was designed for data interchange and explicitly encodes topological linkages for all node, line, and area elements. This makes this format suitable for many applications because a polygon data structure can be easily created.

The DLG-3 Optional data define locations of map features according to a ground-coordinate system. The 1:100,000-scale map files use meters and the Universal Transverse Mercator (UTM) coordinate system.

Land-Use/Land-Cover Digital Data Files

ESIC distributes data sets defining LU/LC conditions and associated digital maps defining boundaries of political units, hydrologic units, census county divisions, Federal land ownership, and (in some instances) State land ownership (U.S. Geological Survey, 1986). The LU/LC maps portray the Level II categories of the USGS land-use and land-cover classification system designed for use with remote sensor data (Anderson and others, 1976). Associated digital-map data portray either natural or administrative regions. These data are defined by and distributed according to the Geographic Information Retrieval and Analysis System (GIRAS) format developed by the USGS to support polygonal data (Mitchell and others, 1977).

The GIRAS data structure involves six topological elements: node, arc, polygon, island, complex island, and polygon label (U.S. Geological Survey, 1986). Figure 2 schematically illustrates these GIRAS topological elements. Use of the GIRAS data structure allows all boundaries to be digitized only once. The resulting arcs are topologically evaluated and assembled into polygons. This is the major difference between the DLG-3 Optional and the GIRAS data structures.

GIRAS data routinely store the locations of polygonal boundaries with reference to the appropriate UTM coordinate system (U.S. Geological Survey, 1986, p. 12). All coordinates are coded within a GIRAS file as 2-byte (16-bit) integers. Since 16 bits are insufficient to store full UTM coordinates (which may exceed 4,000,000 m), the nearest 100,000-m UTM grid intersection to the west and south of the map limits is used as a local origin, and the resolution of the resulting internal coordinates is set to 10 m. Using this system, a GIRAS file may store data covering a square region extending 327,680 m along each side. This is large enough to include any 1:250,000- or 1:100,000-scale quadrangle map. The necessary coordinate definitions are provided in header-record data within each GIRAS file.

GIRAS data files derived from 1:250,000-scale maps were used to extract two distinct data types:

- A compilation of the Level II categories of the USGS land-use and land-cover classification system developed by Anderson and others (1976); and
- A compilation of surface-water basin boundaries that are encoded with an eight-digit number defining the standard Hydrologic Units Codes

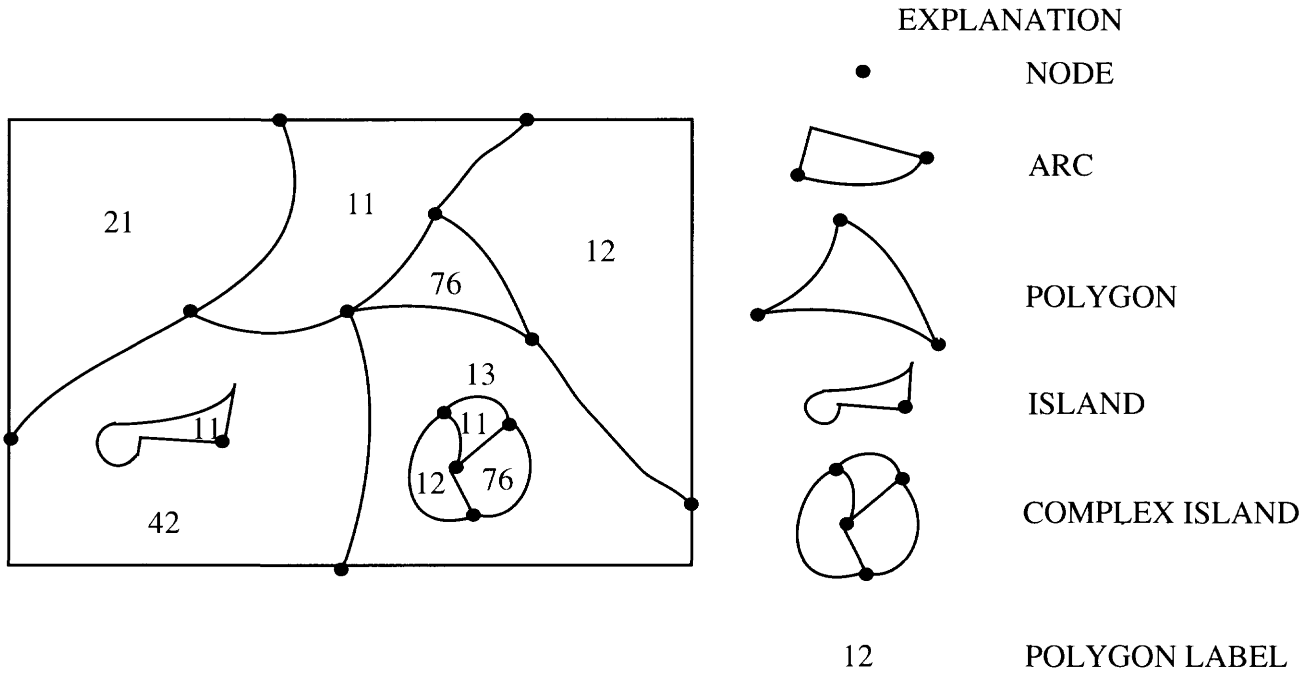

Figure 2. Geographic Information Retrieval and Analysis System (GIRAS) topological elements (U.S. Geological Survey, 1986).

(HUC), as defined by the USGS (U.S. Geological Survey, 1982). These standard surface-water basin boundaries are commonly referred to as Hydrologic Unit boundaries, or HU boundaries.

DATA-PROCESSING PROCEDURES

Similar data-processing procedures were required to compile the hydrographic data from the DLG data-file sources and the LU/LC and HU boundaries data from the GIRAS data sources. Differences in the structure and organization of these two digital data sources required minor differences in the data processing procedures for each source. These differences are discussed in the following sections.

Hydrographic Data

The DLG file formats were originally developed when computer memory capacities were more limited. Because the density of map features on most maps would result in files that exceeded these memory capacities, DLG data were subdivided and grouped into files representing smaller sections, or subregions, of the standard map quadrangles. A 1:100,000-scale map quadrangle covers 60 minutes (1 degree) of longitude by 30 minutes (1/2 degree) of latitude. DLG data for each 1:100,000-scale quadrangle are typically grouped into eight 15-minute by 15-minute subregional files, labelled F01 to F08, as shown in fig. 3. If the feature density is such that this 15-minute subdivision does not reduce the file sizes sufficiently, then smaller 7.5-minute subregions and files are used (U.S. Geological Survey, 1985). The 15-minute level of subdivision was adequate for all the maps used in this project. Individual DLG data files correspond to a 15-minute (or 7.5-minute) map subregion and contain data defining map features for a single broad topic such as hydrography, transportation, etc. Only those DLG files representing hydrographic features were used.

