CRREL REPORT 95-4

Development and Application of a Spatial Database for Emergency Management Operations

1993 Midwest Flood

Joyce A. Nagle, Elke S. Ochs, Andrew J. Bruzewicz and Harlan L. McKim

March 1995

Abstract

During natural and man-made emergencies, there is a need for the rapid development of spatial databases to support recovery efforts. A spatial database was developed to support the U.S. Army Corps of Engineers Disaster Field Offices during the flooding that took place in the Midwest during the summer of 1993. The spatial database contains roads, railroads, hydrography, county boundaries and inundation data for seven rivers located in the Mississippi River basin. The spatial data came from a variety of sources, including U.S. Census Bureau TIGER/Line files, U.S. Geological Survey Digital Line Graphs and satellite imagery. An application of the spatial database is also described. Maps were produced showing roads, railways, hydrography, county boundaries and, when available, inundation data. These maps were then distributed to assist in the recovery efforts and future planning.

Cover: Flooding of the Missouri River between St. Louis and St. Charles in 1993.

For conversion of SI metric units to U.S./British customary units of measurement consult *Standard Practice for Use of the International System of Units (SI)*, ASTM Standard E380-89a, published by the American Society for Testing and Mater-ials, 1916 Race St., Philadelphia, Pa. 19103.

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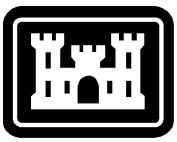

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Prepared for
OFFICE OF THE CHIEF OF ENGINEERS

PREFACE

This report was prepared by Dr. Joyce A. Nagle, Civil Engineer, Elke S. Ochs, Physical Scientist, Andrew J. Bruzewicz, Physical Scientist, and Dr. Harlan L. McKim, Director, U.S. Army Corps of Engineers Remote Sensing/GIS Center (RSGISC). Funding was provided by the Readiness Branch, Headquarters, U.S. Army Corps of Engineers. This paper was prepared at the RSGISC, located at the U.S. Army Cold Regions Research and Engineering Laboratory, as part of the U.S. Army Corps of Engineers Emergency Operations response to the Midwest flooding during the summer of 1993.

The following people provided support and assistance in a variety of ways. The order in which they are mentioned does not reflect the importance of their contributions. Frank D'Erschia, U.S. Fish and Wildlife Service Environmental Management Technical Center, Onalaska, Wisconsin, supplied data for the Mississippi River and Illinois River spatial databases; Timothy Rourke, U.S. Army Engineer District, Omaha (CEMRO), supplied data for the Missouri, Kansas, Republican, Des Moines and Grand rivers; Stuart Challender, State of Utah Automated Geographic Reference Center, Salt Lake City, Utah, supplied technical guidance in writing the basic programs for producing the maps; Michael Barwick and Richard Dobie, U.S. Army Topographic Engineering Center, Fort Belvoir, Virginia, provided inundation vectors and acquired classified satellite imagery; Emily Bryant, Dartmouth College, Hanover, New Hampshire, and William Lamb, Gregg Petrie and George Wukelic, Department of Energy Pacific Northwest Laboratory, Richland, Washington, provided support with rectification of the SAR images; Dr. Robert L. Bolus, RSGISC, coordinated acquisition of the unclassified satellite imagery and, along with Dr. Alison Smith, RSGISC, provided inundation vector files from "heads-up" digitizing of the satellite imagery. Numerous people were involved in map production and database and program development: Bruce Brockett, RSGISC; Mickel Hayward, U.S. Army Waterways Experiment Station, Vicksburg, Mississippi; Thomas Laflin, U.S. Army Engineer District, Kansas City (CEMRK); Bradley Quayle, CEMRO; Joel Schlagel, Vermont Cooperative Fish and Wildlife Research Unit, University of Vermont, Burlington; Shane White and Jeffery Lane, Environmental Systems Research Institute, Inc., Boston, Massachusetts; Rebekah Roland, RSGISC; and Patricia Weyrick, CRREL. Joyce Ryerson, Dartmouth College, provided access to the extensive map collection located at the college. Dianne Nelson, RSGISC, oversaw construction and delivery of the map notebooks. She and Timothy Pangburn, RSGISC, provided administrative support throughout the emergency. Computer support was provided by the Information Systems Branch, Technical Resources Center, CRREL, under the direction of John Bement. Reproduction support was provided by the Visual Information Branch, Technical Resources Center, CRREL, under the direction of Thomas Wiley.

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ACRONYMS

AML	ARC Macro Language
CEMRO	U.S. Army Engineer District, Omaha
CENCR	U.S. Army Engineer District, Rock Island
CETEC	U.S. Army Corps of Engineers Topographic Engineering Center
CFCC	Census Feature Class Codes
DFO	Disaster Field Office
DLG	Digital Line Graphs
EOC	Emergency Operations Center
EOSAT	Earth Observation Satellite Company
EPS	Encapsulated PostScript
ERS	European Remote Sensing satellite
FAT	Feature Attribute Tables
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FTP	File Transfer Protocol
GIS	Geographic Information System
GPS	Global Positioning Systems
GRA	graphics file
GRASS	Geographical Resources Analysis Support System
HQUSACE	Headquarters, U.S. Army Corps of Engineers
IFOV	Instantaneous Field Of View
NAD27	North American Datum of 1927
NAD83	North American Datum of 1983
NSDI	National Spatial Data Infrastructure
RSGISC	Remote Sensing / GIS Center
SAR	Synthetic Aperture Radar
SPOT	Système Probatoire d'Observation de la Terre
TIGER	U.S. Census Bureau Topologically Integrated Geographic Encoding and Referencing database
TM	Landsat Thematic Mapper
USFWS EMTC	U.S. Fish and Wildlife Service Environmental Management Technical Center
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator coordinate system
WGS84	World Geodetic System

Development and Application of a Spatial Database for Emergency Management Operations

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INTRODUCTION

The spring and summer of 1993 brought approximately 200% of average rainfall to the Upper Mississippi River basin. The resulting floods caused an estimated $9.4 billion in damage, affecting about 35,000 homes and 13.9 million acres. Eight states had over 50% of their counties declared Federal disasters. President Clinton declared more than 200 counties Federal disaster areas, including all 99 counties of Iowa. The Mississippi and Missouri rivers were closed to river traffic and all forms of transportation were disrupted throughout the region.

During natural and man-made emergencies, such as the 1993 Midwest flood, spatial databases must be rapidly developed to support response and recovery efforts. Digital data for the database, available from a variety of sources, can provide timely and detailed information over large areas for measuring and monitoring environmental parameters on land or water. Multiband imaging data from airplanes and satellites can be integrated into the spatial database, as can U.S. Census Bureau data for monitoring damage to transportation routes.

The large size of the flooded area made response difficult. In addition, owing to the distribution of the rainfall, the Mississippi River was affected first and then the Missouri River. Multiple crests caused record flooding at many locations. Table 1 shows flood and crest stages along the Mississippi, Missouri and Des Moines rivers.

Table 1. Flood and crest stage at various locations along the Mississippi, Missouri and Des Moines rivers.

City	*Crest date*	*Flood stage (ft)*	*Flood stage (m)*	*Crest stage (ft)*	*Crest stage (m)*
Mississippi River					
St. Paul	26 June	14	4.3	19.2	5.85
Prairie du Chien	30 June	16	4.9	21.9	6.66
Dubuque	6 July	17	5.2	22.7	6.92
Davenport	9 July	15	4.6	22.6	6.89
Keokuk	10 July	16	4.9	27.2	8.29
Quincy	13 July	17	5.2	32.2	9.81
Hannibal	18 July	16	4.9	31.8	9.69
St. Louis	19 July	30	9.1	46.0	14.02
	1 Aug	30	9.1	49.5	15.09
Chester	5 Aug	27	8.2	48.0	14.63
Missouri River					
Nebraska City	14 July	18	5.5	23.5	7.16
St. Joseph	26 July	17	5.2	32.6	9.94
Kansas City	16 July	32	9.8	36.8	11.22
Boonville	30 July	21	6.4	37.1	11.31
Hermann	1 Aug	21	6.4	36.1	11.00
Des Moines River					
Estherville	30 June	7	2.1	15.3	4.66
Des Moines	11 July	23	7.0	34.3	10.65

By agreement with the Operations Directorate, the Remote Sensing / GIS Center (RSGISC) is point of contact for the Emergency Operations Center (EOC) and the Readiness Branch at the U.S. Army Corps of Engineers Headquarters (HQUSACE). This agreement assigns responsibility to the RSGISC for all remote sensing and GIS initiatives during natural and man-induced disasters that

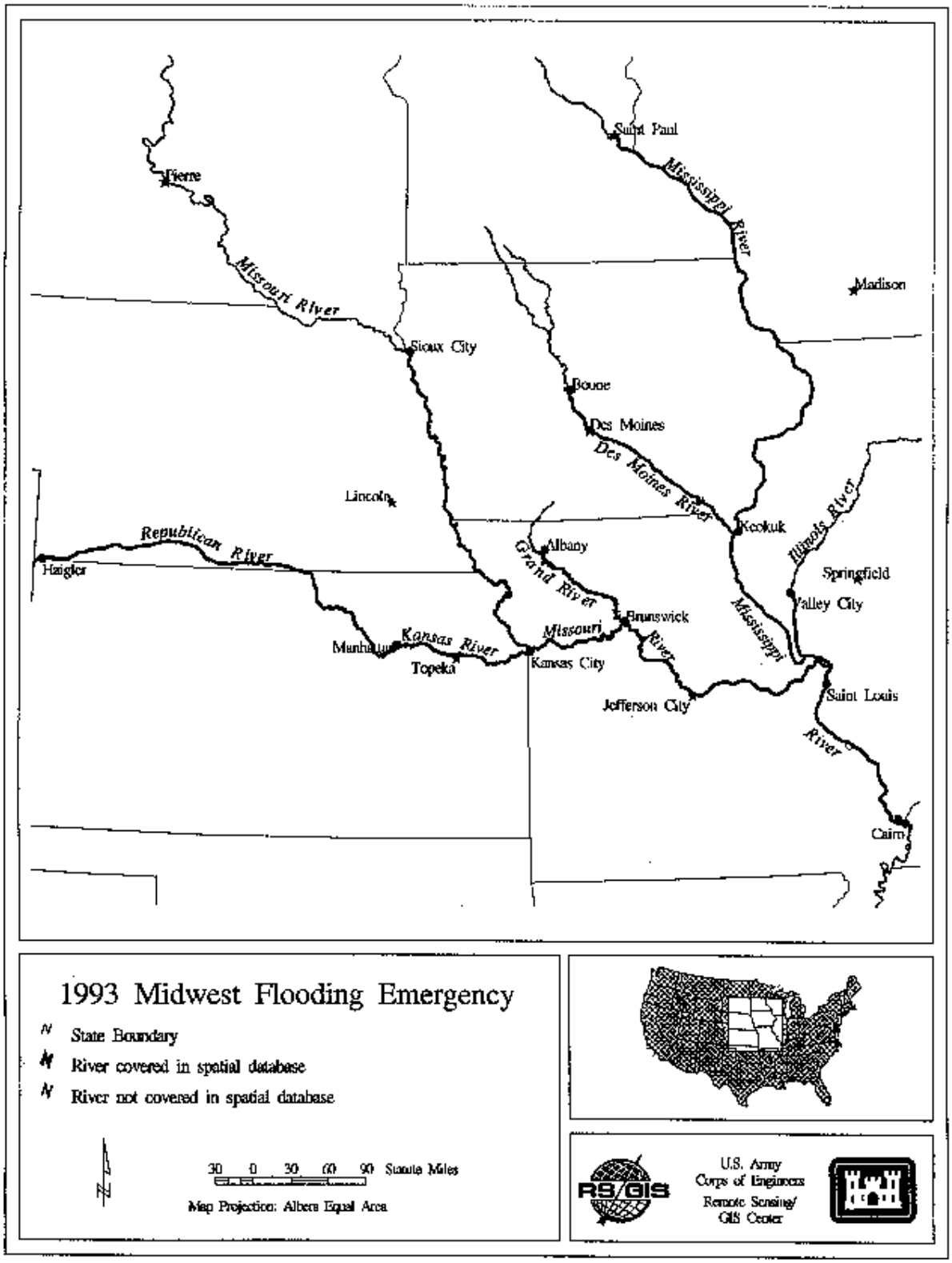

Figure 1. Seven rivers covered in the spatial database.

involve emergency operations. Included in this responsibility are spatial data management, map generation and the coordination of acquisition of satellite images for analysis and display.

To provide support to the U.S. Army Corps of Engineers' response to the Midwest flooding, the RSGISC developed spatial databases containing roads, railroads, hydrography, county boundaries and inundation data for each of seven rivers located in the Mississippi River basin. This report details the development of these databases and the methods used to create support maps during the emergency. In the next section, the present database is described, including the data sources, and the sensors used to acquire the inundation data are discussed. The *Application of the Spatial Database* section details the making of maps during the response phase, which had to be done while the database was being developed. Problems and lessons learned are discussed. The *Spatial Database Distribution* section describes the distribution formats of the database and the associated metadata files, while the last section gives recommendations for the future directions of database development for emergency management.

SPATIAL DATABASE

The overall spatial database is made up of databases for seven rivers in the Mississippi River basin that were affected by flooding during the summer of 1993 (Fig. 1). Separate databases containing roads, railways, hydrography, county boundaries and, when available, inundation extent were created for each of the seven rivers. The present set of databases is in the Universal Transverse Mercator (UTM) coordinate system based on the North American Datum of 1983 (NAD83). The spatial database covers UTM zones 14, 15, and 16 (Fig. 2).

The seven river reaches covered by the spatial database are:

1. Mississippi River between St. Paul, Minnesota, and Cairo, Illinois.
2. Missouri River between Sioux City, Iowa, and its confluence with the Mississippi River near St. Louis, Missouri.
3. Des Moines River between Boone, Iowa, and its confluence with the Mississippi River near Keokuk, Iowa.
4. Kansas River between Manhattan, Kansas, and its confluence with the Missouri River near Kansas City.
5. Republican River between Haigler, Nebraska, and its confluence with the Kansas River near Manhattan, Kansas.
6. Grand River between Albany, Missouri, and its confluence with the Missouri River near Brunswick, Missouri.
7. Illinois River between Valley City, Illinois, and its confluence with the Mississippi River.

The Geographic Information System (GIS) ARC/INFO software (Environmental Systems Research Institute, Redlands, California) was used to develop and manage the spatial database and create maps for the seven reaches of river. This GIS was chosen because of the availability of processed ARC/INFO format data within the Corps of Engineers and other collaborative agencies.

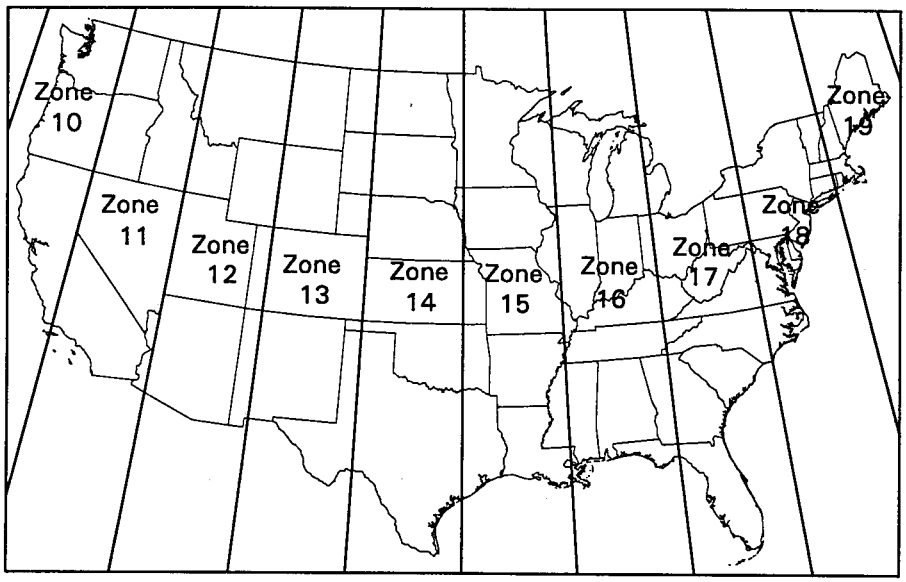

Figure 2. Universal Transverse Mercator (UTM) zones for the continental United States.

