Map MODERNIZATION

Federal Emergency Management Agency

FEMA's Flood Hazard Mapping Program

Guidelines and Specifications *for* Flood Hazard Mapping Partners

Appendix N: Data Capture Standards

FEDERAL EMERGENCY MANAGEMENT AGENCY

www.fema.gov/fhm/dl_cgs.shtm

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April 2004

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Appendix N

Submittal Standards For Mapping Partners

N.1 Overview

N.1.1 Introduction

The purpose of the Data Capture Standards (DCS) is to provide a consistent framework for collection, analyses, storage and retrieval of the data needed for a flood insurance study or Flood Insurance Rate Map (FIRM) revision. By providing this framework, the intention is to make the study assessment process more efficient; make the data more available for future use; and preserve the investment made in the data. It is part of a five-year plan to collect and provide data to the Management Information Portal for sharing through the data federation

For those contractors that use the engineering and mapping tools provided by the National Service Provider (NSP), the required data will be automatically archived in the recommended format. In the case of contractors who have developed other automated processes for performing production style flood mapping, these data standards serve as the mechanism for collecting and archiving the required data. .

These data standards are the vehicles used to help collect and manage the engineering deliverables that result from the flood insurance study process. The DCS also facilitate the building of an Enhanced Digital FIRM (DFIRM) database by providing information that is needed in manageable pieces during the progression of the mapping process. The DCS will also support queries to the Management Information Portal that will track and evaluate progress metrics on studies and report these metrics to the process stakeholders.

The data standards are provided in sections. Each section corresponds to major engineering data capture points and includes guidance on collecting Terrain, Survey, Hydrology, and Hydraulics data. These sections describe the minimum data set of deliverables established by FEMA and the NSP for floodplain mapping submittals. These data standards will serve in addition to the Technical Support Data Notebook and other standards detailed in other specifications.

[April 2004]

N.1.1.1 Terrain

The Terrain section describes what is needed for capture of the digital topography data that were used to create the elevation data representing the terrain environment of a watershed and/or floodplain. It allows for flexibility in the types of information provided while describing in detail the specifics of the deliverables. Once this type of data is provided, the NSP will be able to account for the origins of the flood study elevation data. Appendix A, *Guidance for Aerial Mapping and Surveying*, is still required to define the quality of the topographic data used.

[April 2004]

N.1.1.2 Survey

The Survey section describes those spatial data sets and data tables necessary to digitally represent data collected in the survey phase of the flood insurance study. The survey phase has traditionally been one of the most expensive portions of the study. These standards describe how the survey data should be submitted for features such as dams, culverts, bridges, and channels.

In an effort to aid the mapping partner in disseminating the data requirements to field surveyors, FEMA has prepared *Data Capture Guidelines* for survey data. This manual will guide surveyors in collecting the type of information the engineer requires to create a digital representation of a floodplain hydraulic structure. The *Data Capture Guidelines* are considered "guidelines" because they describe how to collect data and are not required data submittal. The tables in the Survey section of the DCS serve the purpose of archiving the data needed for the application of hydraulic models.

[April 2004]

N.1.1.3 Hydrology

The Hydrology section describes those spatial data sets and data tables necessary for documenting the hydrologic procedures for estimating flood discharges for the flood insurance study. The goal of this section is to describe the format and type of hydrologic data expected by FEMA for new riverine flood insurance studies. The objective is to archive the hydrologic data in a database so that these data can be revised and used with minimum effort in future flood insurance studies or map revisions. Another objective is to collect sufficient data on hydrologic procedures to populate the Enhanced DFRIM database.

The minimum required data set for documenting the hydrologic procedures is described in this section of the data standards. This minimum requirement includes input and output files for all hydrologic models and spatial data sets that are needed to implement the models. Because of the frequent use of hydrologic models such as HEC-1 and HEC-HMS that utilize a design storm event and the Natural Resources Conservation Service hydrologic procedures and regional regression equations, more detailed data are requested to describe these methodologies. Detailed information on continuous simulation models like HSPF, SWMM and MIKE 11 RR are not required but the input and output files and supporting spatial data files are archived. As metrics are collected on the types of hydrologic models used most frequently by mapping partners, additional tables will be added in the future to capture these data in more detail.

[April 2004]

N.1.1.4 Hydraulics

The development of a hydraulic model to provide water surface elevations for floodplain mapping requires a significant investment in time and resources to obtain and process topographic survey data including cross section and bridge surveys. Recent developments in digital terrain and geospatial database management technology make it possible to protect this investment for existing and future projects to a much greater extent than was possible in the past.

This section describes the format and type of hydraulic data to be provided to FEMA for new riverine flood insurance studies.

The minimum required data set for documenting the hydraulic procedures is described in this section of the data standards. This minimum requirement includes input and output files for all hydraulic models and spatial data sets that are needed to implement the models. As with hydrology, there is a focus on HEC hydraulic models such as HEC-2 and HEC-RAS due to their frequency of use and the intent is to capture the data required to populate the Enhanced DFIRM database. Detailed information on 1- and 2-D unsteady flow models like FEQ, ICPR, FLO-2D, and MIKE 11 HD are not required but the input and output files and supporting spatial data files are archived. As metrics are collected on the frequency of use of hydraulic models, additional tables will be added to capture the data from these models in a true database format.

[April 2004]

N.1.1.5 DCS Updates

It is the intention of the NSP to provide yearly management reports as a part of the data standards process. These reports will detail metrics collected on study types, and other key study factors associated with flood mapping. Coastal data are currently not included in the data standards. Methodologies for coastal studies are presently being reviewed and developed. Once this process is complete, detailed coastal data as dictated by the study process would be included in the data standards. Other more specialized flow regimes and processes (for example alluvial fans, closed system pipe flow and interconnected pond hydraulics) will also be evaluated for inclusion in the data standards. These updates will be done on a yearly basis.

[April 2004]

N.1.2 Submittal Information

The Submittal_Info table is a database table. This table holds essential information about the FEMA Case, datums and projections, and location of metadata and study related zipfiles. This table is submitted along with the data given in the four specifications to describe who collected the data and where the data are coming from.