The 3- by 3-degree Death Valley region is covered by eighteen 1:100,000-scale map quadrangles (fig. 4). A total of 144 DLG hydrographic data files were obtained from ESIC; each file represented one of the eight 15-minute subregions for each of the 18 quadrangles. These 144 DLG files were converted to ARC/INFO formats, ARC/INFO coverages were created for each 15-minute subregion, and these individual coverages were merged to form four regional thematic ARC/INFO digital-map coverages by following a logical sequence of procedures suggested in the ARC/INFO Rev. 6.0 users manual (Environmental Systems Research Institute, 1991, pp. 5.1–5.18). A similar sequence of procedures for converting and compiling these files has been standardized by the USGS National Mapping Division (David Hester, U.S. Geological Survey, National Mapping Division, written commun., 1991). The sequence of processing steps used by this project is shown in fig. 5.

For convenience, the procedure began by processing and combining the DLG data files belonging to a single 1:100,000-scale map quadrangle. Thus, the following sequence of steps was repeated 18 times, once for each map quadrangle shown in fig. 4.

Each map quadrangle involved eight DLG data files corresponding to the 15-minute subregions numbered F01–F08 shown in fig. 3. Each file had a unique name, representing the map quadrangle name and the subregion code number (F01–F08). Each of these DLG data files was processed, in turn, as follows:

a. The ARC/INFO "dlgarc" command was used to convert the DLG data file into the basic components of three ARC/INFO map coverages; it created "xcode," "acode," "ncode," and "pcode" ARC geographic data files containing the internal identification numbers and coordinate data for point, line, node, and polygonal map features, respectively. These three coverages separated line and polygonal features, point features, and node features.

b. The ARC/INFO "build" command was used <u>four</u> times to create the topological relationships and the structures of the required ARC/INFO "PAT" and "AAT" data tables; twice to process "point" data, once to process "line" data, and once to process "polygon" data.

c. The ARC/INFO "joinitem" command was used <u>four</u> times; three times to compute the relationships between the geographic data files and the "PAT" attribute entries and once to compute the relationships between the geographic data files and the "AAT" attribute entries.

At this point, each 1:100,000-scale map quadrangle was represented by 24 different ARC/INFO coverages, containing point, line, and polygon data and attributes organized by DLG MAJOR/MINOR attribute codes. There were three coverages providing all the hydrographic data for each 15-minute subregion within the quadrangle. Subsequent applications would be facilitated if these hydrographic features were regrouped to form four themes:

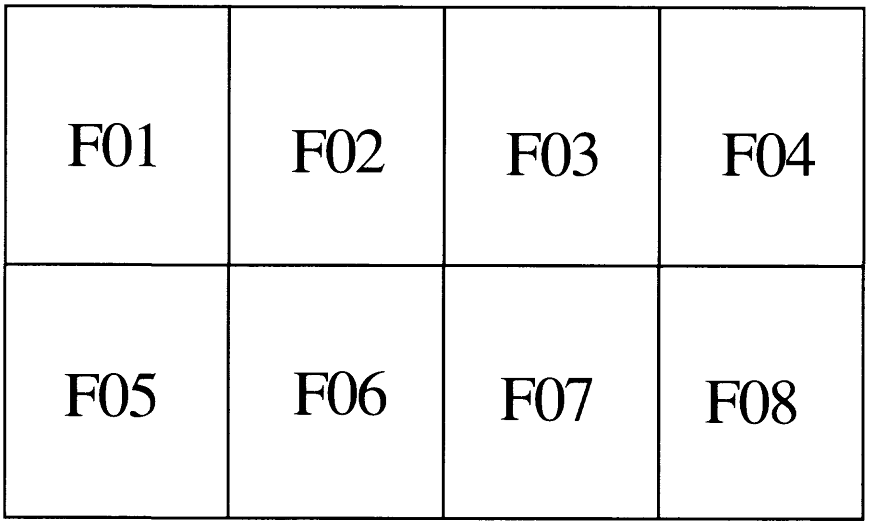

Figure 3. Subdivision of a 1:100,000-scale map quadrangle into Digital Line Graph (DLG) files (U.S. Geological Survey, 1985).