Base map data

A search was made among the Corps Districts and other agencies to find digital data already processed. Three sources of data were found for the seven reaches of river: the U.S. Fish and Wildlife Service Environmental Management Technical Center (USFWS EMTC), Onalaska, Wisconsin, the U.S. Army Corps of Engineers District (CEMRO), Omaha, Nebraska, and the U.S. Army Corps of Engineers District (CENCR), Rock Island, Illinois.

Illinois and Mississippi rivers

The USFWS EMTC provided data derived from the U.S. Geological Survey (USGS) 1:100,000-scale Digital Line Graphs (DLG) (USGS 1989) for the Mississippi River and for the Illinois River. The data were supplied in separate ARC/INFO coverages for the roads, railroads and hydrography present in the 1:24,000-scale USGS quadrangles adjacent to the two rivers. A coverage containing the boundaries of the USGS quadrangles was also supplied.

All coverages were received in the UTM projection for zone 15 based on the North American Datum of 1927 (NAD27). At the RSGISC, all data were imported into ARC/INFO and projected into the actual UTM zones based on NAD83.

The data received from the USFWS EMTC did not include the county boundaries along the Mississippi and the Illinois rivers. The county boundaries for the Illinois River database were acquired from CENCR, digitized from 1:24,000-scale maps and imported into ARC/INFO. The county boundaries for the Mississippi River database were acquired from the ARCUSA 1:2,000,000-scale database (ESRI 1993). Although these data were derived from a map of much smaller scale, they were included in the database for completeness. They were not used in the map making process.

Table 2. Counties along the Mississippi River covered completely or partially by the spatial database.

Minnesota	**Missouri**	**Illinois**	**Wisconsin**
Carver	Cape Girardeau	Adams	Buffalo
Dakota	Clark	Alexander	Crawford
Goodhue	Jefferson	Calhoun	Grant
Hennepin	Lewis	Carroll	LaCrosse
Houston	Lincoln	Hancock	Pepin
Ramsey	Marion	Henderson	Pierce
Scott	Mississippi	Jackson	St. Croix
Wabasha	Perry	Jersey	Trempealeau
Washington	Pike	Jo Daviess	Vernon
Winona	Ralls	Madison	
	Scott	Mercer	
Iowa	St. Charles	Monroe	
Allamake	St. Francois	Pike	
Clayton	St. Louis	Pulaski	
Clinton	St. Louis City	Randolph	
Des Moines	Ste. Genevieve	Rock Island	
Dubuque		St. Clair	
Jackson	**Kentucky**	Union	
Lee	Ballard	Whiteside	
Louisa	Carlisle		
Muscatine			
Scott			

The Mississippi River database covers all 1:24,000 USGS quadrangles adjacent to the river between St. Paul, Minnesota, and Cairo, Illinois. The counties listed in Table 2 are covered either completely or partially by the database. This reach of river is in UTM zones 15 and 16.

The Illinois River database covers all 1:24,000 USGS quadrangles adjacent to the river between Valley City, Illinois, and the confluence with the Mississippi River. The following counties are covered either completely or partially by the database: Calhoun, Greene, Jersey, Pike and Scott. This reach of river is in UTM zone 15.

Des Moines, Grand, Kansas, Missouri and Republican rivers

CEMRO provided digital data for the Des Moines, Grand, Kansas, Missouri and Republican rivers from the U.S. Census Bureau Topologically Integrated Geographic Encoding and Referencing (TIGER) database (U.S. Census Bureau 1991). The data in the 1990 TIGER/Line files are based on the USGS 1:100,000-scale maps and the Census Bureau's 1980 GBF/DIME files. ARC/INFO coverages for county boundaries, roads, railroads and hydrography were supplied by CEMRO for each county along the rivers.

CEMRO extracted the coverages from the TIGER/Line file database and projected the data into the State Plane (feet) coordinate system based on the NAD83, with the exception of the Nebraska counties, which were left in NAD27. At the RSGISC, all data were imported into ARC/INFO and projected into the UTM coordinate system.

The Missouri River database covers 46 counties between Sioux City, Iowa, and the confluence with the Mississippi River near St. Louis, Missouri (Table 3). This reach of river is in UTM zones 14 and 15.

The Des Moines River database covered the following counties between Boone, Iowa, and St. Louis, Missouri: Boone, Dallas, Davis, Lee, Mahaska, Marion, Polk, Van Buren, Wapello and Warren. The region is in UTM zone 15.

The Kansas River database covers the following Kansas counties: Douglas, Geary, Jackson, Jef-

Table 3. Counties along the Missouri River covered in the spatial database.

Missouri	**Iowa**
Andrew	Fremont
Atchinson	Harrison
Boone	Mills
Buchanan	Monona
Callaway	Pottawattamie
Carroll	Woodbury
Chariton	
Clay	**Kansas**
Cole	Atchison
Cooper	Doniphan
Franklin	Leavenworth
Gasconade	Wyandotte
Holt	
Howard	**Nebraska**
Jackson	Burt
Lafayette	Cass
Moniteau	Dakota
Montgomery	Douglas
Osage	Nehama
Platte	Otoe
Ray	Richardson
Saline	Sarpy
St. Charles	Thurston
St. Louis	Washington
St. Louis City	
Warren	

ferson, Johnson, Leavenworth, Marshall, Nemaha, Pottawattamie, Riley, Shawnee, Wabaunsee and Wyandotte. This reach of river is in UTM zones 14 and 15.

The Republican River database consists of eight counties in Nebraska and six counties in Kansas. The Nebraska counties are: Dundy, Hitchcock, Red Willow, Furnas, Harlan, Franklin, Webster and Nuckolls. The Kansas counties are: Jewell, Republic, Cloud, Washington, Clay and Dickinson. This region is in UTM zone 14.

The Grand River database covers the following Kansas counties located below Gentry, Missouri: Carroll, Chariton, Daviess, Gentry, Livingston and Saline. The database is in UTM zone 14.

Inundation data

Flood inundation data were acquired from several military and commercial sources.

Military

The Corps of Engineers Topographic Engineering Center (CETEC), Fort Belvoir, Virginia, supplied inundation data for the Mississippi River from a classified source. The data were reduced to an unclassified mode and drawn on 1:100,000-scale maps at CETEC (Table 4).

The inundation extent data were digitized from

Table 4. U.S. Geological Survey 1:100,000-scale maps for which CETEC provided data.

Aledo — Illinois, Iowa
Cape Girardeau — Missouri, Illinois, Kentucky
Davenport — Iowa, Illinois
Quincy — Illinois, Missouri
St. Louis — Missouri, Illinois
Carbondale — Illinois, Missouri
Festus — Missouri, Illinois
Jerseyville — Illinois, Missouri
Farmington — Missouri, Illinois
Pinckneyville — Illinois
Burlington — Iowa, Illinois, Missouri

the 1:100,000-scale maps at the RSGISC using the GRASS4.0 (USACERL 1988) GIS and exported from GRASS4.0 in a DLG-3 optional distribution format to ARC/INFO. By using GRASS for digitizing, it became possible to use additional equipment and staff at CRREL to assist in the database development without requiring the ARC/INFO capability that was necessary for producing maps.

Commercial

The RSGISC acquired remotely sensed data from three satellite sensors: Landsat TM, SPOT and ERS-1 SAR. Table 5 shows the location and dates for which scenes were acquired during the flooding. This does not represent all the scenes that were available during this period, only the scenes that were acquired and processed by the RSGISC.

Table 5. Satellite data collected during the flooding.

*City**	*Date†*	*Time (GMT)***	*Sensor††*	*Location****
Mississippi River				
Davenport	7 July	1648	ERS-1	10334-169
	14 July	0417	ERS-1	10427-262
Burlington	7 July	1648	ERS-1	10334-169
St.Louis	18 July	1604	TM	024/033
Chester	8 Aug	1644	ERS-1	10792-162
Cairo	27 July	1558	TM	023/033
Missouri River				
Sioux City	26 July	0440	ERS-1	10599-434
Omaha	7 July	0437	ERS-1	10327-169
St. Joseph	2 Aug	1726	SPOT	585,270
Booneville	25 July	1610	TM	025/033
Fulton	4 Aug	1648	SPOT	592,272

* City near the center of the scene.
† When the image was acquired.
** GMT is Greenwich Mean Time.
†† ERS-1 is the European Remote Sensing Satellite Synthetic Aperature Radar; TM is Landsat Thematic Mapper; SPOT is Systeme Probatoire d'Observation de la Terre.
*** Path/row for TM, K,J for SPOT, and orbit-track for ERS-1 SAR.

The dates for which satellite imagery was available were limited by the repeat cycle of each sensor and the weather. The Landsat Thematic Mapper (TM) acquires 8-bit data in seven wavelength bands—three visible (blue, green and red), one near-infrared, two mid-infrared and one thermal infrared band. The near-polar, sun-synchronous orbit of Landsat allows the satellite to image the same area of the earth every 16 days. The TM data are collected using a 30-m instantaneous-field-of-view (IFOV) for all bands except the thermal band, which has a 120-m IFOV. The swath width of the sensor is 185 km. The scenes were purchased from the Earth Observation Satellite Company (EOSAT, Lanham, Maryland) and were geometrically corrected and rectified to the UTM projection based on the NAD27 datum, using 25- × 25-m pixels.

The Système Probatoire d'Observation de la Terre (SPOT) (SPOT Image Corporation, Reston, Virginia) satellite images are acquired in a 10-m resolution panchromatic mode over the spectral range of 0.51 to 0.73 μm. The orbit pattern for SPOT-1 repeats every 26 days. However, the pointable optics of the SPOT enable off-nadir viewing during satellite passes separated alternatively by 1 and 4 days (and occasionally 5), depending on the latitude of the area viewed. This revisit capability is important because it increases the potential frequency of coverage, enabling viewing of a given area at frequencies ranging from successive days to a few weeks. The swath width of the sensor is 60 km. The 8-bit panchromatic data were radiometrically and geometrically corrected and rectified to zone 15 of the UTM projection based on the WGS84 datum with 10- × 10-m pixels.

Microwaves are capable of penetrating the atmosphere under virtually all conditions. Since cloudiness was a continuing problem in portions of the Upper Midwest as floods were cresting, the majority of the imagery acquired for the emergency came from the European Remote Sensing Satellite Synthetic Aperture Radar, ERS-1 SAR (Radarsat International, Richmond, British Columbia). The ERS-1 operates a SAR instrument at the C-band frequency ($\lambda = 5.7$ cm) with VV-polarization, a 100-km swath width and a spatial resolution of better than 30 m, thus allowing the sensor to "see" through the clouds that are present during periods of precipitation.

The 16-bit ERS-1 SAR images were obtained geometrically corrected but not rectified. Rectification was done by the Department of Geological Sciences Remote Sensing Laboratory at Dartmouth College, Hanover, New Hampshire, and the Department of Energy Pacific Northwest Laboratory, Richland, Washington. The 16-bit data were rescaled to 8-bit and rectified to the UTM projection zone 15 based on NAD27 using 30- × 30-m pixels. The images were rectified approximately to National Map Accuracy Standards for maps of scale 1:20,000 or smaller (USGS 1989). The horizontal accuracy standard states that for maps on publication scales of 1:20,000 or smaller, no more than 10% of the points tested shall be in error by more than 1⁄50th of an inch (0.05 cm) from their intended location. The rectified data were not exhaustively evaluated, but the majority of the points met this standard.

The Erdas / PC version 7.4 (Erdas, Inc., Atlanta, Georgia) DIGSCRN module was used for "heads-up" digitizing of the flood vectors from the rectified images. This module allows digitizing of vector data against an image backdrop that is displayed on the computer screen in either the Erdas .LAN or .GIS format. For the TM data, band 4 (0.76–0.90 μm) was used for delineation of the flood vectors. The near-IR wavelengths of band 4 provide a sharper contrast between the vegetation and the water than the other bands.

The digitized vector data were output to a file in a .DIG format. A UNIX awk script was used to convert the .DIG file into a format ready to import into ARC / INFO using the GENERATE command (Appendix A). The TM and ERS-1 data were projected to the correct UTM zone based on NAD83. The datum of the SPOT data was WGS84, which was assumed to be identical to NAD83.

APPLICATION OF SPATIAL DATABASE

In support of emergency management operations being conducted by the Readiness Branch, a series of 8.5- × 11-in. (22- × 28-cm) maps was produced by the RSGISC for each of the seven reaches of river. The maps covered 20,000- × 20,000-m regions and included roads, railways, hydrography, county boundaries and, when available, inundation data.

The 8.5- × 11-in. format was chosen as a result of previous experience gained by the RSGISC through participation in the recovery from Hurricane Andrew and the Federal Emergency Management Agency's (FEMA) earthquake preparedness exercise, Response '93 (FEMA 1993). These experiences showed that by producing the maps in an Encapsulated PostScript (EPS) format they can be

easily printed using laser printers at the Disaster Field Office (DFO), photocopied and provided to as many emergency responders as necessary with minimum delay. The EPS files can also be sent to high quality color printers and reproduced on color copiers for visually pleasing products.

Initially, the Mississippi River map set was produced as if the entire reach was in UTM zone 15, rather than its true location in both UTM zones 15 and 16. While this provided the advantage of a single, seamless database, and reflected the nature of the flood in its initial phase, as the flooding extended downstream into UTM zone 16, the map coordinates no longer reflected true ground locations. As the extent of the flooding increased, it became apparent that the mapping approach needed to be revised to produce the maps in their correct UTM zones. Appendix B describes the procedures used to split the data into the correct UTM zones.

The maps were being created as the database was being built and, so, quality could not be properly controlled before the maps were distributed. During development of the spatial database, all data were imported from the sources described in the *Base Map Data* section into ARC/INFO using the IMPORT command. The data were then projected into the UTM coordinate system based on NAD27 using the PROJECT command. However, a little known bug in ARC/INFO version 6.1 did not allow proper conversion from NAD83 to NAD27.* Thus, the maps were made in both datums. This was not discovered until after the maps were completed and the data were being made final for distribution. All of the data in the finalized database described in the *Spatial Database* section are in the correct UTM zone and are based on NAD83.

The notebooks were distributed to the Chief, Emergency Operations, in each of the affected Districts and Divisions, and to the Disaster Field Offices.

* The Mississippi and Illinois river DLG data and Nebraska TIGER data were in NAD27 and the rest of the data were in NAD83. NAD83 was not converted to NAD27 because, when projecting data using the ARC/INFO v6.1 PROJECT command, both the input and output datum must be defined. It was assumed that the default datum was NAD27 and, thus, the data were projected into the UTM projection without declaring a datum. The error was not detected because when no datum or ellipsoid is declared in the input or output projection, the Clarke1866 ellipsoid associated with NAD27 is stated by default. It was assumed since Clarke1866 existed in the coverage's projection information, the conversion from NAD83 to NAD27 had occurred correctly. However, no datum conversion occurred. Therefore, if no input and output datum are defined in the projection file, the datum remains in the original datum and the Clarke1866 ellipsoid is declared.

Hardware and software

The GIS's ARC/INFO version 6.1 and GRASS4.0 used to develop the database were run on a SUN Sparc 2 platform. The Sparc 2 was configured with 64 Mbyte RAM, 150 Mbyte swap space, two 2.4-Gbyte and one 3.5-Gbyte hard disks and a Calcomp 9500 digitizer. Two Visual Technologies TX600C Xterminals were run from the Sparc 2 CPU allowing access to two additional ARC/INFO licenses that were added to support the recovery effort.

ARC Macro Language (AML) programs

The maps were created using programs written in ARC Macro Language (AML). To make the maps, a database is built and accessed numerous times. The AML allows the user to combine a series of commands from ARC and its subsystems, thereby automating frequently performed tasks and menu-driven user interfaces.

The programs used for producing the maps were based on the AML program developed by Stuart Challender, State of Utah Automated Geographic Reference Center, Salt Lake City, for the FEMA sponsored Response '93 Earthquake Exercise held in June 1993 (Challender 1993, FEMA 1993). A separate program was written for each river because of the different regions and the indexing systems. The AML programs were menu-driven and allowed staff with little or no computer or GIS experience to assist in making maps. The complete AML code for this mapping application can be obtained from the Director, RSGISC.

Output

The 8.5- × 11-in. (22- × 28-cm) hard copy maps were produced by converting the graphics file (GRA) created by the AML programs to an EPS format. The program creates either black and white or color output in a portrait arrangement that has different dimensions from what is seen on the computer screen. This allows for maximum use of the screen space and maximizes the information that can be placed on the output page.