The Submittal_Info table contains the following attributes:

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Table N-1. Submittal_Info Table

Field	Type	Length	Required?	Description
SubInfoID	Long		Yes	Primary key for this table.
CASE_NO	Text	12	Yes	FEMA Case Number for study.
CASE_DESC	Text	254	Yes	General description of the study.
CASE_ZIP	Text	254	No	Full filename and path of Case zipfile that contains engineering support data associated with the case.
EFF_DATE	Date	8	Yes	Effective date of the case.
STUDY_PRE	Text	20	No	Study prefix, i.e. “City of”
STUDY_NM	Text	50	Yes	Study name
STATE_NM	Text	50	Yes	State name
CNTY_NM	Text	50	Yes	County name
JURIS_TYP	Text	50	No	Political jurisdiction type
LG_PAN_NO	Long		Yes	Largest panel number
OPP_TF	Boolean		Yes	Only panel printed?
H_DATUM	Text	10	Yes	Horizontal datum. Valid Entries include “NAD27” or “NAD83”
V_DATM_LID	Text	11	Yes	Vertical datum lookup identification (see Appendix L)
PROJECTION	Text	50	Yes	Map projection used for the hardcopy FIRM publication.
PROJ_ZONE	Text	10	No	Projection zone
CW_TF	Boolean		Yes	Countywide?
CBRS_PHONE	Text	15	No	Coastal Barrier Resources System (CBRS) Phone number
CBRS_REG	Text	1	No	CBRS Coordinator’s region
RTROFT_TF	Boolean		Yes	Retrofit?
META_NM	Text	50	Yes	Metadata filename
STUDY_ZIP	Text	254	No	Full path and filename to zipped file that contains the FIS report or auxiliary data that is relevant to the entire study.
SUBMIT_BY	Text	100	Yes	Company name of Mapping Partner who is submitting this dataset.
SUBMIT_CON	Text	100	Yes	Contact person for this submittal
SUBMIT_PHO	Text	15	Yes	Phone number of Mapping Partner
Restricted	Boolean		Yes	Some data in this submittal can’t be distributed freely. See the metadata file.

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N.1.3 Future Vision

This document presents an interim solution to enable data capture in the short term. The long-term objective is to adopt an approach to data exchange that is open and vendor independent. This release of the standards mandates specific file naming and folder structure. In upcoming versions, the plan is to require a metadata file (read me file) that describes file names and their location in the folder structure of the submittal. This will enable Coordinating Technical Partners (CTPs) to submit data without restrictions on file naming and folder structure.

The vision of FEMA is to establish an Interoperable Framework for Open Data Exchange Standards (OpenDES) that enables the full potential of its information holdings in all mission areas. This framework will consist of common information models and tools for data sharing and exchange based on adopted information technology standards such as: OGC/ISO Geography Markup Language (GML), FGDC/ISO Metadata, and W3C Web Service technologies such as eXtensible Markup Language (XML) and Simple Object Access Protocol (SOAP).

The objectives of this open standards-based approach are to:

- Eliminate interoperability barriers to sharing hazard resources managed by different organizations using different technologies;
- Enable CTPs and Indefinite Delivery Indefinite Quantity (IDIQ) contractors to share and exchange data irrespective of their underlying technologies;
- Define secure and robust formats for data capture and exchange for use across multiple platforms, applications and devices;
- Realize the full integration of resources with Web enabled technologies;
- Deploy the framework to enhance processes and tools for hazard data production, management and dissemination; and
- Leverage related private, local, state, federal and international initiatives, such as:
    - E-Government (e.g. Geospatial One-Stop, DHS, FGDC NSDI, etc) and
    - Industry-driven standards consortia that rapidly seed the market with certified Standards-based Commercial Off The Shelf (SCOTS) products and tools.

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N.2 Terrain Submittal Standards

N.2.1 Overview

The goal of this section is to describe the format and type of terrain data expected by FEMA for new flood insurance studies. The Mapping Partner should refer to Appendix A for guidance on terrain data production.

There is a broad range of methods that Mapping Partners can use to gather terrain data and extract useful information for hydraulic and hydrologic models. The simplest method, but least accurate, is to use hardcopy USGS quadrangles with contours and streams. Using an engineering scale, planimeter and map wheel, cross section geometries and basin areas can be calculated. The main disadvantage to this technique is that the underlying terrain data is not captured in a digital format for potential future use.

Other Mapping Partners may have aerial photography performed and receive contours digitally. This data is useful for automating many hydraulic and hydrologic computations. Its main disadvantage is that the contour maps leave out the details of what is happening in between adjacent contours. This is especially troublesome in coastal areas.

The best type of terrain data is based on 3-d spot elevations and 3-d breaklines. There are many commercial software packages that can use this type of data to create Triangular Irregular Networks (TINs). A TIN is the most precise approximation of the earth's surface, but it is also the most costly in terms of storage size. A TIN can be used to create digital elevation models (DEMs) that are evenly spaced elevations. DEMs are useful for hydrologic analysis and for generating approximate flood boundaries rapidly, however they are still approximations of a better data source (just like contours), and should only be used when necessary.

The rest of this section will explain the data requirements for a terrain submittal.

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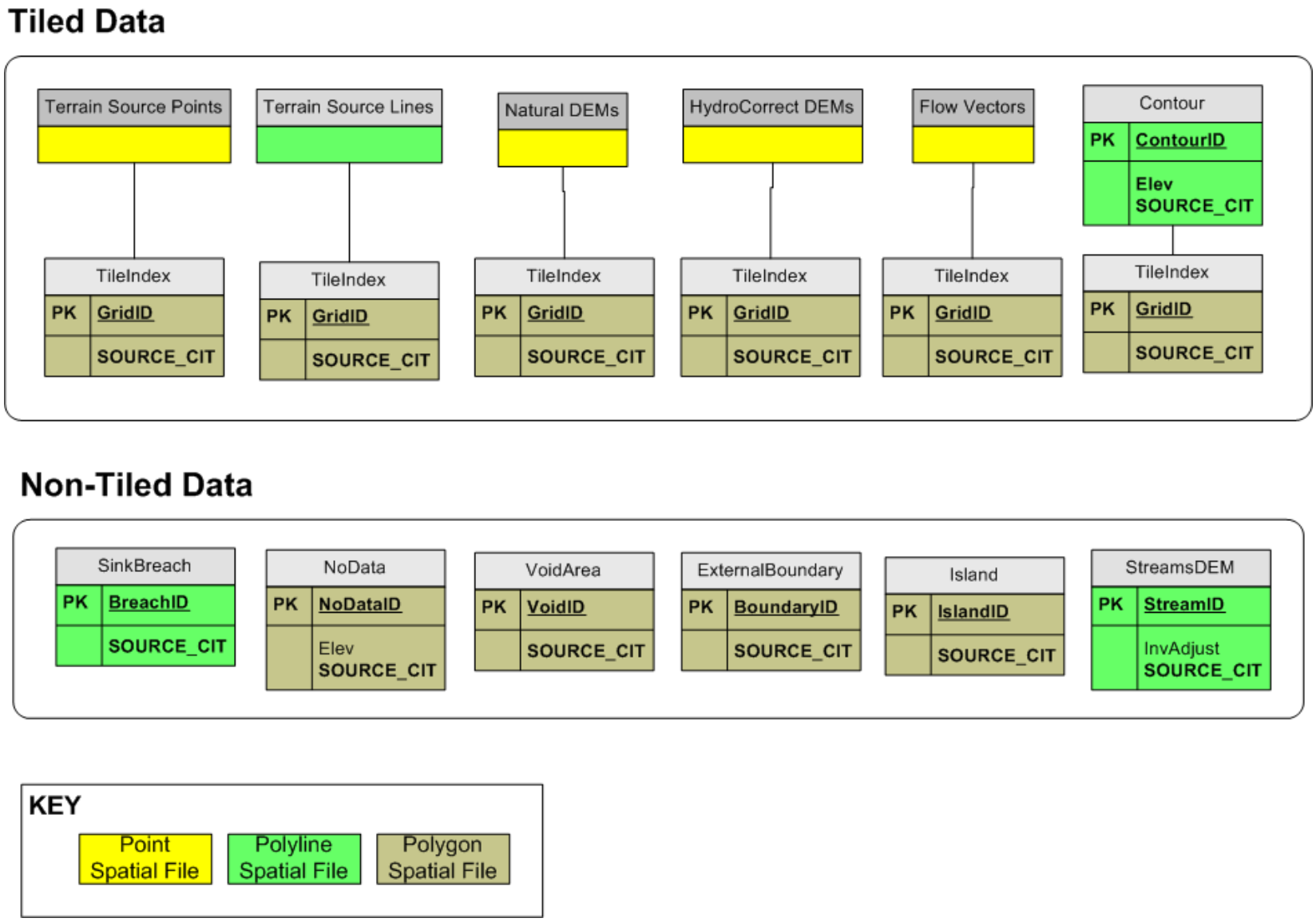
Figure N-1. Terrain Submittal Flowchart