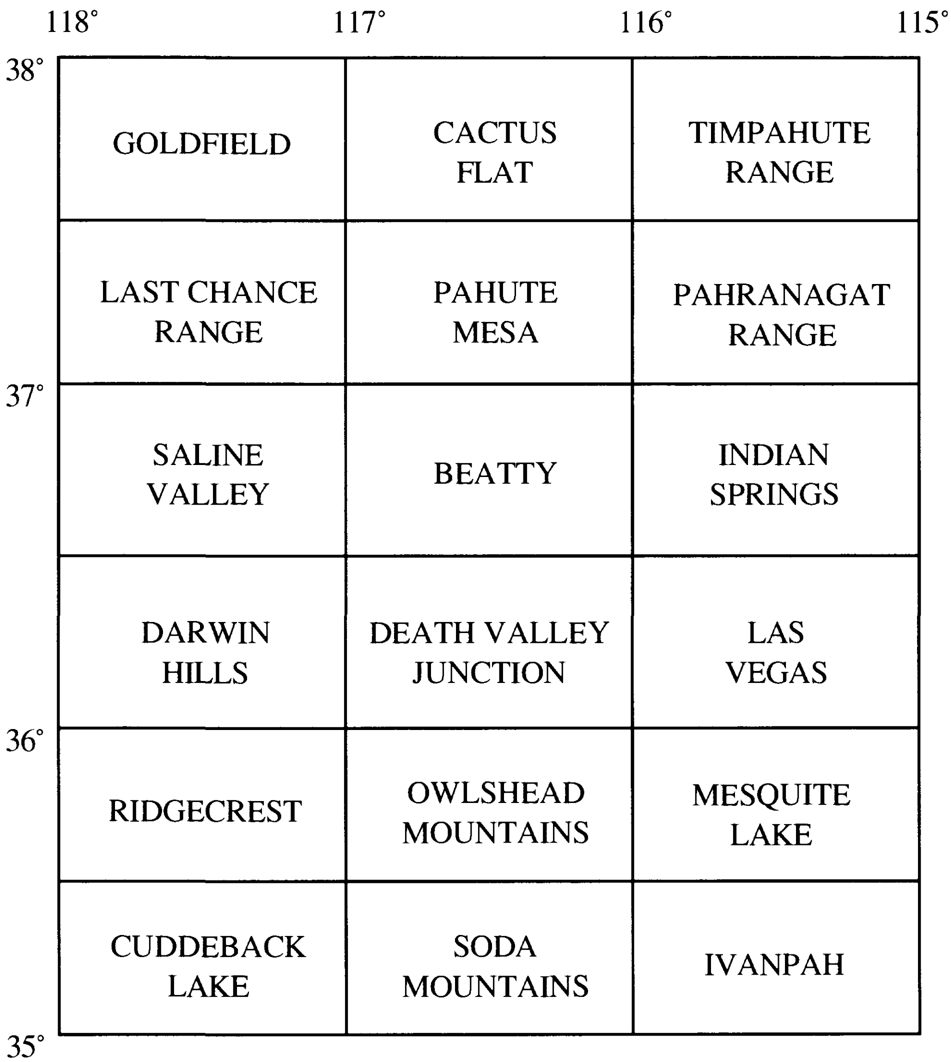

Figure 4. Digital Line Graph (DLG) files used in the study and their corresponding map locations.

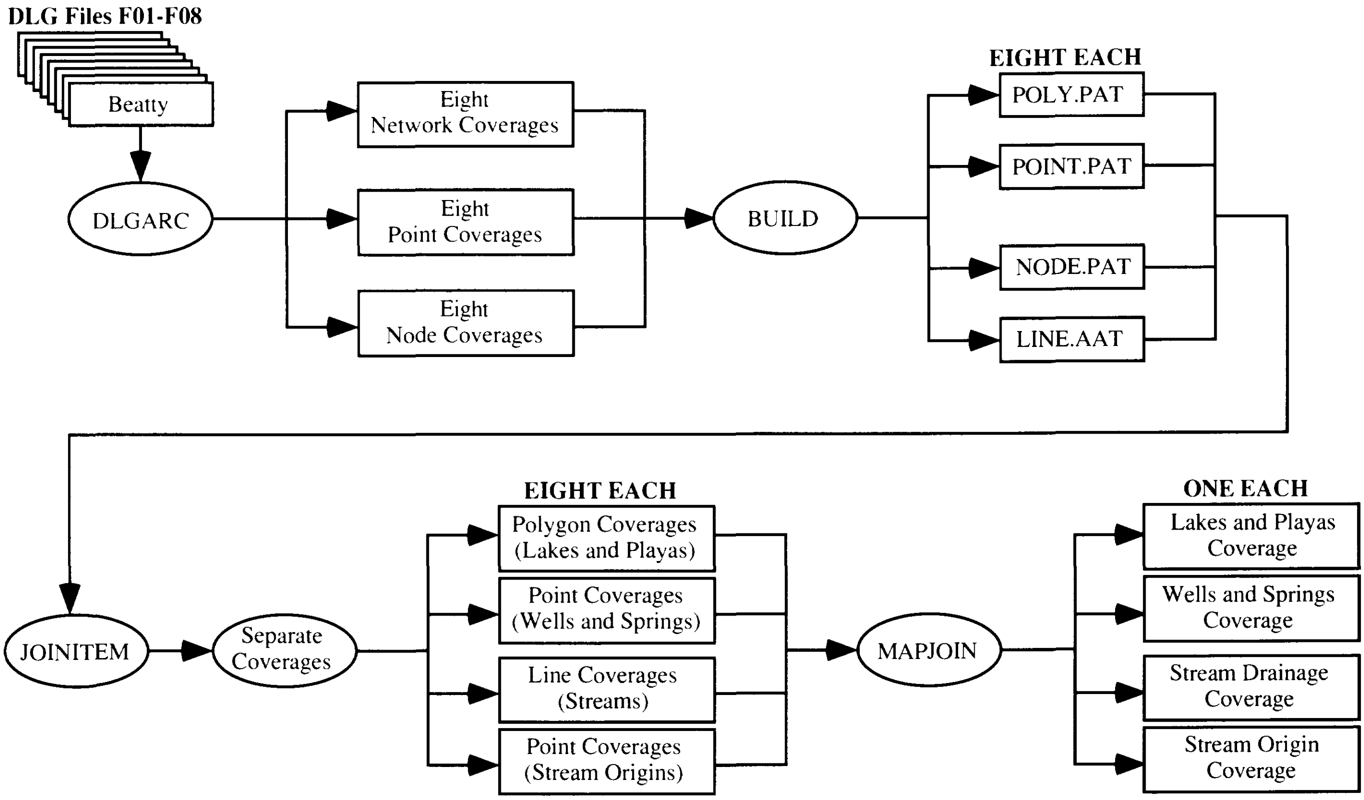

Figure 5. Initial steps in the data flow for compiling Digital Line Graphs and developing primary hydrographic map sets.

1. A polygon coverage containing all of the area features, including lakes, salt flats, playas, and reservoirs;
2. A line coverage containing all arc features, including streams, rivers, ditches, and canals;
3. A point coverage containing all attributed locations (label points in ARC/INFO terminology) that defined stream origins and locations of inflow or outflow to water bodies; and
4. A point coverage containing all degenerate line features, including springs, wells, and windmills.

To create these themes, the subregional ARC/INFO polygonal coverages had to be replicated to generate themes (1) and (2) above. The existing point and node coverages corresponded to themes (3) and (4). The polygonal coverage was duplicated using the ARC "copy" command, and then the desired features belonging to themes (1) or (2) were retained and all other features were deleted. Appropriate ARCEDIT "select," "reselect," and "aselect" commands were used to identify the DLG MAJOR/MINOR attribute codes that were to be deleted from the desired theme, and then the ARCEDIT "delete" command was used to remove those features from the coverage.

At the conclusion of this process, each 1:100,000-scale map quadrangle was represented by 32 ARC/INFO individual map coverages, one coverage for each of four themes for each of the eight subregions. It was then possible to create four thematic ARC/INFO coverages for each 1:100,000-scale map quadrangle by using the ARC "mapjoin" command four times; each time combining the eight subregional thematic coverages to form a single thematic coverage for the entire quadrangle. At this point, each 1:100,000-scale map quadrangle was represented by only four thematic ARC/INFO map coverages.