An original color map for each river region was printed using a Canon Color Laser Copier and copies were made for the distribution notebooks. The EPS files were transferred to a Macintosh II and printed on the Canon Color Laser Copier using a LaserWriter Font Utility application. Using the Macintosh to print the files permitted dedicated use of the Sparc 2 and the Xterminals for map creation, the most computationally intensive task being done. It also decreased production time by allowing an additional person to print the files and assist in assembling the notebooks.

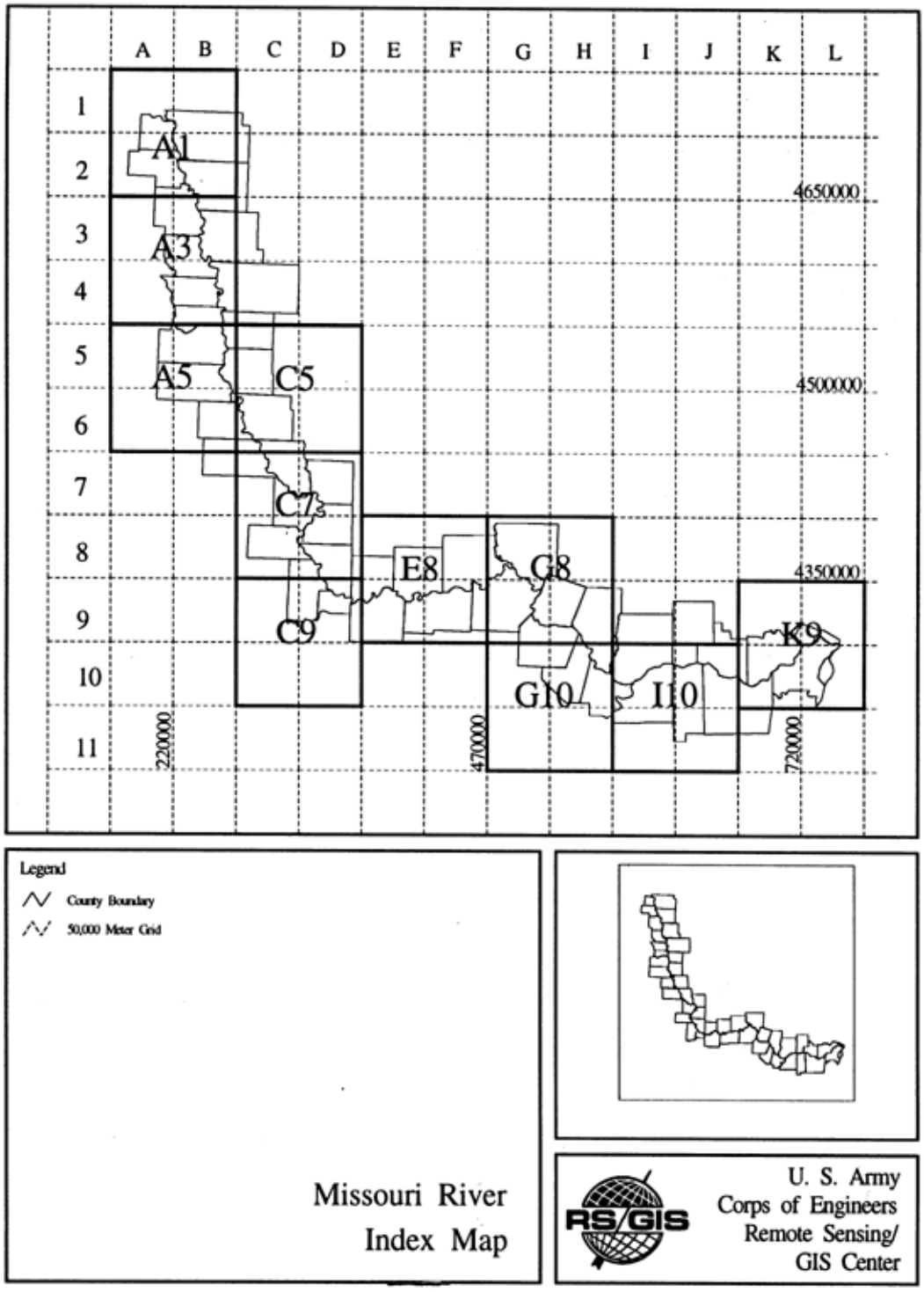

Figure 3. Index map for the Missouri River showing county boundaries, 50,000-m UTM grid and 100,000- × 100,000-m boxes. The projection is UTM zone 15.

River notebooks

For each river, a notebook was created that contained index maps and the 20,000- × 20,000-m maps. At the beginning of each notebook, an indexed map defined the area of interest along the river. Figure 3 shows the index map for the Missouri River. The map shows the counties in the spatial database, a 50,000-m UTM grid and 100,000- × 100,000-m boxes drawn along the river and labeled according to their location on the map.

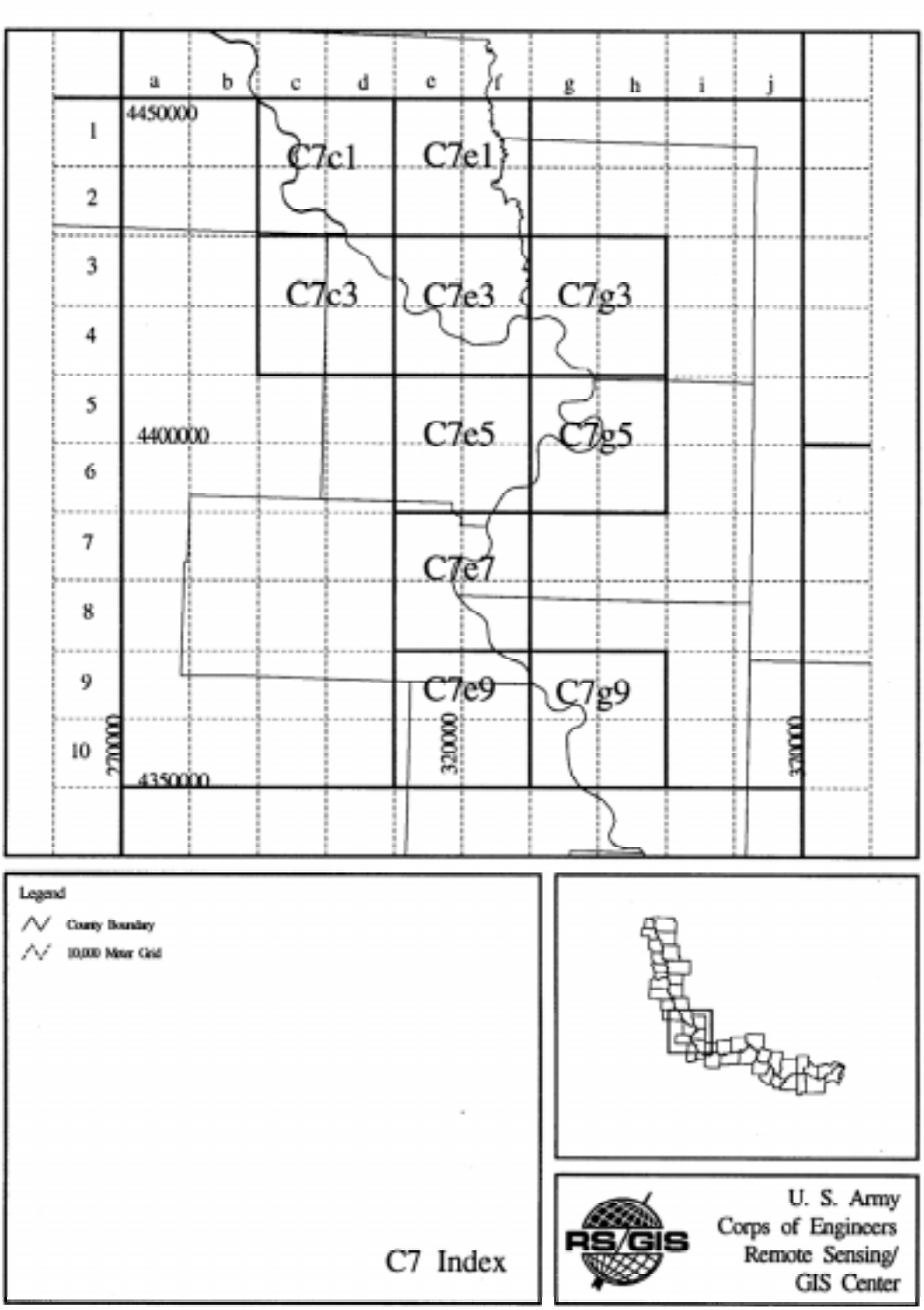

Figure 4. Index map for section C7, Missouri River, showing county boundaries, 10,000-m UTM grid and 20,000- × 20,000-m boxes. The projection is UTM zone 15.

The notebook was then divided into sections for each of these 100,000- × 100,000-m regions. At the beginning of each of these sections, an indexed map of the 100,000- × 100,000-m region shows the 20,000- × 20,000-m regions that were actually mapped (Fig. 4 and 5). Because of the size of the 8.5- × 11-in. page, the 20,000- × 20,000-m maps were generated at a scale of 1:133,333. The roads and railroads were drawn in black with the same line style to place more emphasis on the hydrography, which was drawn in blue, and inundation data, which, when available, were drawn in red.

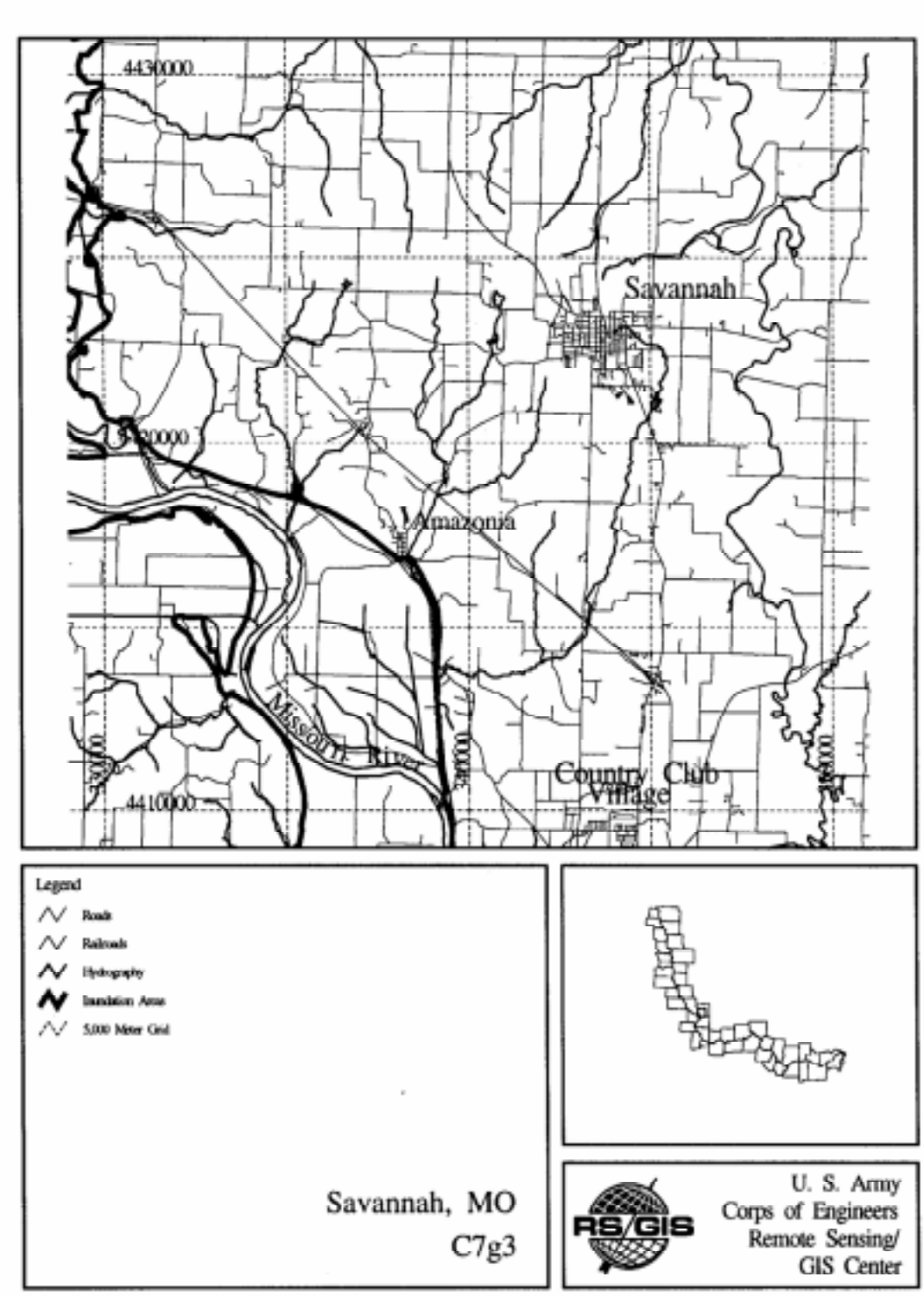

Figure 5. The 20,000- × 20,000-m map for index box C7g3, Missouri River, showing roads, railroads, hydrography, and 5000-m grid. The projection is UTM zone 15.

The annotation for each map included UTM coordinates for the 5000-m grid, and city and river names.

The AML program allows the map producer to zoom into each 100,000- × 100,000-m and 20,000- × 20,000-m region directly by selecting the region from the menu. The AML also has tools to allow annotation by pointing and clicking on the map on the computer screen.

Mississippi River

The first set of maps was produced for the Mississippi River. The reach of river covered in the

database is in UTM zones 15 and 16. The maps were created in UTM zone 15 based on NAD27. The scale of the 20,000- × 20,000-m maps was not exactly 1:133,333 for all the maps. Exact guidelines had not yet been established for zooming in on the 20,000- × 20,000-m regions and, consequently, this initial notebook did not have a consistent map scale. This was rectified for the map notebooks produced for the remaining rivers.

The Mississippi River maps were the only ones that included inundation data, which were provided be CETEC.

Missouri River

The Missouri River database is located in UTM zones 14 and 15. The maps created were in UTM zone 15, based on NAD83 for all counties except those in Nebraska, which were in NAD27 (see footnote, p. 7). There were no inundation data available at the time of production of these maps, thus they serve as base maps.

Des Moines River

The maps created for the Des Moines River were all in UTM zone 15, based on NAD83 (see footnote, p. 7). There were no inundation data available at the time of production of these maps.

Kansas River

The reach of the Kansas River mapped because of flooding is in UTM zones 14 and 15, based on NAD83 (see footnote, p. 7). There were no inundation data available at the time of production of these maps.

Republican River

The reach of the Republican River mapped is in UTM zone 14. The maps were based on NAD83 for all counties except the Nebraska counties, which were based on NAD27 (see footnote, p. 7). There were no inundation data available at the time of production of these maps.

Grand River

The maps that were produced for the Grand River were in UTM zone 15, based on NAD83 (see footnote, p. 7). There were no inundation data available at the time of production of these maps.

Illinois River

The maps that were produced for the Illinois River were in UTM zone 16, based on NAD27. There were no inundation data available at the time of production of these maps.

SPATIAL DATABASE DISTRIBUTION

The spatial database for the Midwest flooding has been prepared for distribution on either magnetic tapes or via the Internet. The seven-river database is approximately 400 Mbytes in size. *All* of the data have been projected to the correct UTM zone and the datum converted to the NAD83, rectifying the problem of mixed datums that was present when the maps were produced.

Distribution formats

The spatial database for the midwest flooding has been prepared for distribution. The data were written in two distribution formats to allow them to be imported into a variety of GIS's: 1) ARC/INFO Export 6.1 and 2) DLG-3 optional. Metadata files were created to accompany the data (see next section).

The conversion to ARC/INFO Export format maintains all information associated with the coverages in the Feature Attribute Tables (FAT). These FATs have a spreadsheet format where each occurrence of the feature (e.g., polygon, arc, point) in the map occupies a row and the descriptive elements of the feature occupy the columns. The descriptive elements, such as length and name, are called "items."