N.2.2 Requirements

N.2.2.1 Data Files

The minimum required data for a terrain submission is the source terrain data. This data can be contained in a single file, or more commonly, a tiled set of files. If any terrain processing has been performed, the intermediate and final files are to be submitted as well. Examples of these additional files are spatial files used to indicate locations for breaching sinks, flow vectors files, and hydrologically correct DEMs.

Most spatial features can be stored in an ESRI shapefile or Open GML document with the necessary attribute fields. Other terrain data can be submitted in the file formats specified in Table N-1. It is important to note that each terrain submission must be accompanied with a completed Submittal_Info table.

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N.2.2.2 Source Terrain Data

Table N-1, below, shows the file formats that are accepted for source terrain data. This data can be contained in a single file or a tiled set of files. If the data is tiled, it is important to note that DTM files must not overlap each other. Any tiled data must have an accompanying index spatial file.

LIDAR data should be submitted as 2 series of files: one for bare earth only, one for all returns.

Table N-2. Accepted File Formats for Source Terrain Data

Format	Extension	References
ArcInfo Tin Generate (line)	LIN	See ESRI support: www.esri.com
ArcInfo Tin Generate (point)	PNT	See ESRI support: www.esri.com
AutoCAD DXF version 12	DXF	www.autodesk.com
ESRI Grid Ascii	ASC	See ESRI support: www.esri.com
Comma delimited point text	XYC	
Space delimited point text	XYS	
LAS Binary LIDAR points	LAS	http://www.lasformat.org/
3-D Point shapefile	SHP (include shx & dbf)	See ESRI support: www.esri.com
3-D Polyline shapefile	SHP (include shx & dbf)	See ESRI support: www.esri.com

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N.2.2.3 Non-Tiled Terrain Spatial Files

Non-tiled spatial files for a terrain submittal are shown below. These files are not required in all cases, but if they are used, they should be submitted.

Table N-3. Non-Tiled Terrain Spatial Files

Spatial File	Description
TileIndex	A polygon spatial file used to identify tiled data. Each tiled data source must have an accompanying Tile Index spatial file.
SinkBreach	A linear spatial file representing sink breaches used to hydrologically correct terrain models.
NoData	A polygon spatial file that is used to modify DEM elevations.
VoidArea	A polygon spatial file used to delete unwanted points before building TINs.
ExternalBoundary	A polygon spatial file used to define the outer extents of a TIN model.
Island	A polygon spatial file used to represent an island within a void area.
StreamsDEM	A linear spatial file used for enforcing flow directions.

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TileIndex Spatial File

This spatial file is required for use whenever terrain data is submitted in a tiled format. A TileIndex spatial file must accompany each different set of tiled data. While all tiled terrain data may reference the same TileIndex, it is possible that each set of tiled data references a unique TileIndex based on different origins and cell sizes. (For example, natural DEMs, Hydro correct DEMs, contours and flow vectors could each be based on a different TileIndex.) Tiles must have only one part, and cannot self-intersect (must be simple). Adjacent tiles should not overlap or have gaps between them.

Table N-4. TileIndex Spatial file

Field	Type	Length	Required?	Description
GridID	Text	20	Yes	Primary key for table. Used to identify tiled data sources. Example: G05, F1254.
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

SinkBreach Spatial File

This linear spatial file should be submitted if used. Sink breach polylines are placed at the toe of fill of culverts and other depressions to help create a hydrologically correct DEM. Breaches must have only one part, and cannot self-intersect (must be simple).

Table N-5. SinkBreach Spatial file

Field	Type	Length	Decimal Places	Required?	Description
BreachID	Long		0	Yes	Primary key for table
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

NoData Spatial File

This polygon spatial file should be submitted if used. No data zones are used primarily for applying a "no data" value like –9999 to specific areas of a DEM. These areas are usually at the fringes of a dataset, where the TIN may be inaccurate. This spatial file can also be used to enforce elevations in other areas such as lakes. No data zones must have only one part, and cannot self-intersect (must be simple). No data zones should not overlap.

Table N-6. NoData Spatial file

Field	Type	Length	Decimal Places	Required?	Description
NoDataID	Long		0	Yes	Primary key for table
Elev	Numeric	10	3	No	Elevation to use other than –9999. Useful for elevation enforcement in lakes, quarries, etc.
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

VoidArea Spatial File

This polygon spatial file should be submitted if used. Void area polygons are used to delete unwanted points before building TINs, usually in 'obstructed' areas. Void areas must have only one part, and cannot self-intersect (must be simple). Void areas should not overlap.

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Table N-7. VoidArea Spatial file

Field	Type	Length	Decimal Places	Required?	Description
VoidID	Long		0	Yes	Primary key for table
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

ExternalBoundary Spatial File

This polygon spatial file should be submitted if used. External boundary polygons can be used to define the outer extents of a TIN model. External boundaries must have only one part, and cannot self-intersect (must be simple). External boundaries should not overlap.

Table N-8. ExternalBoundary Spatial file

Field	Type	Length	Decimal Places	Required?	Description
BoundaryID	Long		0	Yes	Primary key for table
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

Island Spatial File

This polygon spatial file should be submitted if used. Island polygons can be used to represent an area within a void area where it is desired to build TIN's. An example would be the case where a Void Area is used to represent a lake, but an Island polygon is used to build the TIN model for an island within the lake. Islands must have only one part, and cannot self-intersect (must be simple). Islands should not overlap.

Table N-9. Island Spatial file

Field	Type	Length	Decimal Places	Required?	Description
IslandID	Long		0	Yes	Primary key for table
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

StreamsDEM Spatial File

This linear spatial file should be submitted if used. These single-line streams are a typical by-product of cartography, but are also useful during the hydro-correction process. These same streams are often used in the hydraulics portion of a submittal as a modeling baseline. Streams

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must have only one part, and cannot self-intersect (must be simple). Streams should be drawn upstream to downstream, and connect endpoint to endpoint.