The thematic coverages for each 1:100,000-scale map quadrangle next had to be merged to create four regional thematic coverages. This merging process is schematically defined in fig. 6. This process is slightly more complex than the previous joining of the individual 15-minute subregional thematic coverages to form

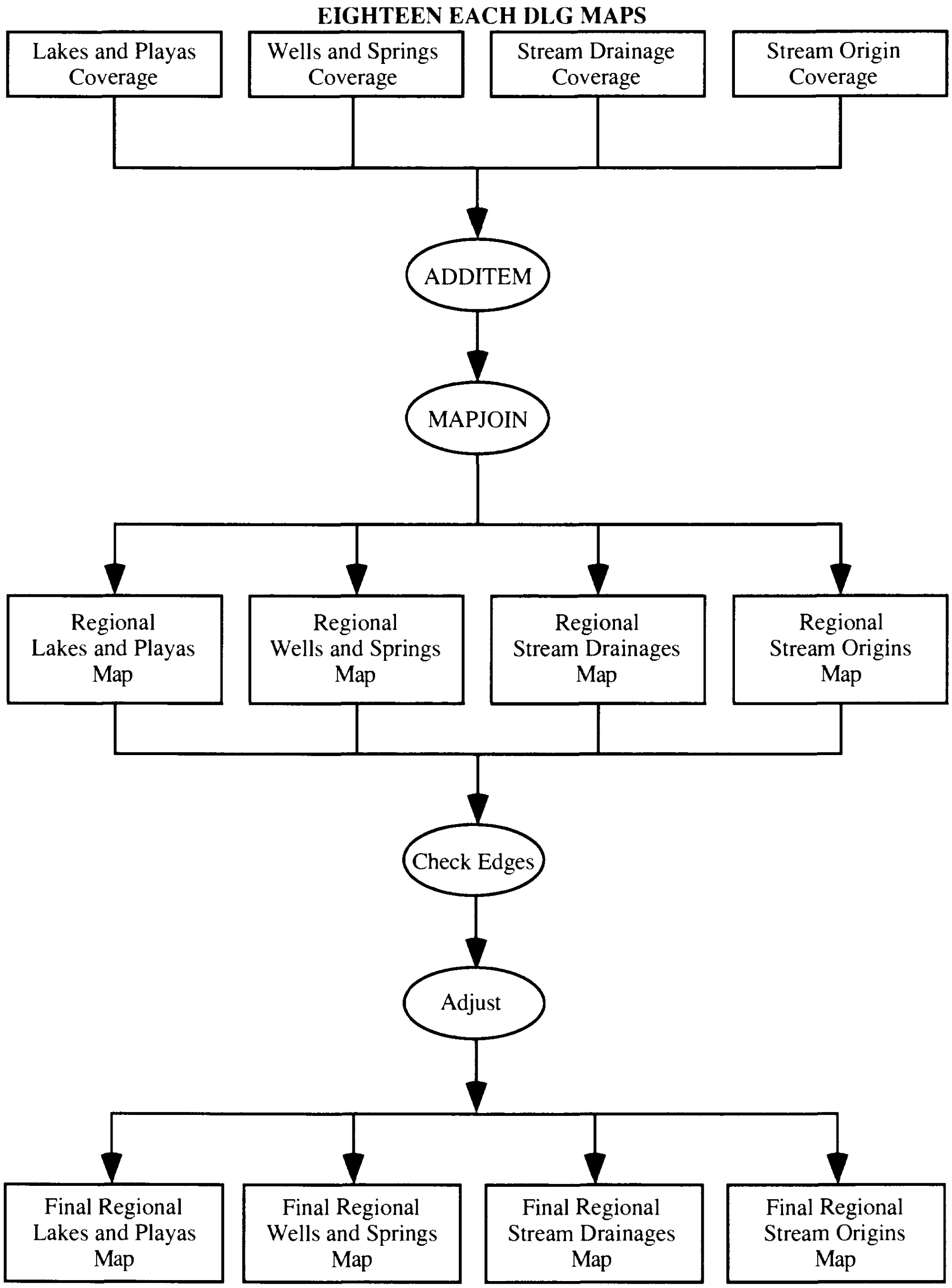

Figure 6. Final steps in the data flow for compiling Digital Line Graphs and developing primary hydrographic map sets.

a single thematic coverage for each 1:100,000-scale map quadrangle. That step merely reassembled data that had been subdivided during the DLG data-file creation process conducted by USGS personnel. Thus, geographic and attribute discrepancies had already been identified and resolved by the personnel creating these products, and no such discrepancies were expected or encountered. However, merging the thematic coverages for the eighteen 1:100,000-scale map quadrangles to form 3- by 3-degree regional thematic coverages did uncover some discrepancies among the DLG data files for different quadrangles.

Because of differences inherent within individual DLG digital source files, not all of the individual thematic map quadrangle coverages created from the DLG data had identical numbers of DLG MAJOR/MINOR attributes. The ARC/INFO "mapjoin" command requires that all the ARC/INFO attribute tables for the map coverages being combined must contain identical attribute column structures. Accordingly, the ARC/INFO "additem" command was first used to add additional attribute columns, as required, to those coverages having fewer DLG MAJOR/MINOR attributes (fig. 6). The contents of these "dummy" attributes were set to "-99999" in order to distinguish them from true values obtained from DLG sources. This attribute reformatting resulted in a consistent format of DLG MAJOR/MINOR codes across the entire Death Valley region. The individual 1:100,000-scale map quadrangle coverages were then merged to form four regional hydrography coverages by use of the ARC/INFO "mapjoin" command (fig. 6). Since DLG source data utilize a UTM coordinate system, no geometric transformation was required.

As shown schematically in the lower portion of fig. 6, the regional polygon and line coverages were checked graphically for any discrepancies along the edges of the 1:100,000-scale map quadrangles. Only a very few discrepancies were encountered. These were adjusted using ARCEDIT on a case-by-case basis. The discrepancies typically included misaligned or unconnected stream drainages or lake polygons that did not close. For example, the Sarcobatus Flat playa crosses a map boundary, and on one map the playa is identified as an alkali flat, whereas on the other map it is not delineated. By reference to other maps, an appropriate additional playa boundary was digitized and added to the combined data set. Any similar discrepancies were resolved by reference to larger scale and/or newer map products.

The procedures adopted for correcting these discrepancies followed the recommendations of Nebert (1989). Both topology and attribution were made consistent on each side of a map boundary. Since these digital files were to be used for much smaller scale regional analysis, corresponding to 1:250,000- or 1:500,000-scale map accuracies at best, the direction of adjustment was not critical. Once the maps were free of discrepancies, the coverages were updated and the topology rebuilt using the ARC/INFO "clean" and "build" commands. Because the point coverages contained only point features that did not cross map boundaries, they required no discrepancy checking.