In the conversion to DLG-3 optional distribution format, only information contained in integer item pairs titled "Major*n*" and "Minor*n*," where *n* = 1, 2, 3, ..., are converted to the new format. To allow conversion of the Census Feature Class Codes (CFCC) for the roads, hydrography and railways data derived from TIGER/Line files and the county names in the counties coverage, modifications were made to the coverages as described in Appendix C. To describe this process briefly, Major1 and Minor1 items were added to the FATs and integers representing the CFCC value or county name were assigned to the Major1 item. A description of the Major1 values was then added to the DLG versions of the metadata files.

Metadata

Metadata, or data about data, were created and placed in text files for distribution with the spatial database. This was done to help other users to understand the data content and to ensure appropriate use based on the accuracy of the data, defined by factors such as resolution and creation date. Files were created for each distribution format and UTM zone for the seven river databases and each distribution format for the inundation databases. Contained in each file are

Table 6. Data elements for metadata files.

Identification section	Projection information	Data custodian information	Source information
Data set identity	Grid coordinate system	Contact organization	Source name
Theme keywords	UTM zone number	Contact person	Bibliographic reference
Data set description	Horizontal datum	Contact mailing address	Source scale
Data structure	Ellipsoid	Contact telephone	Creator of source
Data set extent	Coordinate precision	Contact E-mail	Data set history
Transfer format		Custodial liability	
	Metadata reference section		
	Metadata revision date		

the elements listed in Table 6. These elements describe data contents, origin, projection, processing history and a point of contact. Copies of the metadata files can be found in Appendix D.

The metadata elements included in the file were derived from the draft of the spatial metadata standard developed for the National Geospatial Data Clearinghouse by the Federal Geographic Data Committee (FGDC 1992). The draft, revised 23 July 1993, can be obtained over the Internet from the anonymous FTP site *waisqvarsa.er.usgs.gov* (130.11.51.187) using *anonymous* as both the user name and password. The file is located in the *wais/docs* directory and is titled *metadata.893.text*.

DISCUSSION AND RECOMMENDATIONS

The 1990 TIGER / Line data were released in the end of 1993. The TIGER / Line data in the current spatial database are based on the 1:100,000-scale maps and the Census Bureau's 1980 GBF / DIME files and, hence, do not reflect changes since the 1980 Census. These data could be added to the spatial database to provide more recent data.

Disasters involving large geographic areas or large numbers of people necessarily involve multiple government agencies. As has been noted in the publications of the FGDC dealing with a proposed National Spatial Data Infrastructure (NSDI), it is necessary that all agencies collecting data, particularly those collecting data with Federal funding, minimize duplication of data collection efforts, maximize use of the data for multiple purposes, and coordinate to ensure that knowledge of the existing data is widely accessible (NRC 1993). The NSDI is working vigorously to achieve these goals. Considerable effort is being expended by the Corps of Engineers, as well as by other agencies, to assure that responsible actions are being taken in the collection and sharing of flood-related data.

The development of databases for emergency preparedness will aid in response and recovery efforts for other natural and human-induced disasters. For example, a hurricane database, similar to that for the Midwest flooding, is being developed at the RSGISC for coastal counties where hurricane activity has been historically high. Similar databases need to be developed for earthquake prone areas and areas where the potential of human-induced disasters, such as nuclear power plant accidents, is high. These spatial databases will allow rapid response and expand the focus on additional data needs during the recovery stages.

The Landsat and SPOT data are of significant value when they can be obtained, but also have limitations. Specifically, Landsat data were available as frequently as every 8 days when both Landsats 4 and 5 were operational. However, Landsat 4 was on standby status during the 1993 flood. Additionally, both satellites have only passive sensing systems and thus cannot image in the visible or near infrared when it is dark and cannot image through clouds. The ERS-1 SAR has day, night and all-weather capability and revisits every 35 days. Because of its larger swath width, there is enough overlap that images can be obtained every 7 days. However, none of these commercial satellites assures that an image can be obtained within even several days of when it might be required.

The optimal approach to obtaining imagery during emergencies is to use an all-weather, day and night capable system that could be fielded on the short notice required for rapid response. Furthermore, the ideal system should be able to do real-time deconvolution, with processed data delivered either upon landing or telemetered to the ground while in flight. Airborne SAR with low depression angles and an integrated Global Positioning Systems (GPS) for rectification is one such system. During the Midwest flooding, the use of this was evaluated as it was available for overflights during 4 days. However, because of the large area that was flooded, the peak flow occurred over more than 30 days. Additionally, the cost of rapid data processing to meet National Map Standards accuracy for 1:100,000 scale maps

(±167 ft [±50.9 m] for 90% of the points) had a relatively high cost (ca. $200,000). Consequently, it was decided that the use of this system to observe the extensive flooding was not appropriate.

Significant progress has been made in our ability to rapidly acquire data to meet the needs of the emergency responders during a large-scale disaster. Technological advances in computer speeds and peripheral equipment enable much faster production of hard copy maps than has previously been possible. Electronic data transfer permits spatial information to move over data networks and to be brought up on workstations in near-real-time. With communication of lessons learned, increasing cooperation between Federal agencies, an increasingly effective NSDI (providing information about what spatial data are available, where they are, and how to obtain them), and preparedness for areas that are most likely to suffer future disasters, our ability to provide condition maps, maps that result from analysis, and maps showing the results of models (such as the path of contamination plumes from spills of volatile materials) will continue to get better.

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APPENDIX A: IMPORTING THE DIG FILES TO ARC/INFO

The inundation vector data were created by using the Erdas DIGSCRN module to screen digitize the affected areas in the satellite images. The DIGSCRN module outputs vector data to DIG files, which are formatted ASCII files. Each record of the DIG file contains 25 bytes. All records are terminated with a semicolon, except for record 1, to pad each line to 25 bytes. The ARC/INFO GENERATE command is used to import these data to an ARC/INFO coverage. But first the data in the DIG format must be put in the correct format for the GENERATE command. The GENERATE file needs a User-ID number for each line, followed by the series of *x*,*y* coordinate pairs that define the line. The awk program, *dig2gen*, written by Bradley Quayle (CEMRO), was used to put the data in the ARC/INFO GENERATE format:

```
BEGIN {cnt=1}
{
if ($3>0){
  if($2<0){
   print cnt;}
  else {
   print "END";
   cnt=cnt+1;
   print cnt;
   }
 }
else {
 print $1,$2;
 }
}
END {print "END";
  print "END";}
```

The awk program is run with the DIG file as the input and the GENERATE file as the output. At the UNIX prompt, type

```
$ awk -f dig2gen < dig_filename > generate_filename
```

where < and > are UNIX redirect operators. The output file will have the following format:

```
1
1.00,1.00;
2.00,2.00;
END
2
3.00,3.00;
4.00,4.00;
END
.
.
.
END
```

The semicolon comes from the end of the line in the DIG file and will have no effect on the GENERATE command.

To create the ARC/INFO coverage, at the ARC command, type GENERATE followed by the coverage name. The coverage is then created using the LINE subcommand and the AML &RUN directive to load data from the output file from the AWK program (generate_filename).

Arc: **GENERATE FLOOD***
Generate: **LINES**
Enter lines.
Terminate line by entering END at X,Y: prompt.
Terminate input by entering END at ID: prompt.
ID: **&RUN GENERATE_FILENAME**
Generate: **QUIT**
Externalling BND and TIC...
Arc:

* Bold text signifies items that the user must enter. File names are always lowercase.

APPENDIX B: UPDATING FLOOD DATA TO PROPER UTM ZONES

A procedure for clipping the coverages into the proper UTM zones was developed by Jeffery Lane and Shane White, ESRI, Boston, Massachusetts.

For every river that crosses UTM zone boundaries, do the following steps:

1. Under each river directory, make as many directories as UTM zones—either zone 14 and zone 15 or zone 15 and zone 16 for the rivers in this report. These will be the workspaces in which the clipped and reprojected coverages will be stored. Then go into ARC and set the data directory as the workspace.

2. Generate a "fishnet" to be used as a UTM Zone template. Type the following in bold at the appropriate prompt:

Arc: **GENERATE utmtemp1***
Generate: **FISHNET**
Fishnet origin coordinate (x,y): **-120, 0** (120° W long, 0° lat)
Y-axis coordinate (x,y): **-120, 1**
Cell size (width, height): **6, 90** (6° long, 90° lat)
Number of rows, columns: **1, 2**
Generate: **QUIT**

Note: The origin values are for UTM zones 14 and 15. For zones 15 and 16, change the origin to **-96, 0** and **-96, 1**.

3. On this "fishnet," add a vertex at every one minute of latitude and longitude:

Arc: **DENSIFYARC utmtemp1 utmtemp2 [CALC 1 / 60]**

4. Change the polygon labels to represent the zone number:

Arc: **ARCEDIT**
Arcedit: **EDIT utmtemp2 label**
Arcedit: **DRAWENVIRONMENT ARCS LABELS IDS**
Arcedit: **DRAW**
Arcedit: **SELECT**
Point to the feature to be selected.
Enter point (click on the label point (+ sign) of the left polygon. The + and its number should become highlighted)
Arcedit: **CALC $ID = 14** (space on either side of the =)
Arcedit: **DRAW** (the left polygon should now be labeled as 14)
Arcedit: **UNSELECT ALL**
Arcedit: **SELECT**
Same routine for the right polygon, except label as 15 instead
Arcedit: **SAVE**
Arcedit: **QUIT**

5. Build the topology of this polygon:

Arc: **BUILD utmtemp2 POLY**

* Bold text signifies items that the user must enter. File names are always lowercase.

6. Project the template into UTM coordinates. Use the UTM zone that corresponds to the UTM zone of the existing coverages (hydrography, railroads, counties, roads, etc.). For example, the Kansas River data were all in zone 14, so we projected the template to UTM zone 14. Type the following:

Arc: **PROJECT COVER utmtemp2 utmtemp3**
Arc: **INPUT**
Arc: **PROJECTION GEOGRAPHIC**
Arc: **UNITS DD**
Arc: **DATUM NAD83**
Arc: **PARAMETERS**
Arc: **OUTPUT**
Arc: **PROJECTION UTM**
Arc: **UNITS METERS**
Arc: **ZONE 14 (or 15)**
Arc: **DATUM NAD83**
Arc: **PARAMETERS**
Arc: **END**

7. Build the new template:

Arc: **BUILD utmtemp3 POLY**

8. Using the template, split the coverages into their respective UTM zone boundaries. The following example describes the process for the county boundary coverages for zone 14 and 15:

Arc: **SPLIT counties utmtemp3 utmtemp3-id POLY 1**
(replace POLY with LINE for the other coverages - roads, hydro, rail)
Enter the 1st coverage: **../zone14/counties**
Enter item value: **14**
Enter the 2nd coverage: **../zone15/counties_cp** ("cp" means "change projection")
Enter item value: **15**
Enter the 3rd coverage: **END**

Also split BIG and the section box coverages that fall in between UTM zones, but only for the UTM zone that they are in currently:

Arc: **SPLIT c2boxes utmtemp3 utmtemp3-id LINE 1**
Enter the 1st coverage: **../zone14/c2boxes**
Enter item value: **14**
Enter the 3rd coverage: **END**

Note: It is very important to keep the coverage names the same since the AMLs need to call them. The "cp" extension is put on the output coverage name for the coverages in the wrong projection so that you don't have to waste time renaming later. This will be clearer after the next step.

9. Set the workspace to the zone directory that contains the coverages that need to be re-projected. Following the Kansas River example, the coverages in the **zone15** directory had to be projected into UTM zone 15:

Arc: **W ../zone15**
Arc: **PROJECT COVER counties_cp counties**
Arc: **OUTPUT**
Arc: **PROJECTION UTM**

Arc: **UNIT METERS**
Arc: **ZONE 15**
Arc: **DATUM NAD83**
Arc: **PARAMETERS**
Arc: **END**

10. After projecting all of the coverages into their proper zone, grid lines must be made for the new UTM zone. Go back to the data workspace (**W ../data**). First, make a template of just the new UTM zone (e.g., for Kansas River, it was zone 15) using the existing two UTM zone templates:

Arc: **ARCEDIT**
Arcedit: **CREATE utmtemp4 utmtemp3**
Arcedit: **DRAWE ARCS**
Arcedit: **EDITF ARCS**
Arcedit: **GET utmtemp3**
Arcedit: **SELECT MANY**
(Select all of the arcs that are in the zone that are not needed)
Arcedit: **DELETE**
Arcedit: **EDITF LABEL**
Arcedit: **ADD**
Arcedit: **SAVE**
Arcedit: **QUIT**
Arc: **BUILD utmtemp4 POLY**
Arc: **PROJECT COVER utmtemp4 ../zone15/utmtemp15**
Project: **OUTPUT**
Project: **PROJECTION UTM**
Project: **UNIT METERS**
Project: **ZONE 15**
Project: **DATUM NAD27**
Project: **PARAMETERS**
Project: **END**

11. There are five sets of grids that need to be generated. Three of them will be the new GRID50, GRID10 and GRID5 coverages. The fourth will be the new 100K grid (BIG) and the last will make up the 20K section boxes (e.g., C2BOXES and E2BOXES for the Kansas River). First, go back to the new UTM zone workspace (let's stick to zone 15 for the example: **W ../zone15**). Then type **DESCRIBE utmtemp15**. Find the "xmin," "xmax," and "ymax" values for the coverage. Jot these numbers down someplace and keep them handy.

12. When generating the fishnets, set the x-values of the origin to be the "xmin" value, truncated by the closest multiple of the unit size of the grid. *Example*: If the xmin value is 166338, then, for the 100K grid (BIG), the origin values would be 100000,0 and 100000,1; for GRID50, 150000,0 and 150000,1; etc. To generate a 100K grid, with boundary coordinates (166338,0), (866237,9993455):

Arc: **GENERATE big**
Generate: **GRID**
Fishnet origin coordinate (x,y): **100000,0**
Y-axis coordinate (x,y): **100000,1**
Cell size (width, height): **100000,100000**
Number of rows, columns: **99,8**
Generate: **QUIT**

To generate the 50K grid:

Arc: **GENERATE grid50**
Generate: **GRID**
Fishnet origin coordinate (x,y): **150000,0**
Y-axis coordinate (x,y): **150000,1**
Cell size (width, height): **50000,50000**
Number of rows, columns: **198,16**
Generate: **QUIT**

Use the same logic to create all five grids. For the 20K box grid, give it a coverage name such as **section20**. The individual section group coverages (i.e., c2boxes, e2boxes, etc.) will be constructed later.

13. Build all of the new grids (**BUILD <cover> LINE)**. If **CLEAN** is required, use a fuzzy tolerance of 1 (**CLEAN <cover> # # 1 LINE**).

14. The new GRID50, GRID10 and GRID5 do not require any further editing. However, since BIG and SECTION20 are sets of boxes (not grid line), the extraneous lines need to be deleted. Using BIG as the example:

Arc: **ARCEDIT**
Arcedit: **EDITC BIG**
Arcedit: **DRAWE ARCS**
Arcedit: **BACKCOV counties 2** (Use counties as a reference)
Arcedit: **BACKE ARCS**
Arcedit: **EDITF ARC**
Arcedit: **SELECT MANY** (Select the arcs that are to be kept)
Arcedit: **NSELECT**
Arcedit: **DELETE**
Arcedit: **SAVE**
Arcedit: **QUIT**
Arc: **BUILD BIG LINE**

For the section boxes, it is very likely that there are different groups (e.g., for the Kansas River, UTM zone 15 had C2BOXES and E2BOXES for groups C2 and E2). Use the same steps to select and delete the extra lines then, instead of saving and quitting, type the following:

Arcedit **SELECT MANY** (select arcs of the boxes of one group, i.e., C2)
Arcedit **PUT <cover>**

Then **QUIT** and **BUILD** (**CLEAN** if necessary) each of the new coverages. *Note*: Since the data coverages had to be reprojected, BIG and the section box coverages will *not* appear to be in the same place that they were when the coverages were forced into one zone since distortion has been corrected. This will be especially apparent for the section boxes and it is possible that a different number of boxes may now cover the same areas along the river.

15. Copy all of the annotation coverages from the **agrc/anno** directory into their proper zone directories (e.g., for the Kansas River, the A2 section annotations were put into **zone14**, the E2 section annotations into **zone15**, etc.). The annotation coverages for the new UTM zone must be reprojected (use **PROJECT**) and rebuilt (use **BUILD** with **LINE** option).