Table N-10. StreamsDEM Spatial file

Field	Type	Length	Decimal Places	Required?	Description
StreamID	Long			Yes	Primary key for table
InvAdjust	Numeric	10	3	No	Elevation offset of line.
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

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N.2.2.4 Tiled Terrain Spatial Files

All tiled terrain data should be submitted with an accompanying TileIndex spatial file. While all tiled terrain data may reference the same TileIndex, it is possible that each set of tiled data references a unique TileIndex based on different origins and cell sizes. (For example, natural DEMs, Hydro correct DEMs, contours and flow vectors could each be based on a different TileIndex.)

The names of data files will be constructed using the GridId, the data type suffix, and the file format extension (see Table N-1). The format is ***GridId_datatype.FileformatExtension***

Table N-11. Data Types

Data Type Suffix	Description
ARL	LIDAR – All Returns
BE	Bare Earth Points (LIDAR and non-LIDAR)
3DL	3D Breaklines
2DL	2D (soft) Breaklines
CNT	Elevation contours
DEM_xx	DEM with the minor cell spacing of xx
HDEM_xx	Hydrologically corrected DEM with minor cell spacing of xx
VEC	Flow vectors
Other	Any files that don't fit in the other categories

For example, file G104_CNT.DXF would be the AutoCAD contour file for panel G104, and file G104_DEM_50.ASC would be the 50 foot cell size DEM for panel G104.

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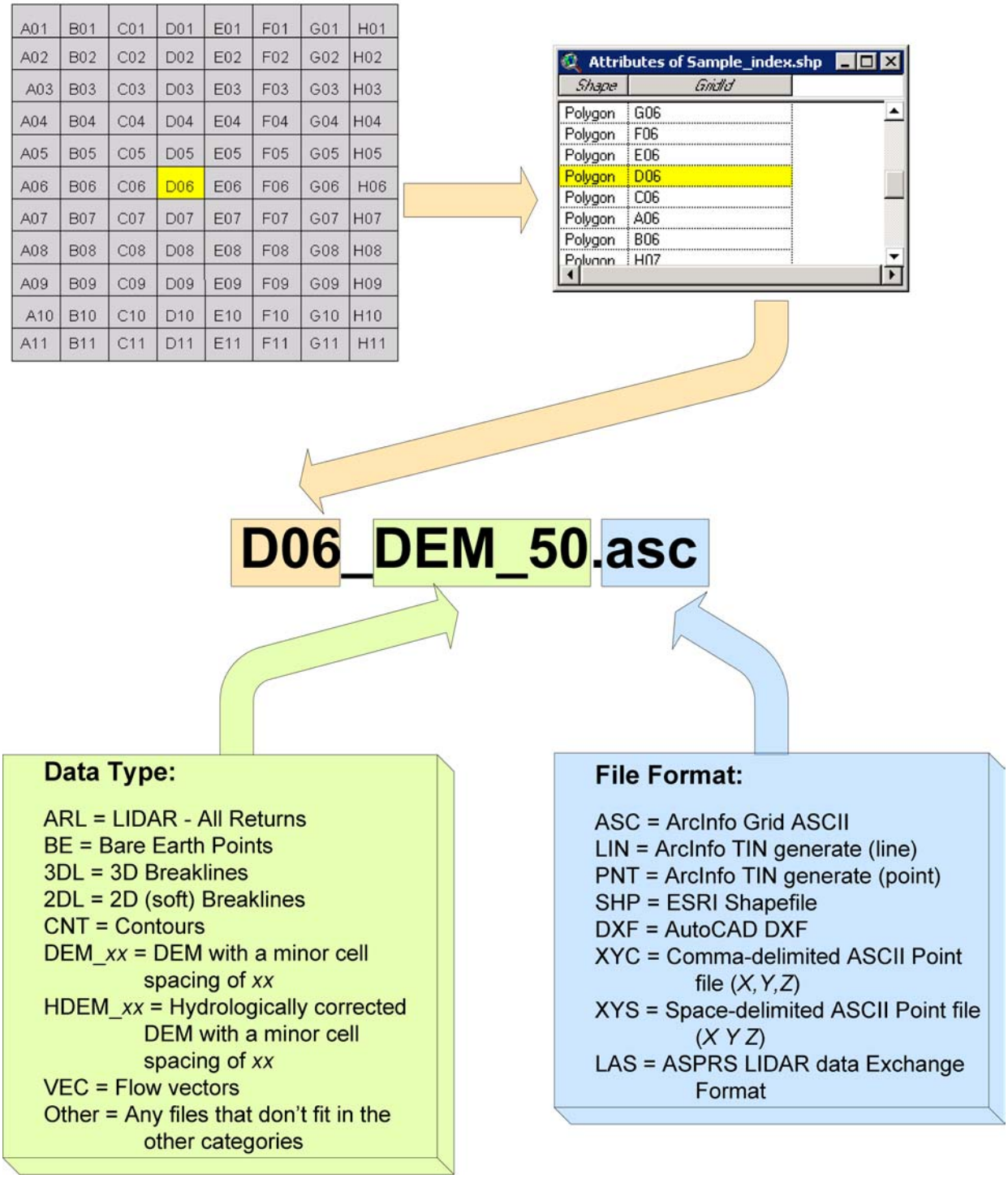
Figure N-2. File Naming Convention



Contour Spatial File

These linear spatial files should be submitted if used. The file naming convention in the "TileIndex" section should be used (i.e. G04_CNT.shp). Contours cannot self-intersect (must be simple).

Table N-12. Contour Spatial file

Field	Type	Length	Decimal Places	Required?	Description
ContourID	Long			Yes	Primary key for table
Elev	Numeric	10	3	Yes	Elevation in feet
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

N.2.2.5 Tiled Elevation Data

If DEMs are generated they should be submitted. The standard ESRI Grid Ascii format can be used to create a tile of elevations at a uniform spacing interval. These elevations can represent both uncorrected and hydrologically corrected DEMs.

N.2.2.6 Flow Vector Data

Flow vector raster files should be submitted if available. They should follow the D-8 format shown below. The standard ESRI Grid Ascii format can be used to create a tile of vectors at a uniform spacing interval.

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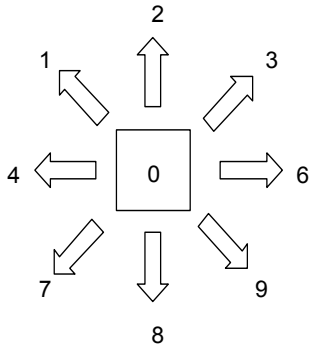
Figure N-3. Flow Direction Values



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N.2.3 Deliverables

N.2.3.1 Metadata

To facilitate the use of these data and the transfer of data files between users, a metadata file shall accompany all digital data submittals. Only one metadata file is required for each submission. However, in this file, the assigned Mapping Partner must distinguish between the different origins of the various datasets included. The metadata file shall follow the *Content Standard for Digital Geospatial Metadata (version 2.0)*, FGDC-STD-001-1998. Details of this standard are available at www.fgdc.gov.