All four 3- by 3-degree regional thematic hydrographic coverages (that is, the point coverages, as well as the polygon and line coverages previously subjected to correction of discrepancies) were plotted, using ARCPLOT, at the original 1:100,000 map scale using a Calcomp Electrostatic Plotter. The plots were overlaid on the manuscript map sheets and checked for any remaining discrepancies in feature locations. Discrepancies less than 2 mm on the map (corresponding to 200 m on the ground) were not corrected. The specifications for snap distances and tolerances can be found in Attachment A.

Land-Use/Land-Cover and Hydrologic Unit Boundaries Data

The available GIRAS data files for this area are related to 1-degree by 2-degree map quadrangles at a scale of 1:250,000. Coverage of the 3- by 3-degree Death Valley region required six GIRAS data files, as shown by fig. 7. Each GIRAS data file contains information on LU/LC conditions and associated digital maps defining political units, standard USGS-defined HU boundaries and associated standard hydrologic unit codes, census county divisions, Federal land ownership, and (in some instances) State land ownership (U.S. Geological Survey, 1986). Only LU/LC and HU boundaries information were extracted from the GIRAS data files for the Death Valley region.

Six LU/LC digital data-source files and six HU boundaries digital data-source files covering the 3- by 3-degree Death Valley region were loaded into ARC/INFO GIS, using the ARC/INFO "girasarc" command, and merged to develop one LU/LC map coverage and one HU boundaries coverage that extended over the entire study area. Since GIRAS source data utilize a UTM coordinate system, no geometric transformation was required. Figure 8 outlines these processing procedures, which may be summarized as follows:

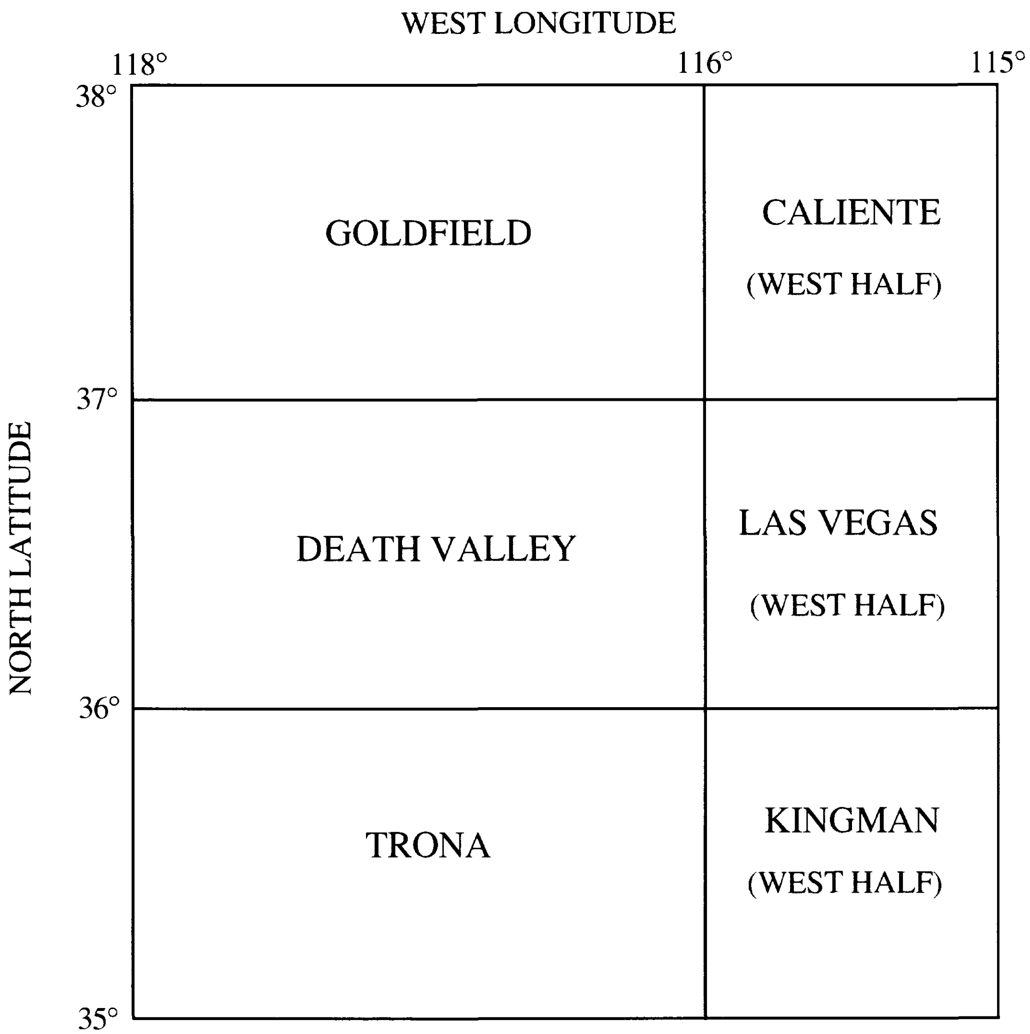

Figure 7. Extents of Geographic Information Retrieval and Analysis System (GIRAS) files within the Death Valley region.

1. The archived GIRAS data files were converted into ARC/INFO map coverages using the ARC/INFO "girasarc" command. Each of the six coverages containing area features was then visually checked on the screen to ensure complete translation of the file data;

2. The 1-degree by 2-degree map coverages were then merged using the ARC/INFO "mapjoin" command to form one regional LU/LC map and one HU boundaries map.

3. These regional coverages were checked graphically to ensure that features crossing map-sheet boundaries matched correctly. The procedure for discrepancy checking along map boundaries was the same as that performed on the regional hydrographic data maps. No errors or discrepancies were encountered on these maps.

4. As a final check on the digital data integrity, the ARC/INFO "clean" and "build" commands were used to verify the topology of these regional LU/LC and HU boundaries coverages.