16. Copy all of the AMLs from the **../kansas/agrc/aml** directory into the **agrc/aml** directory of the river being updated. These have been edited to deal with different UTM zones. Most of the old AMLs can be deleted, but be sure to record what each one is referencing because some changes will

be necessary in the new code. *Things to think about*: Some of the menu AMLs will have to be copied (e.g., **DRW_5KC.MENU**) to make two menus that are referenced by their zone (e.g., **DRW_5KC14.MENU** and **DRW_5KC15.MENU**); most of the mapextent commands are hard coded, so anything in a new UTM zone will be changed.

APPENDIX C: EXPORTING DATA FILES IN THE DLG-3 OPTIONAL DISTRIBUTION FORMAT

A procedure for saving attribute information when converting from ARC to DLG format was developed. The following "cookbook" was written by Elke Ochs.

The procedure is used for saving CFCC information for the roads, rail and hydro coverages and county name information for the counties coverage. Integer codes, with a maximum width of 6, must be developed for the attribute values and assigned to item pairs named "major1" and "minor1," "major2" and "minor2," etc. Documentation of the developed codes (e.g., in a text file) must be provided with the DLG file.

To save the CFCC item information for the roads, hydro and rail coverages, the two digit integer segment of the CFCC value was assigned to the major1 item. To save county name information, the record number or coverage-id value was assigned to major1.

Roads, hydro and rail coverages

1. Make a copy of the coverage upon which to do the additions (the roads coverage will be used as the example):

Arc: **copy roads rd_for_dlg** *

2. Add the major1 and minor1 items to the copied coverage and initialize them with values that will not be confused with the integer code values to be assigned later (in case CFCC information is missing for some records):

Arcedit: **edit rd_for_dlg arc**
Arcedit: **additem major1 6 6 I**
Arcedit: **additem minor1 6 6 I**
Arcedit: **select all**
Arcedit: **calc major1 = -99999**
Arcedit: **calc minor1 = -99999**
Arcedit: **save**

3. Determine all the CFCC occurrences in the coverage attribute table:

Arc: **frequency roads.aat roads_cfcc.frq**
Enter Frequency item names (type END or a blank line when done):
Enter the 1st item: **cfcc**
Enter the 2nd item: **end**
Enter Summary item names (type END or a blank line when done):
Enter the 1st item: **end**

The frequency file (*.frq) generated will be modified for use as a lookup table to aid in assigning major1 values to the coverage. (Only the major1 item was used for coding the CFCC information.)

4. Add the major1 item to the frequency file:

Arcedit: **edit roads_cfcc.frq info**
Arcedit: **additem major1 6 6 I**
Arcedit: **save**

* Bold text signifies items that the user must enter. File names are always lowercase.

5. Assign the two integer segment of the CFCC to the major1 item of each record in the modified frequency file:

Arc: **info**
ENTER USER NAME> **ARC**
ENTER COMMAND> **SELECT ROADS.FRQ**
ENTER COMMAND> **UPDATE**
RECNO?> **1**
CASE# = 1
FREQUENCY = 5678 (this value and the cfcc code are examples)
CFCC = A01
MAJOR1 = 0
?> **MAJOR1 = 01** (there must be a space on either side of the =)
?> **<cr>** (carriage return)
RECNO?> **2**
CASE# = 2
FREQUENCY = 456
CFCC = A12
MAJOR1 = 0
?> **MAJOR1 = 12**
?> **<cr>**

Proceed through the remainder of the records until all CFCC occurrences have a major1 value associated with them. After the last record:

RECNO?> **<cr>**
ENTER COMMAND> **LIST** (to check the file. The major1 values beginning with a zero will only be saved as the second digit. It is assumed the user of the DLG file will be able to interpret the single digit value as being preceded by a zero.)
ENTER COMMAND> **Q STOP**

6. Use the modified .frq file as a lookup table to assign a major1 value to each record in the coverage according to its CFCC item value:

Arcedit: **edit rd_for_dlg arc**
Arcedit: **select all**
Arcedit: **lookup major1 major1 roads_cfcc.frq cfcc**
Arcedit: **save**

7. To check the results, another “frequency” can be executed to determine the combinations of both the CFCC and the major1 items. There must be a 1:1 correspondence:

Arc: **frequency rd_for_dlg.aat rd_check.frq**
Enter Frequency item names (type END or a blank line when done):
Enter the 1st item: **cfcc**
Enter the 2nd item: **major1**
Enter the 3rd item: **end**
Enter Summary item names (type END or a blank line when done):
Enter the 1st item: **end**
Arc: **list rd_check.frq**

8. Create a text file describing the contents of the major1 item (or add to the metadata file).

9. To convert the feature to DLG-3 optional format:

Arc: **arcdlg rd_for_dlg roads.dlg**

10. To ensure that the attribute information was saved:

Arc: **dlgarc optional roads.dlg rd_from_dlg**
Arc: **list rd_from_dlg.acode**

Counties coverage

1. Make a copy of the coverage upon which to do the additions:

Arc: **copy counties cos_for_dlg**

2. Add the major1 and minor1 items to the coverage:

Arcedit: **edit cos_for_dlg poly**
Arcedit: **additem major1 6 6 I**
Arcedit: **additem minor1 6 6 I**
Arcedit: **save**

3. Determine an identifying number (record # or coverage-id #) for each county:

Arcplot: **mape cos_for_dlg**
Arcplot: **polys cos_for_dlg**
Arcplot: **labeltext cos_for_dlg $recno** (for record #)
Arcplot: **labeltext cos_for_dlg cos_for_dlg-id** (for id #)

4. Assign the identifying number to the major1 item in the coverage:

Arc: **info**
ENTER USER NAME> **ARC**
ENTER COMMAND> **SELECT COS_FOR_DLG.PAT**
ENTER COMMAND> **CALCULATE MAJOR1 = $RECNO**
ENTER COMMAND> **LIST** (to check the file)
ENTER COMMAND> **Q STOP**

5. Create a text file containing the county names with their identifying numbers (or add to the metadata file).

6. To convert the coverage to DLG-3 Optional format:

Arc: **arcdlg cos_for_dlg counties.dlg**

APPENDIX D: METADATA

DLG-3 optional distribution format metadata files

Des Moines River UTM zone 15
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data - Des Moines River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries for the counties along the Des Moines River extending southeastward from Boone to Lee County, IA. All data was derived from the 1990 TIGER/Line Census Files, 1:100000 scale, produced and distributed by the Bureau of the Census (1991).
Data_Structure: Vector
Data_Set_Extent: Iowa - Boone, Dallas, Polk, Warren, Marion, Mahaska, Wapello, Davis, Van Buren, Lee Counties
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 15
Horizontal_Datum: NAD 83
Ellipsoid: GRS 80
Coordinate_Precision: Single
Transfer_Format: DLG-3 Optional
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source_Name: Tiger/Line Census Files, 1990; Arc coverages for each county were obtained from Tim Rourke, CEMRO
Bibliographic_Reference: Tiger/Line Census Files, 1990, Technical Documentation/prepared by the Bureau of the Census—Washington: The Bureau, 1991
Source_Scale: 100000
Creator_Of_Source: U.S. Department of Commerce, Bureau of the Census
Data_Set_History: 1. Each county's coverages for the features roads, hydrography, railways and county boundaries were projected from the State Plane coordinate system (using the zone or FIPS Zone Code as described in the source coverage) to UTM Zone 15.
2. Polygon topology was built for the county boundary coverages and arc topology for the roads, hydro and rail coverages.
3. Each of the 4 features was appended into a single coverage covering all the counties using the 'poly' and 'all' options for the county boundaries coverage and the 'arc' and 'all' options for the remaining 3 coverages. Polygon topology for the counties coverage was reconstructed using 'clean'.
4. Coverages were converted to DLG-3 Optional format using the 'arcdlg' command. Just prior to conversion, items of type integer titled 'major1' and 'minor1' were added to the coverages to allow conversion of attribute information. Information was encoded into the major1 item only.

For the counties coverage, the integers correspond to county names as follows: 2 = Boone, 3 = Dallas, 4 = Polk, 5 = Warren, 6 = Mahaska, 7 = Marion, 8 = Wapello, 9 = Van Buren, 10 = Davis, 11 = Lee. Integers for the roads, hydro and rail coverages correspond to the number segment of the CFCC classifications described in the TIGER/Line reference mentioned above. Road features are in classification 'A', hydro in 'H' and rail in 'B'.
Metadata_Date: 11/93

Grand River UTM zone 15
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Grand River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries for the counties along the Grand River from Gentry to Saline County, MO. All data was derived from the 1990 TIGER/Line Census Files, 1:100000 scale, produced and distributed by the Bureau of the Census (1991).
Data_Structure: Vector
Data_Set_Extent: Missouri - Carroll, Chariton, Daviess, Gentry, Livingston, Saline Counties
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 15
Horizontal_Datum: NAD83
Ellipsoid: GRS80
Coordinate_Precision: Single
Transfer_Format: DLG-3 Optional
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source_Name: Tiger/Line Census Files, 1990; Arc coverages for each county were obtained from Tim Rourke, CEMRO
Bibliographic_Reference: Tiger/Line Census Files, 1990, Technical ocumentation/prepared by the Bureau of the Census—Washington: The Bureau, 1991
Source_Scale: 100000
Creator_Of_Source: U.S. Department of Commerce, Bureau of the Census
Data_Set_History: 1. Each county's coverages for the features roads, hydrography, railways and county boundaries were projected from the State Plane coordinate system (using the zone or FIPS Zone Code as described in the source coverage) to UTM Zone 15.
2. Polygon topology was built for the county boundary coverages and arc topology for the roads, hydro and rail coverages.
3. Each of the 4 features was appended into a single coverage covering all the counties using the 'poly' and 'all' options for the county boundaries coverage and the 'arc' and 'all' options for the remaining 3 coverages. Polygon topology for the counties coverage was reconstructed using 'clean'.
4. Coverages were converted to DLG-3 Optional format using the 'arcdlg' command. Just prior to conversion, items of type integer titled 'major1' and 'minor1' were added to the coverages to allow conversion of attribute information. Information was encoded into the major1 item only.
For the counties coverage, the integers correspond to county names as follows: 1 = Carroll, 3 = Chariton, 5 = Daviess, 7 = Gentry, 9 = Livingston, 11 = Saline. Integers for the roads, hydro and rail coverages correspond to the number segment of the CFCC classifications described in the TIGER/Line reference mentioned above. Road features are in classification 'A', hydro in 'H' and rail in 'B'.
Metadata_Date: 11/93

Illinois River UTM zone 15
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Illinois River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries along the lower Illinois River.
Data_Structure: Vector
Data_Set_Extent: Illinois - Calhoun, Greene, Jersey, Pike, Scott Counties
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 15
Horizontal_Datum: NAD83
Ellipsoid: GRS80
Coordinate_Precision: Single
Transfer_Format: DLG-3 Optional
Contact_Organization: USACE Remote Sensing / GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability

Roads, Rail, and Hydrography Source Information:
Source_Name: USGS DLG-3; obtained as ARC / INFO coverages from Frank D'Erchia at U.S. Fish & Wildlife Service Environmental Management Technical Center, Onalaska, WI
Bibliographic_Reference: Digital Line Graphs from 1:100,000-Scale Maps, Data Users Guide 2; 1989; United States Dept. of the Interior, US Geological Survey; Reston, VA
Source_Scale: 100000
Creator_Of_Source: U.S. Geological Survey, National Mapping Division

County Boundary Source Information:
Source_Name: USGS. Digital data obtained from USACE Rock Island District in ARC / INFO format, UTM NAD27. Digitized by another source off quad maps.
Bibliographic_Reference: None
Source_Scale: 24000
Creator_Of_Source: U.S. Geological Survey, National Mapping Division

Data_Set_History:
Roads, Hydrography, Railways:
1. Imported by quad, appended and edgematched to obtain final coverage.
2. Projected from NAD27 to NAD83.
3. Converted to DLG-3 using the 'arcdlg' command. Just prior to conversion, items of type integer titled 'major1' and 'minor1' were added to the coverages to allow conversion of attribute information. Information was encoded into the major1 item only. The integers correspond to the number segment of the CFCC classification described in the TIGER / Line reference. Road features are in classification 'A', hydro in 'H' and rail in 'B'.
County Boundaries:
1. Projected from NAD27 to NAD83.
2. Converted to DLG-3 using the arcdlg command. major1 and minor1 items were added as above and the major1 item filled with integers corresponding to the county names as follows: 1 = Pike,
2 = Scott, 3 = Greene, 4 = Calhoun, 5 = Jersey.
Metadata_Date: 11 / 93

Kansas River UTM zone 14
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Kansas River

Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries for the counties along the Kansas River in UTM Zone 14. All data was derived from the 1990 TIGER/Line Census Files, 1:100000 scale, produced and distributed by the Bureau of the Census (1991).
Data_Structure: Vector
Data_Set_Extent: Kansas - Geary, Jackson, Marshall, Nemaha, Pottawatomie, Riley, Shawnee, Wabaunsee Counties
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 14
Horizontal_Datum: NAD 83
Ellipsoid: GRS 80
Coordinate_Precision: Single
Transfer_Format: DLG-3 Optional
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source_Name: Tiger/Line Census Files, 1990; Arc coverages for each county were obtained from Tim Rourke, CEMRO
Bibliographic_Reference: Tiger/Line Census Files, 1990, Technical Documentation/prepared by the Bureau of the Census—Washington: The Bureau, 1991
Source_Scale: 100000
Creator_Of_Source: U.S. Department of Commerce, Bureau of the Census
Data_Set_History: 1. Each county's coverages for the features roads, hydrography, railways and county boundaries were projected from the State Plane coordinate system (using the zone or FIPS Zone Code as described in the source coverage) to UTM Zone 14.
2. Polygon topology was built for the county boundary coverages and arc topology for the roads, hydro and rail coverages.
3. Each of the 4 features was appended into a single coverage covering all the counties using the 'poly' and 'all' options for the county boundaries coverage and the 'arc' and 'all' options for the remaining 3 coverages. Polygon topology for the counties coverage was reconstructed using 'clean'.
4. Coverages were converted to DLG-3 Optional format using the 'arcdlg' command. Just prior to conversion, items of type integer titled 'major1' and 'minor1' were added to the coverages to allow conversion of attribute information. Information was encoded into the major1 item only. For the counties coverage, the integers correspond to county names as follows:
3 = Geary, 5 = Jackson, 13 = Marshall, 15 = Nemaha, 17 = Pottawatomie, 19 = Riley, 21 = Shawnee, 23 = Wabaunsee. Integers for the roads, hydro and rail coverages correspond to the number segment of the CFCC classifications described in the TIGER/Line reference mentioned above. Road features are in classification 'A', hydro in 'H' and rail in 'B'.
Metadata_Date: 11/93

Kansas River UTM zone 15
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Kansas River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries for the counties along the Kansas River in UTM Zone 15. All data was derived from the 1990 TIGER/Line Census Files, 1:100000 scale, produced and distributed by the Bureau of the Census (1991).
Data_Structure: Vector

Data_Set_Extent: Kansas - Douglas, Jackson, Jefferson, Johnson, Leavenworth, Nemaha, Shawnee, Wabaunsee, Wyandotte Counties
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 15
Horizontal_Datum: NAD 83
Ellipsoid: GRS 80
Coordinate_Precision: Single
Transfer_Format: DLG-3 Optional
Contact_Organization: USACE Remote Sensing / GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source_Name: Tiger / Line Census Files, 1990; Arc coverages for each county were obtained from Tim Rourke, CEMRO
Bibliographic_Reference: Tiger / Line Census Files, 1990, Technical Documentation / prepared by the Bureau of the Census—Washington: The Bureau, 1991
Source_Scale: 100000
Creator_Of_Source: U.S. Department of Commerce, Bureau of the Census
Data_Set_History: 1. Each county's coverages for the features roads, hydrography, railways and county boundaries were projected from the State Plane coordinate system (using the zone or FIPS Zone Code as described in the source coverage) to UTM Zone 15.
2. Polygon topology was built for the county boundary coverages and arc topology for the roads, hydro and rail coverages.
3. Each of the 4 features was appended into a single coverage covering all the counties using the 'poly' and 'all' options for the county boundaries coverage and the 'arc' and 'all' options for the remaining 3 coverages. Polygon topology for the counties coverage was reconstructed using 'clean'.
4. Coverages were converted to DLG-3 Optional format using the 'arcdlg' command. Just prior to conversion, items of type integer titled 'major1' and 'minor1' were added to the coverages to allow conversion of attribute information. Information was encoded into the major1 item only.
For the counties coverage, the integers correspond to county names as follows: 1 = Douglas, 5 = Jackson, 7 = Jefferson, 9 = Johnson, 11 = Leavenworth, 15 = Nemaha, 21 = Shawnee, 23 = Wabaunsee, 25 = Wyandotte. Integers for the roads, hydro and rail coverages correspond to the number segment of the CFCC classifications described in the TIGER / Line reference mentioned above. Road features are in classification 'A', hydro in 'H' and rail in 'B'.
Metadata_Date: 11 / 93

Mississippi River UTM zone 15
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Mississippi River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, county boundaries and 1:24000 USGS 7.5 min. quad boundaries along the Mississippi River in UTM Zone 15 (from St. Paul, MN to Ste. Genevieve, MO).
Data_Structure: Vector
Data_Set_Extent: See county and state list below (in Data_Set_History)
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 15
Horizontal_Datum: NAD83
Ellipsoid: GRS80
Coordinate_Precision: Single
Transfer_Format: DLG-3 Optional

Contact_Organization: USACE Remote Sensing / GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability

Roads, Hydrography, and Rail Source Information:
Source_Name: USGS DLG-3, obtained as ARC / INFO coverages from Frank D'Erchia at U.S. Fish & Wildlife Service Environmental Management Technical Center (EMTC), Onalaska, WI
Bibliographic_Reference: Digital Line Graphs from 1:100,000-Scale Maps, Data Users Guide 2; 1989; United States Dept. of the Interior, US Geological Survey; Reston, VA
Source_Scale: 100000
Creator_Of_Source: U.S. Geological Survey, National Mapping Division

County Boundary Source Information:
Source_Name: Unknown
Bibliographic_Reference: None
Source_Scale: 2,000,000

USGS Quad Boundary Source Information:
Source_name: Unknown
Bibliographic_Reference: None
Source_Scale: 24000

Data_Set_History:

Roads, Hydrography, Railways:

1. Imported by quad, appended and edgematched to obtain final coverage (performed at EMTC).
2. Projected from NAD27 to NAD83.
3. Converted to DLG-3 using the 'arcdlg' command. Just prior to conversion, items of type integer titled 'major1' and 'minor1' were added to the coverages to allow conversion of attribute information. Information was encoded into the major1 item only. The integers correspond to the number segment of the CFCC classification described in the TIGER / Line reference. Road features are in classification 'A', hydro in 'H' and rail in 'B'.