This metadata file must include a description of the source material from which the data were derived and the methods of derivation, including all transformations involved in producing the final digital files. The description must include the dates of the source material and the dates of ancillary information used for update. The date assigned to a source must reflect the date that the information corresponds to the ground. If the Mapping Partner does not know this date, the Mapping Partner may use a date of publication and indicate as such. For each data source in the metadata file, the Mapping Partner shall assign a Source Citation Abbreviation as described under Data Sources in Subsection L.2.2.1.

The assigned Mapping Partner shall describe any database created by merging information obtained from distinct sources in sufficient detail to identify the actual source for each element in the file.

Because not all DFIRM database tables are included in every draft DFIRM digital data submittal, the Overview Description Section of the Entity and Attribute Information of the metadata file must include a list of all DFIRM database tables included in the submittal.

Portions of the file that are double underlined typically vary with each Mapping Partner's submittal. In addition, the Mapping Partner should modify or replace any other portions of the metadata file to fully document the data submitted.

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N.2.3.2 Hardcopy Deliverables

There are no hardcopy deliverables for submittal of terrain data.

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N.2.3.3 Digital Deliverables

Transfer Media

Mapping Partners must submit files on one of the following electronic media:

- CD-ROM (preferred); or
- DVD; or

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- Upload to Management Information Portal (MIP) (http://www.fema.gov/)

As technology changes or in special situations, other media may be acceptable if coordinated with FEMA.

Directory Structure and Folder Naming Conventions

An FDGC compliant metadata file will be placed in the "General" folder on the root directory of Disk1.

The Mapping Partner is required to submit the source terrain data as well as any files used to process this data.

Terrain files are arranged into appropriate directories based on data type. The index spatial file used for each data type needs to be placed in each applicable directory (if the files are tiled). Data must be located in the appropriate directory, as follows.

\General

- Metadata file
- Submittal_Info table

\ARL

- LIDAR data – All Returns
- LIDAR TileIndex spatial file (if used)

\BE

- LIDAR data – Bare Earth Points
- LIDAR TileIndex spatial file (if used)

\3DL

- 3D breakline spatial files
- 3D breakline TileIndex spatial file (if used)

\2DL

- 2D breakline spatial files
- 2D breakline TileIndex spatial file (if used)

\CNT

- Contour spatial files
- Contour TileIndex spatial file (if used)

\DEM_xx

- Uncorrected DEM files with a minor cell spacing of xx (i.e. "***DEM_50***")
- TileIndex spatial file (if used)

\HDEM_xx

- Hydrologically correct DEM files with a minor cell spacing of xx (i.e. "***HDEM_50***")
- TileIndex spatial file (if used)

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VEC

- Flow vectors
- TileIndex spatial file (if used)

Other

- Any files that don't fit into the other categories

For example, the file G104_CNT.DXF, which is an indexed contour file, should be placed in the CNT directory, along with the appropriate index spatial file. The file G104_DEM_50.ASC would be placed in the DEM_50 directory, along with the appropriate index spatial file.

Data Identification Requirements

All digital media submitted must be labeled with at least the following information:

- Mapping Partner name;
- Community name and state for which the FIS was prepared;
- Terrain Data;
- Date of submission (formatted mm/dd/yyyy); and
- Disk [*sequential number*] of [*number of disks*].

The media must be numbered sequentially, starting at Disk 1. The [***number of disks***] is the total number of disks in the submission.

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N.3 Survey Submittal Standards

N.3.1 Overview

The purpose of this section is to provide guidance and specifications to the Mapping Partner that prepares digital data for Digital Flood Insurance Rate Map (DFIRM) production. This section is not intended to specify in-process compilation or procedures, but rather to present the specifications and requirements for output and deliverables. The Mapping Partner should refer to *Appendix A: Guidance for Aerial Mapping and Surveying* for guidance on the performance of surveying.

This section will focus on the data that is obtained during the survey of the following features:

- Cross Sections
- Elevation Reference Marks
- High Water Marks
- Structures for Detailed Study
    - Bridges
    - Channels
    - Culverts
    - Dams
    - Levees
- Structures for Limited Detail Study
    - Bridges
    - Culverts
    - Dams

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A major aspect of GIS is horizontal and vertical position on the earth. Survey data must be referenced to a standard coordinate system, employ a standard projection, and specify both the horizontal and the vertical datums used. These positional references are established prior to the field data collection and topographic mapping phase of the project. All planimetric and topographic features must be collected and referenced to this coordinate system and projection. See *Appendix A: Guidance for Aerial Mapping and Surveying* for a detailed discussion of aerial mapping and surveying specifications, which includes horizontal and vertical control for new mapping. Also see *Appendix B: Guidance for Converting to the North American Vertical Datum of 1988* for a discussion of vertical datum selection and conversion.

Considerations for transfer of digital data also must include the file structure of the data, the transfer medium, and acceptable data formats. The organization and accepted formats for the intermediate submittal of survey data are discussed in Section N.3.3 of these standards.
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N.3.2 Requirements

N.3.2.1 Cross Sections

These deliverables are required whenever cross sections are shown in the flood profile.

- Database Tables
- Spatial File
- Survey Files
- Digital Photographs
- Digital Sketches

The following sections detail the requirements for each deliverable.

Database Tables

The database will contain the following tables related to cross sections.

Table N-13. Database Tables for Cross Sections

Table	Related Table	Description
S_SXS		This table contains survey data related to cross sections.
L_XSPht	S_SXS and Photo	This table is a look up table for the photos associated with each structure.
L_XSSkt	S_SXS and Sketch	This table is a look up table for the sketches associated with cross section.

See Figure N-4 for an entity relationship diagram of the tables for cross sections.

A database dictionary for these tables can be found in section N.3.4 . The database dictionary lists the attributes, definitions, and data requirements.