DATA LIMITATIONS

These data sets were derived from USGS DLG and GIRAS data sources obtained from ESIC. The accuracy of these data, and their fitness for particular applications, are restricted by the basic accuracy of the source data and by the actions taken within ARC/INFO

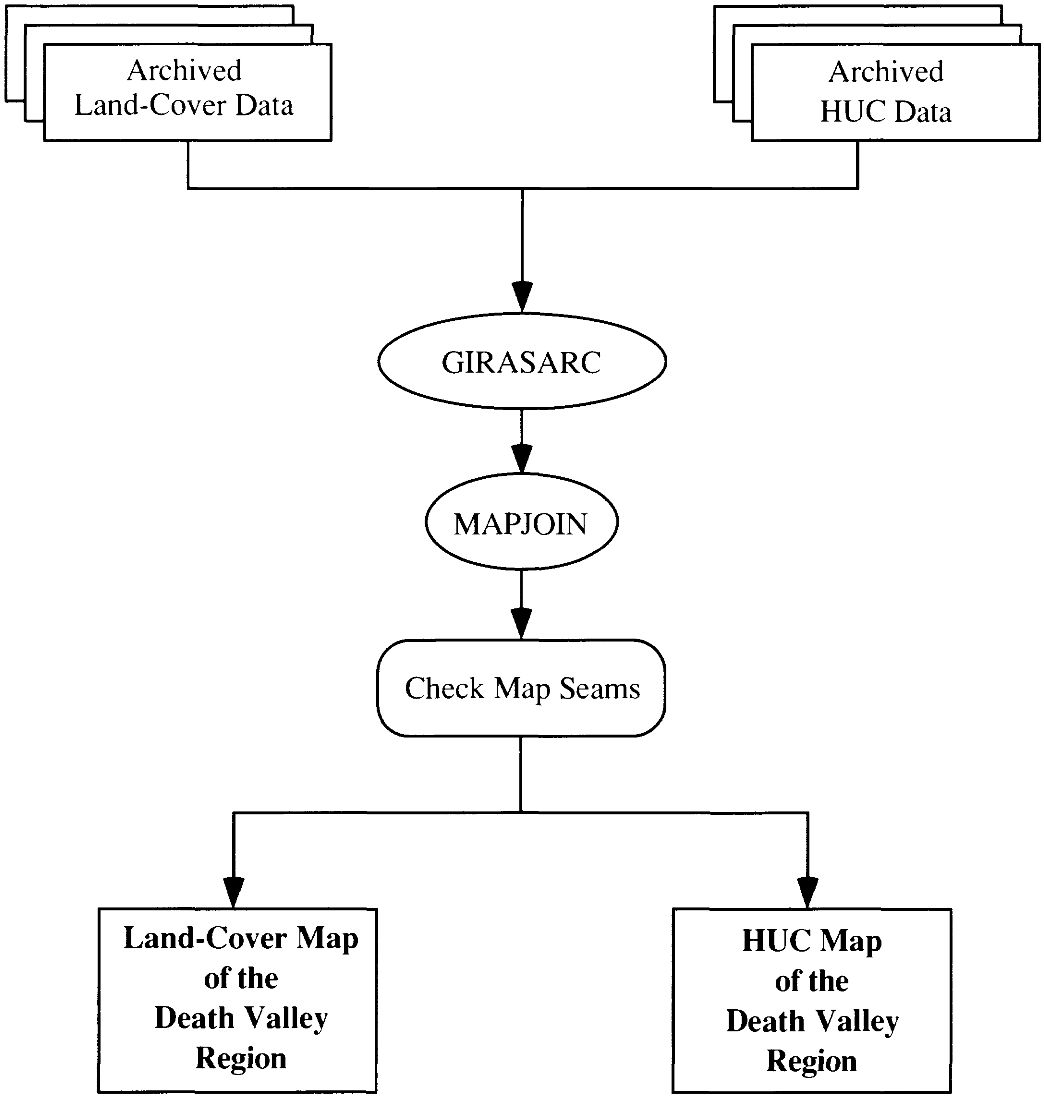

Figure 8. Data flow for compiling land-use/land-cover and hydrologic unit boundaries maps.

in converting these data to ARC/INFO regional coverage files.

Hydrographic Data

The hydrographic data resulted from the merging of several DLG-3 Optional format data files derived from 1:100,000-scale maps. The data characteristics of the four regional ARC/INFO coverages defining the hydrographic data thus depend on the inherent quality of the DLG data sources.

Location Accuracy

According to USGS documentation (U.S. Geological Survey, 1985), DLG data are either manually digitized using equipment with a resolution of 0.001 inch and an absolute accuracy of from 0.003 to 0.005 inch, or are scanned on an automatic device with a resolution of 30 points per millimeter, or 0.0013 inch. The positional accuracy of the data and completeness of the file are checked by visually comparing proof plots with the original stable-base material 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. These specifications translate into spatial accuracies, in terms of actual ground dimensions, of about 10 m when 1:100,000-scale maps are digitized.

Since the DLG source data utilize a UTM coordinate system, no additional geometric transformation was required, and no significant degradation of the spatial accuracy is believed to have occurred. The merged files created by the ARC/INFO procedures were plotted, with ARCPLOT, at the original 1:100,000 map scale using a Calcomp Electrostatic Plotter. The plots were then overlaid on the manuscript map sheets and checked for any remaining discrepancies in feature locations. Discrepancies less than 200 m on the ground were not corrected. The specifications for snap distances and tolerances can be found in Attachment A.

Contextual Accuracy

Visual review of plots of the hydrographic data confirmed that the four coverages provided a consistent and coherent representation of the hydrographic features because:

1. The polygon coverage included all of the lakes, salt flats, playas, and reservoirs shown on the 1:100,000-scale source maps;
2. The line coverage included all streams, rivers, ditches, and canals shown on the 1:100,000-scale source maps;
3. Occurrences of inflow or outflow to water bodies, shown on a point coverage, were located along the margins of lakes, salt flats, playas, or reservoirs, and at locations coincident with streams, rivers, ditches, or canals; and
4. A second point coverage contained all springs, wells, and windmills shown on the 1:100,000-scale source maps.

Attribute Accuracy

The hydrologic data attributes are derived by ARC/INFO from the DLG MAJOR/MINOR attribute codes contained within the DLG sources. According to USGS documentation (U.S. Geological Survey, 1985), 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. Further validation of the codes is part of the manual review of the proof plots.

However, the construction of the regional ARC/INFO coverages revealed some minor discrepancies where mapped features crossed map quadrangle boundaries. Many of these discrepancies are related to differences between the source maps. As a consequence of such corrections, the attribute accuracy of the regional coverages is believed to be improved over those of the original DLG products, but absolute fidelity of all attributes cannot be ensured.

Topological Consistency

ARC/INFO software created the topology for the combined regional coverages based on interpretation of the topological structures provided by the DLG source data. According to the USGS reference sources (U.S. Geological Survey, 1985, p.21): "The DLG topological structures are fully validated by software. There are no extraneous line intersections or extensions of lines through a node. Polygon adjacency is also validated. Validation of DLG data is performed for each category in the file." No topological inconsistencies were uncovered during the ARC/INFO topological reconstruction of these regional coverages.