County Boundaries:

1. Projected from NAD27 to NAD83.
2. Converted to DLG-3 using the arcdlg command. Major1 and minor1 items were added as above and the major1 item filled with integers corresponding to the county names as follows:

601=Washington MN, 618=St. Croix WI, 629=Ramsey MN, 617=Hennepin MN, 640=Carver MN, 642=Dakota MN, 655=Pierce WI, 665=Scott MN, 681=Pepin WI, 696=Trempealeau WI, 697=Buffalo WI, 679=Goodhue MN, 726=Wabasha MN, 771=Winona MN, 792=La Crosse WI, 836=Houston MN, 857=Vernon WI, 892=Allamakee IA, 904=Crawford WI, 933=Grant WI, 969=Clayton IA, 1036=Dubuque IA, 1065=Jo Daviess IL, 1094=Jackson IA, 1164=Clinton IA, 1216=Rock Island IL, 1219=Scott IA, 1260=Henry IL, 1267=Muscatine IA, 1312=Louisa IA, 1331=Mercer IL, 1394=Henderson IL, 1396=Des Moines IA, 1459=Lee IA, 1468=Fulton IL, 1513=Hancock IL, 1530=Clark MO, 1599=Schuyler IL, 1619=Lewis MO, 1631=Adams IL, 1644=Cass IL, 1654=Brown IL, 1699=Marion MO, 1701=Morgan IL, 1722=Pike IL, 1765=Ralls MO, 1807=Greene IL, 1733=Scott IL, 1795=Pike MO, 1853=Calhoun IL, 1898=Lincoln MO, 1882=Jersey IL, 1968=St. Charles MO, 2012=St. Louis City MO, 1991=St. Louis MO, 2104=Monroe IL,2107=Jefferson MO,2202=Ste. Genevieve MO, 2220=St. Francois MO, 1121=Carroll IL, 1182=Whiteside IL, 1554=Mason IL, 1796=Macoupin IL,

1950=Madison IL, 2052=St. Clair IL, 2170=Randolph IL, 2264=Perry MO
USGS Quad Boundaries:
1. Projected from NAD27 to NAD83.
2. Converted to DLG-3 using the arcdlg command. Quad name information was lost in this step. Names are available on request.
Metadata_Date: 11/93

Mississippi River UTM zone 16
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Mississippi River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, county boundaries and 1:24000 USGS 7.5 min quad boundaries along the Mississippi River in UTM Zone 16 (from Ste. Genevieve, MO to Cairo, IL).
Data_Structure: Vector
Data_Set_Extent: See county and state list below (in Data_Set_History)
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 16
Horizontal_Datum: NAD83
Ellipsoid: GRS80
Coordinate_Precision: Single
Transfer_Format: DLG-3 Optional
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability

Roads, Hydrography, and Rail Source Information:
Source_Name: USGS DLG-3, obtained as ARC/INFO coverages from Frank D'Erchia at U.S. Fish & Wildlife Service Environmental Management Technical Center (EMTC), Onalaska, WI
Bibliographic_Reference: Digital Line Graphs from 1:100,000-Scale Maps, Data Users Guide 2; 1989; United States Dept. of the Interior, US Geological Survey; Reston, VA
Source_Scale: 100000
Creator_Of_Source: U.S. Geological Survey, National Mapping Division

County Boundary Source Information:
Source_Name: Unknown
Bibliographic_Reference: None
Source_Scale: 2,000,000

USGS Quad Boundary Source Information:
Source_name: Unknown
Bibliographic_Reference: None
Source_Scale: 24,000

Data_Set_History:
Roads, Hydrography, Railways:
1. Imported by quad, appended and edgematched to obtain final coverage (performed at EMTC).
2. Projected from NAD27 to NAD83.
3. Converted to DLG-3 using the 'arcdlg' command. Just prior to conversion, items of type

integer titled ‘major1’ and ‘minor1’ were added to the coverages to allow conversion of attribute information. Information was encoded into the major1 item only. The integers correspond to the number segment of the CFCC classification described in the TIGER / Line reference. Road features are in classification ‘A’, hydro in ‘H’ and rail in ‘B’.
County Boundaries:
1. Projected from NAD27 to NAD83.
2. Converted to DLG-3 using the arcdlg command. Major1 and minor1 items were added as above and the major1 item filled with integers corresponding to the county names as follows: 1065 = Jo Daviess IL, 1121 = Carroll IL, 1106 = Cook IL, 1136 = Du Page IL, 1182 = Whiteside IL, 1203 = Will IL, 1206 = Kendall IL, 1197 = Lake IN, 1235 = La Salle IL, 1260 = Henry IL, 1250 = Bureau IL, 1269 = Grundy IL, 1316 = Putnam IL, 1359 = Marshall IL, 1403 = Peoria IL, 1406 = Woodford IL, 1452 = Tazewell IL, 1468 = Fulton IL, 1554 = Mason IL, 1644 = Cass IL, 1701 = Morgan IL, 1796 = Macoupin IL, 1950 = Madison IL, 2052 = St. Clair IL, 2104 = Monroe IL, 2170 = Randolph IL, 2202 = Ste. Genevieve MO, 2240 = Jackson IL, 2264 = Perry MO, 2337 = Cape Girardeau MO, 2326 = Union IL, 2404 = Alexander IL, 2399 = Pulaski IL, 2424 = Scott MO, 2426 = Ballard KY, 2459 = Mississippi MO, 2474 = Carlisle KY
USGS Quad Boundaries:
1. Projected from NAD27 to NAD83.
2. Converted to DLG-3 using the arcdlg command. Quad name information was lost in this step. Names are available on request.
Metadata_Date: 11 / 93

Missouri River UTM zone 14
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Missouri River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries for the counties along the Missouri River in UTM Zone 14. All data was derived from the 1990 TIGER / Line Census Files, 1:100000 scale, produced and distributed by the Bureau of the Census (1991).
Data_Structure: Vector
Data_Set_Extent: Iowa - Harrison, Monona, Pottawattamie, Woodbury Counties Nebraska - Burt, Cass, Dakota, Douglas, Nemaha, Otoe, Richardson, Sarpy, Thurston, Washington Counties
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 14
Horizontal_Datum: NAD 83
Ellipsoid: GRS 80
Coordinate_Precision: Single
Transfer_Format: DLG-3 Optional
Contact_Organization: USACE Remote Sensing / GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source_Name: Tiger / Line Census Files, 1990; Arc coverages for each county were obtained from Tim Rourke, CEMRO
Bibliographic_Reference: Tiger / Line Census Files, 1990, Technical Documentation / prepared by the Bureau of the Census—Washington: The Bureau, 1991
Source_Scale: 100000
Creator_Of_Source: U.S. Department of Commerce, Bureau of the Census
Data_Set_History: 1. Each county’s coverages for the features roads, hydrography, railways and county boundaries were projected from the State Plane coordinate system (using the zone or FIPS Zone Code as described in the source coverage) to UTM Zone 14. Nebraska had to be projected from NAD27 to NAD83 to correspond with the remaining coverages.

2. Polygon topology was built for the county boundary coverages and arc topology for the roads, hydro and rail coverages.
3. Each of the 4 features was appended into a single coverage covering all the counties using the 'poly' and 'all' options for the county boundaries coverage and the 'arc' and 'all' options for the remaining 3 coverages. Polygon topology for the counties coverage was reconstructed using 'clean'.
4. Coverages were converted to DLG-3 Optional format using the 'arcdlg' command. Just prior to conversion, items of type integer titled 'major1' and 'minor1' were added to the coverages to allow conversion of attribute information. Information was encoded into the major1 item only.
For the counties coverage, the integers correspond to county names: NE: 53 = Burt, 55 = Cass, 57 = Dakota, 59 = Douglas, 61 = Nemaha, 63 = Otoe, 65 = Richardson, 67 = Sarpy, 69 = Thurston, 71 = Washington, IA: 83 = Harrison, 87 = Monona, 89 = Pottawattamie, 91 = Woodbury.
Integers for the roads, hydro and rail coverages correspond to the number segment of the CFCC classification described in the TIGER/Line reference. Road features are in classification 'A', hydro in 'H' and rail in 'B'.

Metadata_Date: 11/93

Missouri River UTM zone 15

Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Missouri River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries for the counties along the Missouri River in UTM Zone 15. All data was derived from the 1990 TIGER/Line Census Files, 1:100000 scale, produced and distributed by the Bureau of the Census (1991).
Data_Structure: Vector
Data_Set_Extent: Counties in Iowa, Kansas, Nebraska and Missouri along the Missouri River (see below for list)
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 15
Horizontal_Datum: NAD 83
Ellipsoid: GRS 80
Coordinate_Precision: Single
Transfer_Format: DLG-3 Optional
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source_Name: Tiger/Line Census Files, 1990; Arc coverages for each county were obtained from Tim Rourke, CEMRO
Bibliographic_Reference: Tiger/Line Census Files, 1990, Technical Documentation/prepared by the Bureau of the Census -Washington: The Bureau, 1991
Source_Scale: 100000
Creator_Of_Source: U.S. Department of Commerce, Bureau of the Census
Data_Set_History: 1. Each county's coverages for the features roads, hydrography, railways and county boundaries were projected from the State Plane coordinate system (using the zone or FIPS Zone Code as described in the source coverage) to UTM Zone 14. Nebraska had to be projected from NAD27 to NAD83 to correspond with the remaining coverages.
2. Polygon topology was built for the county boundary coverages and arc topology for the roads, hydro and rail coverages.

3. Each of the 4 features was appended into a single coverage covering all the counties using the 'poly' and 'all' options for the county boundaries coverage and the 'arc' and 'all' options for the remaining 3 coverages. Polygon topology for the counties coverage was reconstructed using 'clean'.

4. Coverages were converted to DLG-3 Optional format using the 'arcdlg' command. Just prior to conversion, items of type integer titled 'major1' and 'minor1' were added to the coverages to allow conversion of attribute information. Information was encoded into the major1 item only.

For the counties coverage, the integers correspond to county names: MO: 1=Andrew, 3=Atchison, 5=Boone, 7=Buchanan, 9=Callaway, 11=Carroll, 13=Chariton, 15=Clay, 17=Cole, 19=Cooper, 21=Franklin, 23=Gasconade, 25=Holt, 27=Howard, 29=Jackson, 31=Lafayette, 33=Moniteau, 35=Montgomery, 37=Osage, 39=Platte, 41=Ray, 43=Saline, 45=St. Charles, 47=St. Louis City, 49=St. Louis, 51=Warren; NE: 55=Cass, 59=Douglas, 61=Nemaha, 63=Otoe, 65=Richardson, 67=Sarpy, 71=Washington; KS: 73=Atchison, 75=Doniphan, 77=Leavenworth, 79=Wyandotte; IA: 81=Fremont, 83=Harrison, 85=Mills, 87=Monona, 89=Pottawattamie, 91=Woodbury.

Integers for the roads, hydro and rail coverages correspond to the number segment of the CFCC classification described in the TIGER/Line reference. Road features are in classification 'A', hydro in 'H' and rail in 'B'.

Metadata_Date: 11/93

Republican River UTM zone 14

Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Republican River

Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation

Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries for the counties along the Republican River extending from Dundy County, NE, to Dickinson County, KS. All data was derived from the 1990 TIGER/Line Census Files, 1:100000 scale, produced and distributed by the Bureau of the Census (1991).

Data_Structure: Vector

Data_Set_Extent: Nebraska - Dundy, Hitchcock, Red Willow, Furnas, Harlan, Franklin, Webster, Nuckolls Counties; Kansas - Jewell, Republic, Cloud, Washington, Clay, Dickinson Counties

Grid_Coordinate_System: Universal Transverse Mercator

UTM_Zone_Number: 14

Horizontal_Datum: NAD 83

Ellipsoid: GRS 80

Coordinate_Precision: Single

Transfer_Format: DLG-3 Optional

Contact_Organization: USACE Remote Sensing/GIS Center

Contact_Person: Dr. Joyce Nagle, Civil Engineer

Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290

Contact_Telephone: (603)646-4100

Contact_Email: nagle@crrel41.crrel.usace.army.mil

Custodial_Liability: Custodian does not assume liability

Source_Name: Tiger/Line Census Files, 1990; Arc coverages for each county were obtained from Tim Rourke, CEMRO

Bibliographic_Reference: Tiger/Line Census Files, 1990, Technical Documentation/prepared by the Bureau of the Census—Washington: The Bureau, 1991

Source_Scale: 100000

Creator_Of_Source: U.S. Department of Commerce, Bureau of the Census

Data_Set_History: 1. Each county's coverages for the features roads, hydrography, railways and county boundaries were projected from the State Plane coordinate system (using the zone or FIPS Zone Code as described in the source coverage) to UTM Zone 14. Nebraska coverages were projected from NAD27 to NAD83 (Kansas coverages were in NAD83). NOTE: The western edge of Dundy county extends approx. 500 ft. into UTM Zone 13. Because the area in

question was so small, projection adjustments were not made. Data in this region will not be accurate.

2. Polygon topology was built for the county boundary coverages and arc topology for the roads, hydro and rail coverages.

3. Each of the 4 features was appended into a single coverage covering all the counties using the 'poly' and 'all' options for the county boundaries coverage and the 'arc' and 'all' options for the remaining 3 coverages. Polygon topology for the counties coverage was reconstructed using 'clean'.

4. Coverages were converted to DLG-3 Optional format using the 'arcdlg' command. Just prior to conversion, items of type integer titled 'major1' and 'minor1' were added to the coverages to allow conversion of attribute information. Information was encoded into the major1 item only. For the counties coverage, the integers correspond to county names as follows: 2 = Dundy, 3 = Hitchcock, 4 = Red Willow, 5 = Furnas, 6 = Nuckolls, 7 = Harlan, 8 = Webster, 9 = Franklin, 10 = Washington, 11 = Republic, 12 = Jewell, 13 = Cloud, 14 = Clay, 15 = Dickinson.

Integers for the roads, hydro and rail coverages correspond to the number segment of the CFCC classification described in the TIGER/Line reference. Road features are in classification 'A', hydro in 'H' and rail in 'B'.