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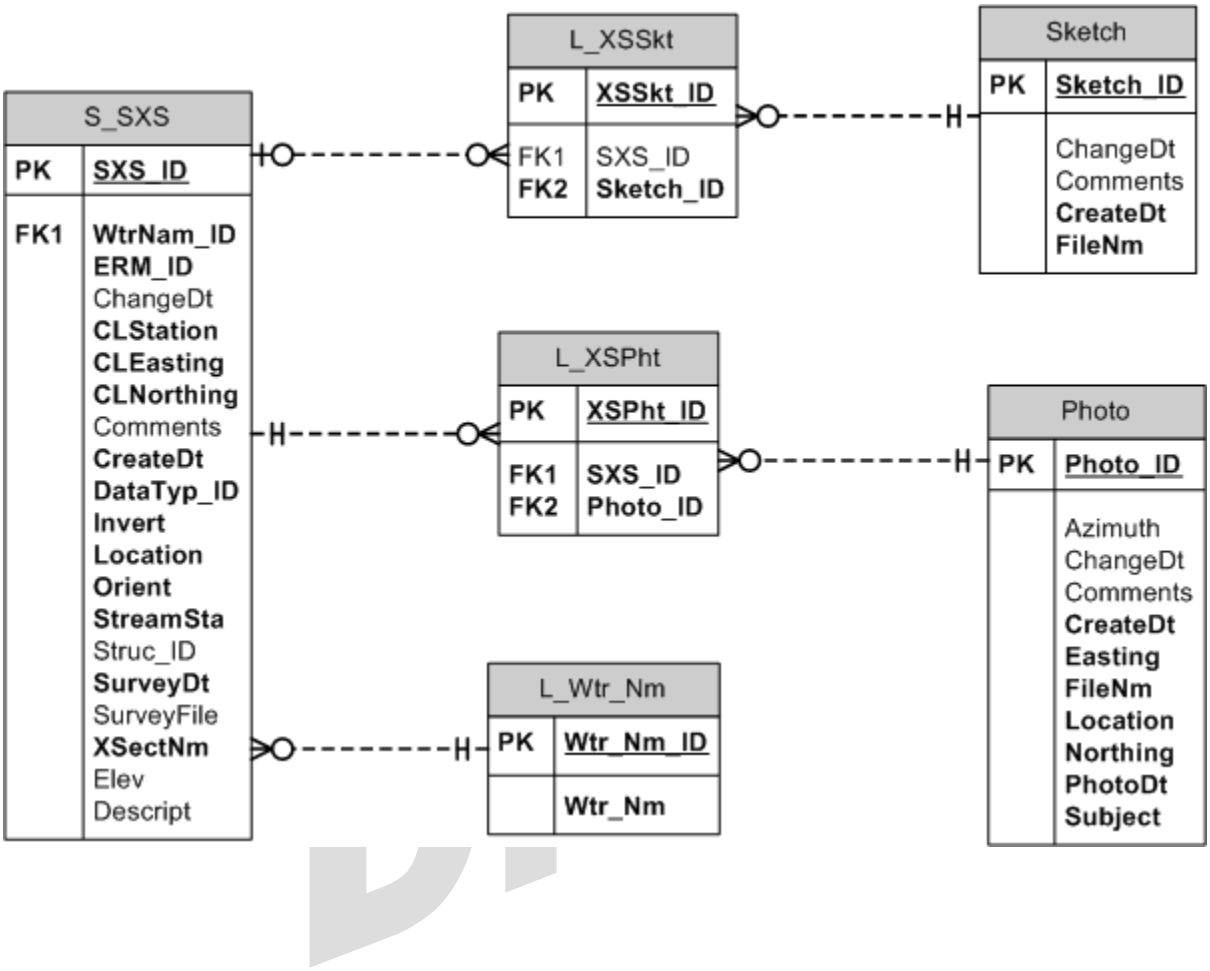
Figure N-4. Entity Relationship Diagram for Cross Sections



Spatial File

Description

One spatial file with location information also corresponds with the data table, ***S_SXS***. Each survey shot or entry in the survey text file for a cross section, should be represented spatially by a single point (see Section 3.2.1 Survey Files).

Naming Convention

The spatial files containing the locational information for the cross sections will be named S_SXS and the extension appropriate for the file format. For example, the components of a shapefile would be named S_SXS.shp, S_SXS.dbf, S_SXS.shx, and S_SXS.prj.

Attributes

The spatial file will contain the following attributes.

Table N-14. Attributes for Spatial Files for Cross Sections

Field Name	Type	Length	Description
XSPT_ID	Number		Assigned by table creator.
XS_ID	Number		Foreign key for table lookup. Assigned by table creator. This field links the spatial entity to the database table, S_SXS
DESCRIPT	String	100	Description of surveyed cross section shot or point.
ELEV	NUMBER		Elevation of surveyed cross section shot or point.
SOURCE_CIT	String	255	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_XSS_SXS table.
WTR_NM	String	100	Surface Water Feature Name. This is the formal name of the surface water feature associated with the structure, as it will appear on the hardcopy FIRM. This name should be populated in L_Wtr_NmL_Wtr_Nm.
XSECTNM	String	65	Cross Section Name. This is the name of the cross section and the name that will be shown on the hardcopy FIRM.

Survey Files

Description

A separate survey file must be submitted for each cross section.

Naming Convention

The filename for the survey file will be based upon the name of the cross section, which is found in the ***XSectNm*** field in ***S_SXS*** table. However, the filename will use underscores to indicate spaces in the name of the cross section. In a submission, each survey file must have a unique filename.

For example, XS_1.TXT

The filename of the survey file for a cross section must be populated in the ***SurveyFile*** field in the ***S_SXS*** table, in the record corresponding to that cross section.

Draft

Attributes

Each survey file should include all survey data for a cross section.

Digital Photographs

Description

A minimum of two digital photographs will be submitted for each cross section. The required aspects or view of the photographs include:

- Standing at cross section, looking upstream at the channel (USC)
- Standing at cross section, looking downstream at the channel (DSC)

Naming Convention

The filename of the digital photograph will be based on the name of the cross section (with underscores rather than spaces), an underscore, the aspect or view of the photograph, and the extension. In a submission, each digital photograph must have a unique filename.

For examples, XS_1_USC.PNG
XS_1_DSC.PNG

Draft

Attributes

A record must be populated in the ***Photo*** table for each photograph. The filename of the photograph must be populated in the ***FileNm*** field in the ***Photo*** table, corresponding to that photograph. In addition, a record must be populated in the ***L_XSPht*** table for each photograph. See N.3.4 for additional requirements for attributes or data requirements of the photographs.

Digital Sketches

Description

Any sketch that is prepared during the survey of a cross section must be submitted in digital format. If a sketch is drawn on paper in the field, it must be scanned into digital format. Each sketch must be in a separate digital file.

Naming Convention

The filename of the digital sketch will be based on the name of the cross section (with underscores rather than spaces), an underscore, "SK" and a number, and the extension. In a submission, each sketch file must have a unique filename.

For example, XS_1_SK1.PNG

Attributes

A record must be populated in the ***Sketch*** table for each sketch. The filename of the sketch must be populated in the ***FileNm*** field in the ***Sketch*** table, corresponding to that sketch. In addition, a record must be populated in the ***L_XSSkt*** table for each sketch. See N.3.4 for additional requirements for sketches.

[April 2004]

N.3.2.2 Elevation Reference Marks

A spatial file with elevation reference marks is required whenever elevation reference marks are shown on the DFIRM.

The following section details the requirements for the deliverable.

Description

One spatial file with locational information also corresponds with the data table, ***S_ERM***. Each elevation reference mark is to be represented spatially by a single point.

Naming Convention

The spatial files containing the locational information for the elevation reference marks will be named S_ERM and the extension appropriate for the file format. For example, the components of a shapefile would be named S_ERM.shp, S_ERM.dbf, S_ERM.shx, and S_ERM.prj.

Attributes

The spatial file will contain the following attributes.