Land-Use/Land-Cover and Hydrologic Unit Boundaries Data

The LU/LC and HU boundaries data result from the merging of several GIRAS-formatted data files derived from 1:250,000-scale maps. The data characteristics of the regional ARC/INFO coverages defining these data thus depend largely on the inherent quality of the GIRAS-formatted digital data sources obtained from ESIC.

Location Accuracy

GIRAS-formatted data files utilize a UTM coordinate system, with coordinates providing a 10-m resolution (U.S. Geological Survey, 1986). Because the minimum line width and, hence, the digitizing accuracy of the 1:250,000-scale source maps is 0.1 mm, the absolute ground placement accuracy is no better than 25 m. Since no additional geometric transformation of these data was required, no significant degradation of the spatial accuracy of these data is believed to have occurred during their conversion to ARC/INFO data formats.

Contextual Accuracy

LU/LC data-collection standards include minimum areas and minimum dimensions of land-use classes in order for features to be digitized and included in the GIRAS-formatted data files (U.S. Geological Survey, 1986, p. 3). For certain urban and specialized land-use activity classes, these specifications require a minimum area of 4 ha and a minimum dimension of 200 m; all other land-use classes must have a minimum area of 16 ha and a minimum dimension of 400 m. Land-use activities that fall below the minimum specified sizes are not included in these GIRAS-formatted data files. Rivers shown as double lines on 1:250,000-scale maps, and certain highway classes, are exempted from these minimum width specifications.

The GIRAS-formatted data files containing HU boundaries data are encoded with an eight-digit number (HUC) that indicates the hydrologic region, subregion, accounting unit, and cataloging unit. These codes have been previously subjected to rigorous quality-assurance checks.

Conversion of these GIRAS-formatted data files to ARC/INFO coverages did not alter the contextual accuracy or content of these data sources.

Attribute Accuracy

The basic sources of GIRAS-formatted LU/LC compilation data are NASA high-altitude aerial photographs and National High-Altitude Photography (NHAP) program photographs, acquired at scales smaller than 1:60,000 and mapped onto a 1:250,000 topographic base map. The land-use and land-cover classification adheres to the Anderson Level II system developed by the USGS to meet the needs of Federal and State agencies for an up-to-date overview of conditions that exist throughout the country (Anderson and others, 1976). However, because these maps were developed in the early 1980's, existing land-use conditions described by these maps do not represent current conditions. However, within most of the Death Valley region, except in the vicinity of Las Vegas, only very slight land use changes have occurred during the past 10 to 15 years.

The GIRAS-formatted hydrologic unit map is based on the Hydrologic Unit maps published by the USGS Office of Water Data Coordination describing surface-water basin delineations for the entire United States (U.S. Geological Survey, 1982). The hydrologic units on these maps are defined by an eight-digit number (HUC Code) that indicates the hydrologic region, subregion, accounting unit, and cataloging unit. These codes, and the spatial definition of the hydrologic units, have been previously subjected to rigorous quality-assurance checks by USGS personnel.

Topological Consistency

ARC/INFO software created the topology for the combined regional coverages based on interpretation of the topological structures provided by the GIRAS-formatted source data. The GIRAS topological structures are fully validated by software so that no extraneous arc intersections or arc extensions remain. Polygon adjacency is ensured by the method of polygon construction from arc segments. No topological inconsistencies are believed to remain in these regional coverages. No topological errors were experienced during the importation of these data into ARC/INFO coverages.

Data-Base Limitations

All six regional thematic ARC/INFO coverages appear to meet their intended application of being used as part of a smaller scale (1:500,000) regional groundwater study. Because the data were originally digitized at scales of 1:100,000 and 1:250,000, it may be suitable for studies conducted at these scales. Additional work may be necessary before these data may be used for other studies. For example, the LU/LC classifications are based on information reflecting conditions in the 1980's; limitations concerning their accuracy have been noted. In contrast, comparison of the hydrologic data attributes along the boundaries of map quadrangles revealed some discrepancies in the original DLG data files; these discrepancies have been corrected by reference to newer and larger scale map products.

PRODUCED DIGITAL DATA FILES

These digital data products represent hydrographic features, land-use/land-cover conditions, and HU boundaries for the Death Valley region, which includes those areas of Nevada and California between lat 35°N., long 115°W. and lat 38°N., long 118°W. These digital data are represented as six ARC/INFO map coverages. The digital files are in ARC/INFO ARC EXPORT uncompressed ASCII format. The files have the following names:

HYDLG3X3POLY.E00	(Hydrography area features)
HYDLG3X3LINE.E00	(Hydrography line features)
HYDLG3X3NOD.E00	(Hydrography label point features)
HYDLG3X3PTS.E00	(Hydrography degenerate line features)
LULC3X3.E00	(Land-use and land-cover map)
HBU3X3.E00	(Hydrologic units map)

The digital files were first developed on a PRIME computer system. Later, the files were moved to a Sun Sparc Workstation. ARC/INFO Version 5.0.1 was used on the PRIME and Version 6.0 on the Sun Workstation. The contents of each file and map projection information are summarized in Attachment A.

The digital files described in this report are available from the USGS, Denver, Internet repository via 'anonymous ftp' at ympbserv1.cr.usgs.gov.

REFERENCES CITED

Anderson, J.R., Hardy, E.E., Roach, J.T., and Witmer, R.E., 1976, A land-use and land-cover classification system for use with remote sensor data: U.S. Geological Survey Professional Paper 964, 28 p.

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ATTACHMENT A

RESULTS OF "DESCRIBE" COMMAND ON EACH COVERAGE

The following tables provide the quantitative measures for each of the ARC/INFO coverages. These tables are direct reproductions of the data displayed by the ARC/INFO **"describe"** command. Identical results should be obtained by users who load these data files into their own ARC/INFO systems.

TABLE A-1

ARC/INFO Coverage HYDLG3X3POLY: Hydrographic Data Area Features (lakes, salt flats, playas, and reservoirs)

Description of SINGLE precision coverage hydlg3x3poly

ARCS

Arcs	=	757
Segments	=	42935

0 bytes of Arc Attribute Data

POLYGONS

Polygons	=	601

Polygon Topology is present.
64 bytes of Polygon Attribute Data

NODES

Nodes	=	686

0 bytes of Node Attribute Data

POINTS

Label Points	=	600

TOLERANCES

Fuzzy	=	20.000
Dangle	=	0.000

SECONDARY FEATURES

VTics	=	128
VLinks	=	0

COVERAGE BOUNDARY

Xmin	=	408745.438	Ymin	=	3872844.500
Xmax	=	682520.750	Ymax	=	4207495.000

STATUS

The coverage has not been edited since the last BUILD or CLEAN.