Metadata_Date: 11/93

Commercial satellite derived inundation data

Data_Set_Identity: Midwest Inundation Data Derived from Satellite Imagery

Theme_Keywords: Inundation

Data_Set_Description: This data set contains flood extents for river regions in UTM Zones 14, 15 and 16. Data was digitized from Landsat TM, SPOT Panchromatic, and ERS-1 SAR imagery.

Data_Structure: Vector

Data_Set_Extent:

Zone 14 - Omaha, NE; Sioux City, IA

Zone 15 - Boonville, MO; Burlington, IA; Chester, IL; Davenport, IA; Fulton/Hermann, MO; Omaha, NE; St. Louis, MO; St. Joseph, MO

Zone 16 - Cairo, IL; Chester, IL

Grid_Coordinate_System: Universal Transverse Mercator

UTM_Zone_Numbers: 14,15,16

Horizontal_Datum: NAD 83

Ellipsoid: GRS 1980

Coordinate_Precision: Single

Transfer_Format: DLG-3 Optional

Contact_Organization: USACE Remote Sensing/GIS Center

Contact_Person: Dr. Joyce Nagle, Civil Engineer

Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290

Contact_Telephone: (603) 646-4100

Contact_Email: nagle@crrel41.crrel.usace.army.mil

Custodial_Liability: Custodian does not assume liability

Source: ERS-1 SAR (12.5 m res; 100 km swath width):

AREA	ZONE	DATE	TIME
Omaha, NE	14,15	07-07-93	04:37:14
Burlington, IA	15	07-07-93	16:48:52
Davenport, IA	15	07-07-93	16:48:40
Davenport, IA	15	07-14-93	04:17:11
Sioux City, IA	14	07-26-93	04:40:33
Chester, IL	15,16	08-08-93	16:44:03
Landsat TM (25 m res; 185 km swath width):			
St. Louis, MO	15	07-18-93	16:04
Boonville, MO	15	07-25-93	16:10
Cairo, IL	16	07-27-93	15:58
SPOT Panchromatic (10 m res; 60 km swath width):			
St. Joseph, MO	15	08-02-93	17:26:46
Fulton, MO	15	08-04-93	16:48:15

Creator_Of_Source:
ERS-1 SAR: Radarsat International, Richmond, British Columbia; Rectification was performed separately by Dept. of Geological Sciences Remote Sensing Laboratory, Dartmouth College, Hanover, NH (Omaha, Chester and Sioux City scenes) and by Dept. of Energy Pacific Northwest Laboratory, Richland, WA (remaining scenes).
Landsat TM: Earth Observation Satellite Company (EOSAT), Lanham, MD
SPOT Panchromatic: SPOT Image Corporation, Reston, VA
Data_Set_History: 1. Imagery was rectified using UTM data with the following datums: TM -> NAD27, SAR -> NAD27, SPOT -> WGS84.
2. Vector data was screen digitized and imported to ARC/INFO using 'generate' with the 'line' command.
3. Projections were assigned to each arc coverage using 'projectdefine'. For the purposes of this data set, WGS84 was defined as NAD83.
4. The NAD27 data were transformed to NAD83.
5. The Omaha and Chester coverages were clipped to contain only the region within the UTM Zone to which their images were rectified.
6. Coverages were converted to DLG-3 Optional using 'arcdlg'.
Metadata_Date: 11/93

Military derived inundation data zone 15
Data_Set_Identity: Midwest Inundation Data
Theme_Keywords: Inundation
Data_Set_Description: This data set contains flooded river regions in UTM Zone 15. Data wa digitized from 1:100000-scale maps provided by the U.S. Army Topographic Engineering Center (TEC).
Data_Structure: Vector
Data_Set_Extent: River sections in the following USGS 1:100000-scale maps:
Aledo - Illinois, Iowa
Davenport - Iowa, Illinois
Quincy - Illinois, Missouri
St. Louis - Missouri, Illinois
Festus - Missouri, Illinois
Jerseyville - Illinois, Missouri
Farmington - Missouri, Illinois
Burlington - Iowa, Illinois, Missouri
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 15
Horizontal_Datum: NAD 83
Ellipsoid: GRS 1980
Coordinate_Precision: Single
Transfer_Format: DLG-3 Optional
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603) 646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source: Classified. Data reduced to an unclassified mode and drawn on maps
Source_Scale: 100000
Creator_of_Source: U.S. Army Topographic Engineering Center, Ft. Belvoir, VA
Data_Set_History: 1. Digitized off the 1:100000-scale maps using GRASS 4.0.
2. Exported to ARC/INFO in DLG-3 optional distribution format.
3. Appended using the 'line' and 'all' options.
4. Projected from NAD27 to NAD83.

5. Converted to DLG-3 optional distribution format using 'arcdlg'.
Metadata_Date: 11/93

Military derived inundation data zone 16
Data_Set_Identity: Midwest Inundation Data
Theme_Keywords: Inundation
Data_Set_Description: This data set contains flooded river regions in UTM Zone 16. Data was digitized from 1:100000-scale maps provided by the U.S. Army Topographic Engineering Center (TEC).
Data_Structure: Vector
Data_Set_Extent: River sections in the following USGS 1:100000-scale maps: Cape Girardeau - Missouri, Illinois, Kentucky
Carbondale - Illinois, Missouri
Pinckneyville - Illinois
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 16
Horizontal_Datum: NAD 83
Ellipsoid: GRS 1980
Coordinate_Precision: Single
Transfer_Format: DLG-3 Optional
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603) 646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source: Classified. Data reduced to an unclassified mode and drawn on maps
Source_Scale: 100000
Creator_of_Source: U.S. Army Topographic Engineering Center, Ft. Belvoir, VA
Data_Set_History: 1. Digitized off the 1:100000-scale maps using GRASS 4.0.
2. Exported to ARC/INFO in DLG-3 optional distribution format.
3. Appended using the 'line' and 'all' options.
4. Projected from NAD27 to NAD83.
5. Converted to DLG-3 optional distribution format using 'arcdlg'.
Metadata_Date: 11/93

ARC export format metadata files

Des Moines River UTM zone 15
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data —Des Moines River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries for the counties along the Des Moines River extending southeastward from Boone to Lee County, IA. All data was derived from the 1990 TIGER/Line Census Files, 1:100000 scale, produced and distributed by the Bureau of the Census (1991).
Data_Structure: Vector
Data_Set_Extent: Iowa - Boone, Dallas, Polk, Warren, Marion, Mahaska, Wapello, Davis, Van Buren, Lee Counties
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 15
Horizontal_Datum: NAD 83
Ellipsoid: GRS 80
Coordinate_Precision: Single

Transfer_Format: ARC / INFO Export 6.1
Contact_Organization: USACE Remote Sensing / GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source_Name: Tiger / Line Census Files, 1990; Arc coverages for each county were obtained from Tim Rourke, CEMRO
Bibliographic_Reference: Tiger / Line Census Files, 1990, Technical Documentation / prepared by the Bureau of the Census—Washington: The Bureau, 1991
Source_Scale: 100000
Creator_Of_Source: U.S. Department of Commerce, Bureau of the Census
Data_Set_History: 1. Each county's coverages for the features roads, hydrography, railways and county boundaries were projected from the State Plane coordinate system (using the zone or FIPS Zone Code as described in the source coverage) to UTM Zone 15.
2. Polygon topology was built for the county boundary coverages and arc topology for the roads, hydro and rail coverages.
3. Each of the 4 features was appended into a single coverage covering all the counties using the 'poly' and 'all' options for the county boundaries coverage and the 'arc' and 'all' options for the remaining 3 coverages. Polygon topology for the counties coverage was reconstructed using 'clean'.
4. An item titled 'cnty_name' was added to the counties coverage and filled with the county names.
5. Coverages were exported using the 'none' option for no compression.
Metadata_Date: 11 / 93

Grand River UTM zone 15
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Grand River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries
Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries for the counties along the Grand River from Gentry to Saline County, MO. All data was derived from the 1990 TIGER / Line Census Files, 1:100000 scale, produced and distributed by the Bureau of the Census (1991).
Data_Structure: Vector
Data_Set_Extent: Missouri - Carroll, Chariton, Daviess, Gentry, Livingston, Saline Counties
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 15
Horizontal_Datum: NAD83
Ellipsoid: GRS80
Coordinate_Precision: Single
Transfer_Format: ARC / INFO Export 6.1
Contact_Organization: USACE Remote Sensing / GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source_Name: Tiger / Line Census Files, 1990; Arc coverages for each county were obtained from Tim Rourke, CEMRO
Bibliographic_Reference: Tiger / Line Census Files, 1990, Technical Documentation / prepared by the Bureau of the Census—Washington: The Bureau, 1991
Source_Scale: 100000
Creator_Of_Source: U.S. Department of Commerce, Bureau of the Census

Data_Set_History: 1. Each county's coverages for the features roads, hydrography, railways and county boundaries were projected from the State Plane coordinate system (using the zone or FIPS Zone Code as described in the source coverage) to UTM Zone 15.
2. Polygon topology was built for the county boundary coverages and arc topology for the roads, hydro and rail coverages.
3. Each of the 4 features was appended into a single coverage covering all the counties using the 'poly' and 'all' options for the county boundaries coverage and the 'arc' and 'all' options for the remaining 3 coverages. Polygon topology for the counties coverage was reconstructed using 'clean'.
4. An item titled 'cnty_name' was added to the counties coverage and filled with the county names.
5. Coverages were exported using the 'none' option for no compression.
Metadata_Date: 11/93

Illinois River UTM zone 15
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—llinois River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries along the lower Illinois River.
Data_Structure: Vector
Data_Set_Extent: Illinois - Calhoun, Greene, Jersey, Pike, Scott Counties
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 15
Horizontal_Datum: NAD83
Ellipsoid: GRS80
Coordinate_Precision: Single
Transfer_Format: ARC/INFO Export 6.1
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability

Roads, Rail, and Hydrography Source Information:
Source_Name: USGS DLG-3; obtained as ARC/INFO coverages from Frank D'Erchia at U.S. Fish & Wildlife Service Environmental Management Technical Center, Onalaska, WI
Bibliographic_Reference: Digital Line Graphs from 1:100,000-Scale Maps, Data Users Guide 2; 1989; United States Dept. of the Interior, US Geological Survey; Reston, VA
Source_Scale: 100000
Creator_Of_Source: U.S. Geological Survey, National Mapping Division

County Boundary Source Information:
Source_Name: USGS. Digital data obtained from USACE Rock Island District in ARC/INFO format, UTM NAD27. Digitized by another source off quad maps.
Bibliographic_Reference: None
Source_Scale: 24000
Creator_Of_Source: U.S. Geological Survey, National Mapping Division

Data_Set_History:
Roads, Hydrography, Railways:
1. Imported by quad, appended and edgematched to obtain final coverage.
2. Projected from NAD27 to NAD83.
3. Exported using no compression.

County Boundaries:
1. Projected from NAD27 to NAD83.
2. Exported using no compression.
Metadata_Date: 11/93

Kansas River UTM zone 14
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Kansas River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries for the counties along the Kansas River in UTM Zone 14. All data was derived from the 1990 TIGER/Line Census Files, 1:100000 scale, produced and distributed by the Bureau of the Census (1991).
Data_Structure: Vector
Data_Set_Extent: Kansas - Geary, Jackson, Marshall, Nemaha, Pottawatomie, Riley, Shawnee, Wabaunsee Counties
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 14
Horizontal_Datum: NAD 83
Ellipsoid: GRS 80
Coordinate_Precision: Single
Transfer_Format: ARC/INFO Export 6.1
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source_Name: Tiger/Line Census Files, 1990; Arc coverages for each county were obtained from Tim Rourke, CEMRO
Bibliographic_Reference: Tiger/Line Census Files, 1990, Technical Documentation/prepared by the Bureau of the Census—Washington: The Bureau, 1991
Source_Scale: 100000
Creator_Of_Source: U.S. Department of Commerce, Bureau of the Census
Data_Set_History: 1. Each county's coverages for the features roads, hydrography, railways and county boundaries were projected from the State Plane coordinate system (using the zone or FIPS Zone Code as described in the source coverage) to UTM Zone 14.
2. Polygon topology was built for the county boundary coverages and arc topology for the roads, hydro and rail coverages.
3. Each of the 4 features was appended into a single coverage covering all the counties using the 'poly' and 'all' options for the county boundaries coverage and the 'arc' and 'all' options for the remaining 3 coverages. Polygon topology for the counties coverage was reconstructed using 'clean'.
4. An item titled 'cnty_name' was added to the counties coverage and filled with the county names.
5. Coverages were exported using the 'none' option for no compression.
Metadata_Date: 11/93

Kansas River UTM zone 15
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Kansas River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries for the counties along the Kansas River in UTM Zone 15. All data was derived from the 1990 TIGER/Line Census Files, 1:100000 scale, produced and distributed by the Bureau of the Census (1991).

Data_Structure: Vector
Data_Set_Extent: Kansas - Douglas, Jackson, Jefferson, Johnson, Leavenworth, Nemaha, Shawnee, Wabaunsee, Wyandotte Counties
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 15
Horizontal_Datum: NAD 83
Ellipsoid: GRS 80
Coordinate_Precision: Single
Transfer_Format: ARC/INFO Export 6.1
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source_Name: Tiger/Line Census Files, 1990; Arc coverages for each county were obtained from Tim Rourke, CEMRO
Bibliographic_Reference: Tiger/Line Census Files, 1990, Technical Documentation/prepared by the Bureau of the Census -Washington: The Bureau, 1991
Source_Scale: 100000
Creator_Of_Source: U.S. Department of Commerce, Bureau of the Census
Data_Set_History: 1. Each county's coverages for the features roads, hydrography, railways and county boundaries were projected from the State Plane coordinate system (using the zone or FIPS Zone Code as described in the source coverage) to UTM Zone 15.
2. Polygon topology was built for the county boundary coverages and arc topology for the roads, hydro and rail coverages.
3. Each of the 4 features was appended into a single coverage overing all the counties using the 'poly' and 'all' options or the county boundaries coverage and the 'arc' and 'all' options for the remaining 3 coverages. Polygon topology for the counties coverage was reconstructed using 'clean'.
4. An item titled 'cnty_name' was added to the counties coverage and filled with the county names.
5. Coverages were exported using the 'none' option for no compression.
Metadata_Date: 11/93

Mississippi River UTM zone 15
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Mississippi River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, county boundaries and 1:24000 USGS 7.5 min. quad boundaries along the Mississippi River in UTM Zone 15 (from St. Paul, MN to Ste. Genevieve, MO).
Data_Structure: Vector
Data_Set_Extent: Illinois - Adams, Brown, Calhoun, Carroll, Cass, Fulton, Greene, Hancock, Henderson, Henry, Jersey, Jo Daviess, Macoupin, Madison, Mason, Mercer, Monroe, Morgan, Pike, Randolph, Rock Island, Schuyler, Scott, St. Clair, Whiteside Counties
Iowa - Allamakee, Clayton, Clinton, Des Moines, Dubuque, Jackson, Lee, Louisa, Muscatine, Scott Counties
Minnesota - Carver, Dakota, Goodhue, Hennepin, Houston, Ramsey, Scott, Wabasha, Washington, Winona Counties
Missouri - Clark, Jefferson, Lewis, Lincoln, Marion, Perry, Pike, Ralls, St. Charles, St. Francois, Ste. Genevieve, St. Louis, St. Louis City Counties
Wisconsin - Buffalo, Crawford, Grant, La Crosse, Pepin, Pierce, St. Croix, Trempealeau, Vernon Counties
Grid_Coordinate_System: Universal Transverse Mercator

UTM_Zone_Number: 15
Horizontal_Datum: NAD83
Ellipsoid: GRS80
Coordinate_Precision: Single
Transfer_Format: ARC/INFO Export 6.1
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability

Roads, Hydrography, and Rail Source Information:
Source_Name: USGS DLG-3, obtained as ARC/INFO coverages from Frank D'Erchia at U.S. Fish & Wildlife Service Environmental Management Technical Center (EMTC), Onalaska, WI
Bibliographic_Reference: Digital Line Graphs from 1:100,000-Scale Maps, Data Users Guide 2; 1989; United States Dept. of the Interior, US Geological Survey; Reston, VA
Source_Scale: 100000
Creator_Of_Source: U.S. Geological Survey, National Mapping Division

County Boundary Source Information:
Source_Name: Unknown
Bibliographic_Reference: None
Source_Scale: 2,000,000