Draft

Table N-15. Attributes for Spatial Files for Elevation Reference Marks

Field Name	Data Type	Length	Description
ERM_ID	Number		Primary key for table lookup. Unique identifier for elevation reference mark.
ERM_NM	String	50	Elevation Reference Mark Name. This is the name of the elevation reference mark and the name that will be shown on the hardcopy FIRM.
CHANGEDT	Date		Date the record for the Elevation Reference Mark was last updated.
CREATEDT	Date		Date the record for the Elevation Reference Mark was created.
DESCRIP	String	255	Description of directions to location Elevation Reference Mark.
ELEV	Numeric		Elevation of Elevation Reference Mark, feet above the mean sea level.
OWNER	String	50	Agency or municipality owns the monument.
SURVEYDT	Date		Date the Elevation Reference Mark was surveyed.
SOURCE_CIT	String	255	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_Struc table.

Draft

N.3.2.3 High Water Marks

These deliverables are required whenever high water marks have been identified and surveyed during the performance of a Flood Insurance Study.

- Database Table
- Spatial File
- Digital Photographs
- Digital Sketches

The following sections detail the requirements for each deliverable.

Database Tables

The database will contain the following tables related to high water marks.

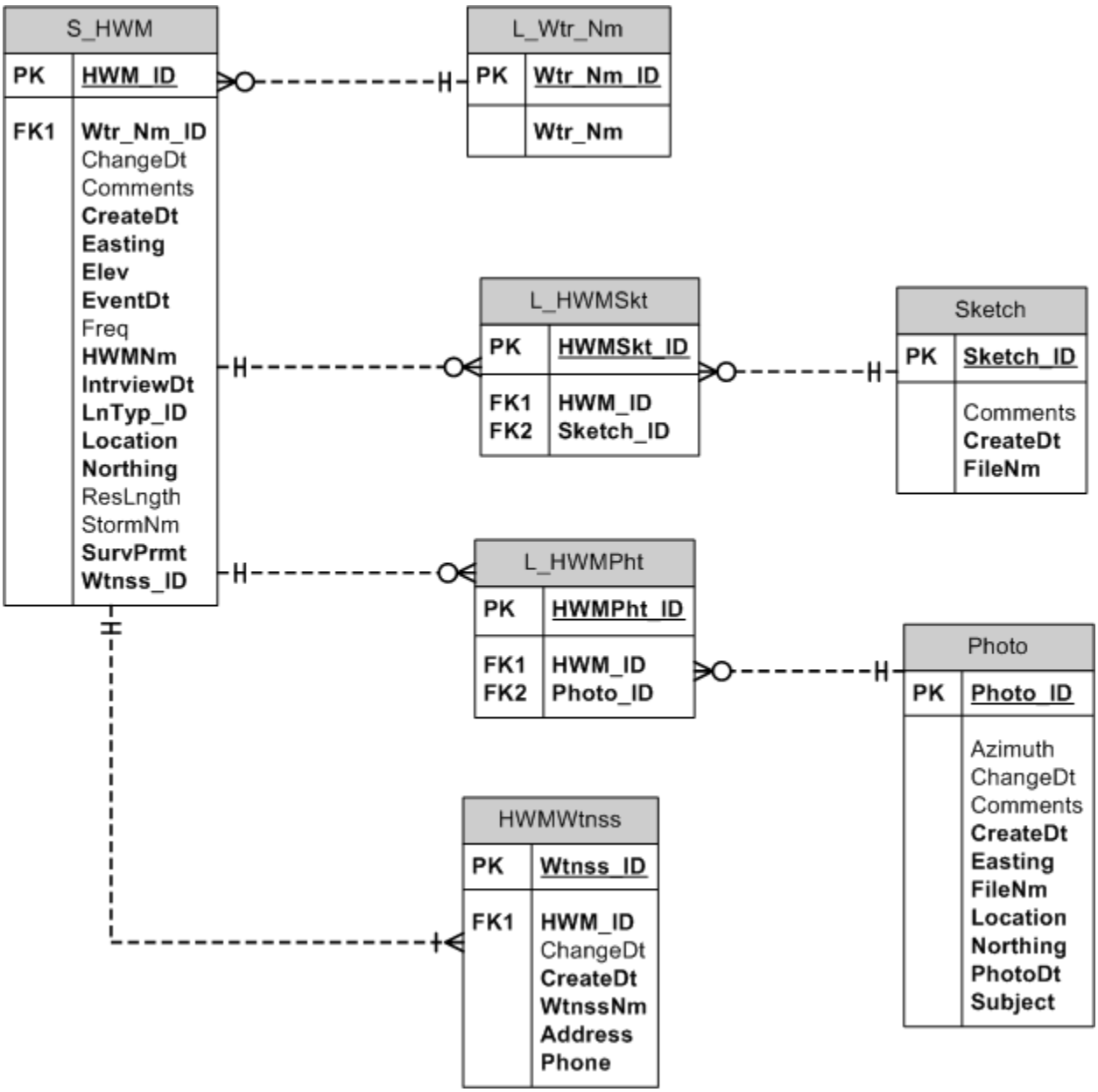
Table N-16. Tables for High Water Marks

Table	Related Table	Description
S_HWM		This table contains information about High Water Marks (HWM).
L_HWMPht	S_HWM and Photo	This table is a look up table for the photos associated with each high water mark.
L_HWMSkt	S_HWM and Sketch	This table is a look up table for the sketches associated with each high water mark.

See Figure N-5 for an entity relationship diagram of the tables for high water marks.

Draft

Figure N-5. Entity Relationship Diagram for High Water Marks



Attributes

A database dictionary for these tables can be found in N.3.4 . The database dictionary lists the attributes, definitions, and data requirements.

Spatial File

Description

One spatial file with locational information also corresponds with the data table, ***S_HWM***. Each high water mark is to be represented spatially by a single point.

Naming Convention

The spatial files containing the locational information for the high water marks will be named S_HWM and the extension appropriate for the file format. For example, the components of a shapefile would be named S_HWM.shp, S_HWM.dbf, S_HWM.shx, and S_HWM.prj.

Attributes

The spatial file will contain the following attributes.

Table N-17. Attributes for Spatial Files for High Water Marks

Field Name	Data Type	Length	Description
HWM_ID	Number		Primary key for table lookup. Assigned by table creator. This field links the spatial entity to the database table, S_HWM
HWM_NM	String	50	High Water Mark Feature Name. This is the formal name of the High Water Mark
WTR_NM	String	100	Surface Water Feature Name. This is the formal name of the surface water feature associated with the structure, as it will appear on the hardcopy FIRM. This name should be populated in L_Wtr_Nm.
SOURCE_CIT	String	255	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_HWM table.
ELEV	Long		Elevation of the High Water Mark, feet above the mean sea level.
EVENTDT	Date		Date of the event associated with the High Water Mark.

Digital Photographs

Description

A minimum of one digital photograph will be submitted for each high water mark. The photographs should be in color. The required aspects or view of the photograph include:

- Standing approximately twenty feet away from the high water mark

Naming Convention

The filename of the digital photograph will be based on the name of the high water mark (with underscores rather than spaces), an underscore, and the extension. In a submission, each digital photograph must have a unique filename.