COORDINATE SYSTEM DESCRIPTION

Projection	UTM		
Zone	11		
Datum	NAD27		
Units	METERS	Spheroid	CLARKE1866
Parameters:			

TABLE A-2

ARC/INFO Coverage HYDLG3X3LINE: Hydrographic Data Line Features (streams, rivers, ditches, and canals)

Description of SINGLE precision coverage hydlg3x3line

ARCS			POLYGONS		
Arcs	=	28187	Polygons	=	0
Segments	=	644427	There is NO Polygon Topology.		
76 bytes of Arc Attribute Data			0 bytes of Polygon Attribute Data		
NODES			**POINTS**		
Nodes	=	29926	Label Points	=	0
0 bytes of Node Attribute Data					
TOLERANCES			**SECONDARY FEATURES**		
Fuzzy	=	20.000	VTics	=	1152
Dangle	=	0.000	VLinks	=	0

COVERAGE BOUNDARY

Xmin	=	408745.438	Ymin	=	3872844.500
Xmax	=	682520.750	Ymax	=	4207495.000

STATUS

The coverage has not been edited since the last BUILD or CLEAN.

COORDINATE SYSTEM DESCRIPTION

Projection	UTM		
Zone	11		
Datum	NAD27		
Units	METERS	Spheroid	CLARKE1866
Parameters:			

TABLE A-3

ARC/INFO Coverage HYDLG3X3NOD: Hydrographic Data Label Point Features (stream origins and locations of inflow and outflow to [or from] water bodies)

Description of SINGLE precision coverage hydlg3x3nod

ARCS			POLYGONS		
Arcs	=	0	Polygons	=	0
Segments	=	0	There is NO Polygon Topology.		
0 bytes of Arc Attribute Data			0 bytes of Polygon Attribute Data		
NODES			**POINTS**		
Nodes	=	0	Label Points	=	12788
0 bytes of Node Attribute Data			52 bytes of Point Attribute Data		
TOLERANCES			**SECONDARY FEATURES**		
Fuzzy	=	33.362 N	Tics	=	1140
Dangle	=	0.000 N	Links	=	0

COVERAGE BOUNDARY

Xmin	=	408745.438	Ymin	=	3872846.500
Xmax	=	682520.750	Ymax	=	4207495.000

STATUS

The coverage has not been edited since the last BUILD or CLEAN.

COORDINATE SYSTEM DESCRIPTION

Projection	UTM		
Zone	11		
Datum	NAD27		
Units	METERS	Spheroid	CLARKE1866
Parameters:			

TABLE A-4

ARC/INFO Coverage HYDLG3X3PTS: Hydrographic Data Degenerate Line Features (springs, wells, and windmills)

Description of SINGLE precision coverage hydlg3x3pts

ARCS

Arcs	=	0
Segments	=	0

0 bytes of Arc Attribute Data

POLYGONS

Polygons	=	0

There is NO Polygon Topology.
0 bytes of Polygon Attribute Data

NODES

Nodes	=	0

0 bytes of Node Attribute Data

POINTS

Label Points	=	1526

40 bytes of Point Attribute Data

TOLERANCES

Fuzzy	=	33.190 N
Dangle	=	0.000 N

SECONDARY FEATURES

Tics	=	704
Links	=	0

COVERAGE BOUNDARY

Xmin	=	408745.438	Ymin	=	3872846.500
Xmax	=	682520.750	Ymax	=	4207495.000

STATUS

The coverage has not been edited since the last BUILD or CLEAN.

COORDINATE SYSTEM DESCRIPTION

Projection	UTM		
Zone	11		
Datum	NAD27		
Units	METERS	Spheroid	CLARKE1866
Parameters:			

TABLE A-5

ARC/INFO Coverage LULC3X3: GIRAS Land-Use and Land-Cover (LU/LC) Data

Description of SINGLE precision coverage lulc3x3

ARCS

Arcs	=	3086
Segments	=	83782

0 bytes of Arc Attribute Data

POLYGONS

Polygons	=	1988

Polygon Topology is present.

20 bytes of Polygon Attribute Data

NODES

Nodes	=	2438

0 bytes of Node Attribute Data

POINTS

Label Points	=	1988

TOLERANCES

Fuzzy	=	0.840 V
Dangle	=	0.000 V

SECONDARY FEATURES

Tics	=	639
Links	=	0

COVERAGE BOUNDARY

Xmin	=	408763.312	Ymin	=	3873285.000
Xmax	=	682586.000	Ymax	=	4207450.000

STATUS

The coverage has not been edited since the last BUILD or CLEAN.

COORDINATE SYSTEM DESCRIPTION

Projection	UTM		
Zone	11		
Datum	NAD27		
Units	METERS	Spheroid	CLARKE1866
Parameters:			

TABLE A-6

ARC/INFO Coverage HBU3X3: Hydrologic Unit Boundaries Map

Description of SINGLE precision coverage hbu3x3

ARCS			POLYGONS		
Arcs	=	88	Polygons	=	22
Segments	=	10696	Polygon Topology is present.		
0 bytes of Arc Attribute Data			20 bytes of Polygon Attribute Data		

NODES			POINTS		
Nodes	=	68	Label Points	=	21
0 bytes of Node Attribute Data					

TOLERANCES			SECONDARY FEATURES		
Fuzzy	=	33.465 V	Tics	=	3792
Dangle	=	0.000 V	Links	=	0

COVERAGE BOUNDARY

Xmin	=	408763.250	Ymin	=	3873283.000
Xmax	=	682586.125	Ymax	=	4207450.000

STATUS

The coverage has not been edited since the last BUILD or CLEAN.

COORDINATE SYSTEM DESCRIPTION

Projection	UTM		
Zone	11		
Datum	NAD27		
Units	METERS	Spheroid	CLARKE1866
Parameters:			

CITATION:

A. Keith Turner, Frank A. D'Agnese, and Claudia C. Faunt, 1996. Digital hydrographic, land-use/land-cover, and hydrologic unit boundary files for the Death Valley region of southern Nevada and southeastern California processed from U.S. Geological Survey 1:100,000- and 1:250,000-scale digital data files. U.S. Geological Survey Open-File Report 95-362. ARC/INFO Export format.

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