USGS Quad Boundary Source Information:
Source_name: Unknown
Bibliographic_Reference: None
Source_Scale: 24000

Data_Set_History:
Roads, Hydrography, Railways:
1. Imported by quad, appended and edgematched to obtain final coverage (performed at EMTC).
2. Projected from NAD27 to NAD83.
3. Exported using no compression.
County Boundaries:
1. Projected from NAD27 to NAD83.
2. Exported using no compression.
USGS Quad Boundaries:
1. Projected from NAD27 to NAD83.
2. Exported using no compression.
Metadata_Date: 11/93

Mississippi River UTM zone 16
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Mississippi River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, county boundaries and 1:24000 USGS 7.5 min quad boundaries along the Mississippi River in UTM Zone 16 (from Ste. Genevieve, MO to Cairo, IL).
Data_Structure: Vector
Data_Set_Extent: Illinois - Alexander, Bureau, Carroll, Cass, Cook, Du Page, Fulton, Grundy, Henry, Jackson, Jo Daviess, Kendall, La Salle, Macoupin, Madison, Marshall, Mason, Mon-

roe, Morgan, Peoria, Pulaski, Putnam, Randolph, St. Clair, Tazewell, Union, Whiteside, Will, Woodford Counties
Kentucky - Ballard, Carlisle Counties
Indiana - Lake County
Missouri - Cape Girardeau, Mississippi, Perry, Scott, Ste. Genevieve Counties
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 16
Horizontal_Datum: NAD83
Ellipsoid: GRS80
Coordinate_Precision: Single
Transfer_Format: ARC/INFO Export 6.1
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability

Roads, Hydrography, and Rail Source Information:
Source_Name: USGS DLG-3, obtained as ARC/INFO coverages from Frank D'Erchia at U.S. Fish & Wildlife Service Environmental Management Technical Center (EMTC), Onalaska, WI
Bibliographic_Reference: Digital Line Graphs from 1:100,000-Scale Maps, Data Users Guide 2; 1989; United States Dept. of the Interior, US Geological Survey; Reston, VA
Source_Scale: 100000
Creator_Of_Source: U.S. Geological Survey, National Mapping Division

County Boundary Source Information:
Source_Name: Unknown
Bibliographic_Reference: None
Source_Scale: 2,000,000

USGS Quad Boundary Source Information:
Source_name: Unknown
Bibliographic_Reference: None
Source_Scale: 24000

Data_Set_History:
Roads, Hydrography, Railways:
1. Imported by quad, appended and edgematched to obtain final coverage (performed at EMTC).
2. Projected from NAD27 to NAD83.
3. Exported using no compression.
County Boundaries:
1. Projected from NAD27 to NAD83.
2. Exported using no compression.
USGS Quad Boundaries:
1. Projected from NAD27 to NAD83.
2. Exported using no compression.
Metadata_Date: 11/93

Missouri River UTM zone 14
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Missouri River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation

Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries for the counties along the Missouri River in UTM Zone 14. All data was derived from the 1990 TIGER/Line Census Files, 1:100000 scale, produced and distributed by the Bureau of the Census (1991).
Data_Structure: Vector
Data_Set_Extent: Iowa - Harrison, Monona, Pottawattamie, Woodbury Counties
Nebraska - Burt, Cass, Dakota, Douglas, Nemaha, Otoe, Richardson, Sarpy, Thurston, Washington Counties
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 14
Horizontal_Datum: NAD 83
Ellipsoid: GRS 80
Coordinate_Precision: Single
Transfer_Format: ARC/INFO Export 6.1
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source_Name: Tiger/Line Census Files, 1990; Arc coverages for each county were obtained from Tim Rourke, CEMRO
Bibliographic_Reference: Tiger/Line Census Files, 1990, Technical Documentation/prepared by the Bureau of the Census—Washington: The Bureau, 1991
Source_Scale: 100000
Creator_Of_Source: U.S. Department of Commerce, Bureau of the Census
Data_Set_History: 1. Each county's coverages for the features roads, hydrography, railways and county boundaries were projected from the State Plane coordinate system (using the zone or FIPS Zone Code as described in the source coverage) to UTM Zone 14. Nebraska had to be projected from NAD27 to NAD83 to correspond with the remaining coverages.
2. Polygon topology was built for the county boundary coverages and arc topology for the roads, hydro and rail coverages.
3. Each of the 4 features was appended into a single coverage covering all the counties using the 'poly' and 'all' options for the county boundaries coverage and the 'arc' and 'all' options for the remaining 3 coverages. Polygon topology for the counties coverage was reconstructed using 'clean'.
4. The item 'cnty_name' was added to the counties coverage and filled with the county names.
5. Coverages were exported using the 'none' option for no compression.
Metadata_Date: 10/93

Missouri River UTM zone 15
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Missouri River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries for the counties along the Missouri River in UTM Zone 15. All data was derived from the 1990 TIGER/Line Census Files, 1:100000 scale, produced and distributed by the Bureau of the Census (1991).
Data_Structure: Vector
Data_Set_Extent: Iowa - Fremont, Harrison, Mills, Monona, Pottawattamie, Woodbury Counties;
Kansas - Atchison, Doniphan, Leavenworth, Wyandotte Counties;
Missouri - Andrew, Atchison, Boone, Buchanan, Callaway, Carroll, Chariton, Clay, Cole, Cooper, Franklin, Gasconade, Holt, Howard, Jackson, Lafayette, Moniteau, Montgomery, Osage, Platte, Ray, Saline, St. Charles, St. Louis City, St. Louis, Warren Counties;
Nebraska - Cass, Douglas, Nemaha, Otoe, Richardson, Sarpy, Washington Counties

Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 15
Horizontal_Datum: NAD 83
Ellipsoid: GRS 80
Coordinate_Precision: Single
Transfer_Format: ARC/INFO Export 6.1
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source_Name: Tiger/Line Census Files, 1990; Arc coverages for each county were obtained from Tim Rourke, CEMRO
Bibliographic_Reference: Tiger/Line Census Files, 1990, Technical Documentation/prepared by the Bureau of the Census—Washington: The Bureau, 1991
Source_Scale: 100000
Creator_Of_Source: U.S. Department of Commerce, Bureau of the Census
Data_Set_History: 1. Each county's coverages for the features roads, hydrography, railways and county boundaries were projected from the State Plane coordinate system (using the zone or FIPS Zone Code as described in the source coverage) to UTM Zone 14. Nebraska had to be projected from NAD27 to NAD83 to correspond with the remaining coverages.
2. Polygon topology was built for the county boundary coverages and arc topology for the roads, hydro and rail coverages.
3. Each of the 4 features was appended into a single coverage covering all the counties using the 'poly' and 'all' options for the county boundaries coverage and the 'arc' and 'all' options for the remaining 3 coverages. Polygon topology for the counties coverage was reconstructed using 'clean'.
4. The item 'cnty_name' was added to the counties coverage and filled with the county names.
5. Coverages were exported using the 'none' option for no compression.
Metadata_Date: 10/93

Republican River UTM zone 14
Data_Set_Identity: 1993 Midwest Flooding Emergency Management Data—Republican River
Theme_Keywords: Roads, Rail, Hydrography, County Boundaries, Inundation
Data_Set_Description: This data set includes the roads, hydrography, railways, and county boundaries for the counties along the Republican River extending from Dundy County, NE, to Dickinson County, KS. All data was derived from the 1990 TIGER/Line Census Files, 1:100000 scale, produced and distributed by the Bureau of the Census (1991).
Data_Structure: Vector
Data_Set_Extent: Nebraska - Dundy, Hitchcock, Red Willow, Furnas, Harlan, Franklin, Webster, Nuckolls Counties; Kansas - Jewell, Republic, Cloud, Washington, Clay, Dickinson Counties
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 14
Horizontal_Datum: NAD 83
Ellipsoid: GRS 80
Coordinate_Precision: Single
Transfer_Format: ARC/INFO Export 6.1
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603)646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil

Custodial_Liability: Custodian does not assume liability
Source_Name: Tiger / Line Census Files, 1990; Arc coverages for each county were obtained from Tim Rourke, CEMRO
Bibliographic_Reference: Tiger / Line Census Files, 1990, Technical Documentation / prepared by the Bureau of the Census -Washington: The Bureau, 1991
Source_Scale: 100000
Creator_Of_Source: U.S. Department of Commerce, Bureau of the Census
Data_Set_History: 1. Each county's coverages for the features roads, hydrography, railways and county boundaries were projected from the State Plane coordinate system (using the zone or FIPS Zone Code as described in the source coverage) to UTM Zone 14. Nebraska coverages were projected from NAD27 to NAD83 (Kansas coverages were in NAD83). NOTE: The western edge of Dundy county extends approx. 500 ft. into UTM Zone 13. Because the area in question was so small, projection adjustments were not made. Data in this region will not be accurate.

2. Polygon topology was built for the county boundary coverages and arc topology for the roads, hydro and rail coverages.

3. Each of the 4 features was appended into a single coverage covering all the counties using the 'poly' and 'all' options for the county boundaries coverage and the 'arc' and 'all' options for the remaining 3 coverages. Polygon topology for the counties coverage was reconstructed using 'clean'.

4. An item titled 'cnty_name' was added to the counties coverage and filled with the county names.

5. Coverages were exported using the 'none' option for no compression.

Metadata_Date: 11 / 93

Commercial satellite derived inundation data
Data_Set_Identity: Midwest Inundation Data Derived from Satellite Imagery
Theme_Keywords: Inundation
Data_Set_Description: This data set contains flood extents for river regions in UTM Zones 14, 15 and 16. Data was digitized from Landsat TM, SPOT Panchromatic, and ERS-1 SAR imagery.
Data_Structure: Vector
Data_Set_Extent:

Zone 14 - Omaha, NE; Sioux City, IA

Zone 15 - Boonville, MO; Burlington, IA; Chester, IL; Davenport, IA; Fulton / Hermann, MO; Omaha, NE; St. Louis, MO; St. Joseph, MO

Zone 16 - Cairo, IL; Chester, IL

Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Numbers: 14,15,16
Horizontal_Datum: NAD 83
Ellipsoid: GRS 1980
Coordinate_Precision: Single
Transfer_Format: ARC / INFO Export 6.1
Contact_Organization: USACE Remote Sensing / GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603) 646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source: ERS-1 SAR (12.5 m res; 100 km swath width):

AREA	ZONE	DATE	TIME
Omaha, NE	14,15	07-07-93	04:37:14
Burlington, IA	15	07-07-93	16:48:52
Davenport, IA	15	07-07-93	16:48:40
Davenport, IA	15	07-14-93	04:17:11
Sioux City, IA	14	07-26-93	04:40:33

Chester, IL 15,16 08-08-93 16:44:03
Landsat TM (25 m res; 185 km swath width):
St. Louis, MO 15 07-18-93 16:04
Boonville, MO 15 07-25-93 16:10
Cairo, IL 16 07-27-93 15:58
SPOT Panchromatic (10 m res; 60 km swath width):
St. Joseph, MO 15 08-02-93 17:26:46
Fulton, MO 15 08-04-93 16:48:15

Creator_Of_Source:
ERS-1 SAR: Radarsat International, Richmond, British Columbia; Rectification was performed separately by Dept. of Geological Sciences Remote Sensing Laboratory, Dartmouth College, Hanover, NH (Omaha, Chester and Sioux City scenes) and by Dept. of Energy Pacific Northwest Laboratory, Richland, WA (remaining scenes). Landsat TM: Earth Observation Satellite Company (EOSAT), Lanham, MD SPOT Panchromatic: SPOT Image Corporation, Reston, VA

Data_Set_History: 1. Imagery was rectified using UTM data with the following datums: TM -> NAD27, SAR -> NAD27, SPOT -> WGS84.
2. Vector data was screen digitized and imported to ARC/INFO using 'generate' with the 'line' command.
3. Projections were assigned to each arc coverage using 'projectdefine'. For the purposes of this data set, WGS84 was defined as NAD83.
4. The NAD27 data were transformed to NAD83.
5. The Omaha and Chester coverages were clipped to contain only the region within the UTM Zone to which their images were rectified.
6. Coverages were exported using no compression.

Metadata_Date: 11/93

Military derived inundation data zone 15

Data_Set_Identity: Midwest Inundation Data
Theme_Keywords: Inundation
Data_Set_Description: This data set contains flooded river regions in UTM Zone 15. Data was digitized from 1:100000-scale maps provided by the U.S. Army Topographic Engineering Center (TEC).
Data_Structure: Vector
Data_Set_Extent: River sections in the following USGS 1:100000-scale maps:
Aledo - Illinois, Iowa
Davenport - Iowa, Illinois
Quincy - Illinois, Missouri
St. Louis - Missouri, Illinois
Festus - Missouri, Illinois
Jerseyville - Illinois, Missouri
Farmington - Missouri, Illinois
Burlington - Iowa, Illinois, Missouri
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 15
Horizontal_Datum: NAD 83
Ellipsoid: GRS 1980
Coordinate_Precision: Single
Transfer_Format: ARC/INFO Export 6.1
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603) 646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability

Source: Classified. Data reduced to an unclassified mode and drawn on maps
Source_Scale: 100000
Creator_of_Source: U.S. Army Topographic Engineering Center, Ft. Belvoir, VA
Data_Set_History: 1. Digitized off the 1:100000-scale maps using GRASS 4.0.
2. Exported to ARC/INFO in DLG-3 optional distribution format.
3. Appended using the 'line' and 'all' options.
4. Projected from NAD27 to NAD83.
5. Exported using no compression.
Metadata_Date: 11/93

Military derived inundation data zone 16
Data_Set_Identity: Midwest Inundation Data
Theme_Keywords: Inundation
Data_Set_Description: This data set contains flooded river regions in UTM Zone 16. Data was digitized from 1:100000-scale maps provided by the U.S. Army Topographic Engineering Center (TEC).
Data_Structure: Vector
Data_Set_Extent: River sections in the following USGS 1:100000-scale maps:
Cape Girardeau - Missouri, Illinois, Kentucky
Carbondale - Illinois, Missouri
Pinckneyville - Illinois
Grid_Coordinate_System: Universal Transverse Mercator
UTM_Zone_Number: 16
Horizontal_Datum: NAD 83
Ellipsoid: GRS 1980
Coordinate_Precision: Single
Transfer_Format: ARC/INFO Export 6.1
Contact_Organization: USACE Remote Sensing/GIS Center
Contact_Person: Dr. Joyce Nagle, Civil Engineer
Contact_Mailing_Address: 72 Lyme Road, Hanover, NH 03755-1290
Contact_Telephone: (603) 646-4100
Contact_Email: nagle@crrel41.crrel.usace.army.mil
Custodial_Liability: Custodian does not assume liability
Source: Classified. Data reduced to an unclassified mode and drawn on maps
Source_Scale: 100000
Creator_of_Source: U.S. Army Topographic Engineering Center, Ft. Belvoir, VA
Data_Set_History: 1. Digitized off the 1:100000-scale maps using GRASS 4.0.
2. Exported to ARC/INFO in DLG-3 optional distribution format.
3. Appended using the 'line' and 'all' options.
4. Projected from NAD27 to NAD83.
5. Exported using no compression.
Metadata_Date: 11/93

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Development and Application of a Spatial Database for Emergency Management Operations: 1993 Midwest Flood

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6. AUTHORS
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For conversion of SI units to non-SI units of measurement consult *Standard Practice for Use of the International System of Units (SI)*, ASTM Standard E380-93, published by the American Society for Testing and Materials, 1916 Race St., Philadelphia, Pa. 19103.

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

Available from NTIS, Springfield, Virginia 22161.

12b. DISTRIBUTION CODE

13. ABSTRACT (*Maximum 200 words*)

During natural and man-made emergencies, there is a need for the rapid development of spatial databases to support recovery efforts. A spatial database was developed to support the U.S. Army Corps of Engineers Disaster Field Offices during the flooding that took place in the Midwest during the summer of 1993. The spatial database contains roads, railroads, hydrography, county boundaries and inundation data for seven rivers located in the Mississippi River basin. The spatial data came from a variety of sources, including U.S. Census Bureau TIGER/Line files, U.S. Geological Survey Digital Line Graphs and satellite imagery. An application of the spatial database is also described. Maps were produced showing roads, railways, hydrography, county boundaries and, when available, inundation data. These maps were then distributed to assist in the recovery efforts and future planning.

14. SUBJECT TERMS
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