For example, HWM_1.PNG

Attributes

A record must be populated in the ***Photo*** database table for each photograph. The filename of the photograph must be populated in the ***FileNm*** field in the ***Photo*** table, corresponding to that photograph. In addition, a record must be populated in the ***L_HWMPht*** table for each photograph. See N.3.4 for additional requirements for attributes or data requirements of the photographs.

Digital Sketches

Description

Any sketch that is prepared during the survey of a high water mark must be submitted in digital format. If a sketch is drawn on paper in the field, it must be scanned into digital format. Each sketch must be in a separate digital file.

Naming Convention

The filename of the digital sketch will be based on the name of the high water mark (with underscores rather than spaces), an underscore, "SK" and a number, and the extension. In a submission, each sketch file must have a unique filename.

For example, HWM_1_SK1.PNG

Attributes

A record must be populated in the Sketch table for each sketch. The filename of the sketch must be populated in the ***FileNm*** field in the Sketch table, corresponding to that sketch. In addition, a record must be populated in the ***L_HWMSkt*** table for each sketch. See N.3.4 for additional requirements for sketches.

[April 2004]

Draft

N.3.2.4 Structures for Detailed Study

These deliverables are required whenever hydraulic structures have been surveyed to support Detailed Studies. They are also required if levees are shown on the FIRM, channels containing the flooding are shown on the FIRM, or any other structure that impacts the area's flood risk is shown on the FIRM.

- Database Tables
- Spatial Files
- Survey Files
- Photographs
- Sketches

For cross sections related to structures, refer to N.3.2.1 and to the *Data Capture Guidelines*. The following sections detail the requirements for each deliverable.

Database Tables

Description

The database will contain the following tables related to survey data for structures.

Draft

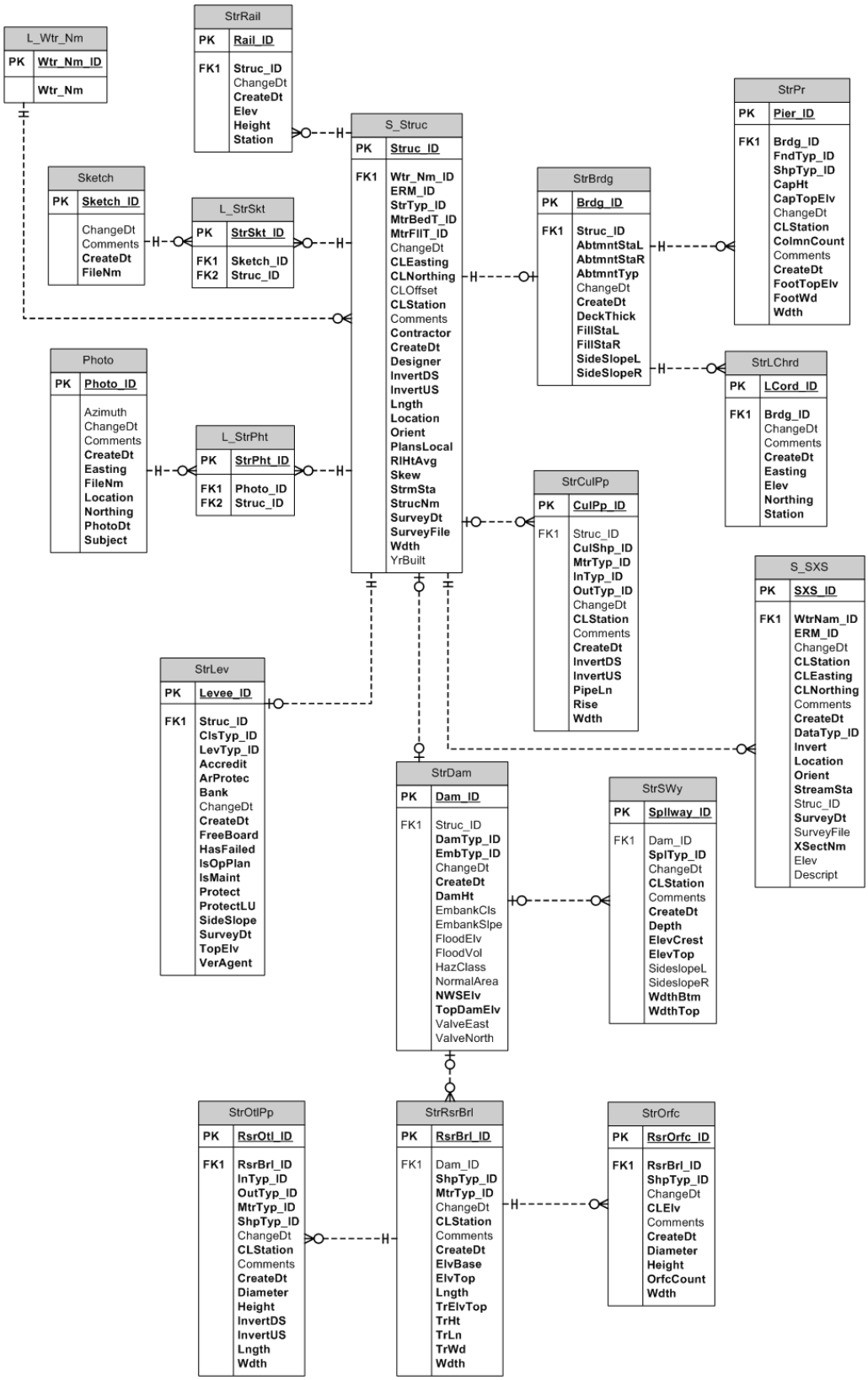
Table N-18. Tables for Structures

Table	Related Table	Description
S_Struc		The S_Struc table contains information about the hydraulic structures that have been surveyed within the study area. It should include all structures shown in the flood profiles. In addition, levees, sea walls, channels that contain flooding, and other significant flood control structures shown on the Flood Insurance Rate Map (FIRM) should be included.
L_StrPht	S_Struc and Photo	This table is a look up table for the photos of each structure.
L_StrSkt	S_Struc and Sketch	This table is a look up table for the sketches of each structure.
StrBrdg	S_Struc	Each record in this contains information specific to a bridge, such as abutment stations.
StrLChrd	StrBrdg	Each record in this table contains information about a low chord shot. Only bridges may have low chord shots.
StrPr	StrBrdg	This table contains information on piers, such as pier width and shape. Only bridges may have related records to this table.
StrCulPp	S_Struc	Each record in this table contains information about one pipe, at a culvert crossing.
StrDam	S_Struc	Each record in this table contains information specific to a dam, such as embankment type or location of a drain valve.
StrRsrBrl	StrDam	Each record in this table contains information specific to one riser barrel, such as size and trash rack information.
StrOrfc	StrDam	Each record in this table contains information specific to the size and number of similar orifices clustered together on a riser barrel.
StrOtlPp	StrDam	Each record in this table contains information specific to one outlet pipe, at the bottom of a riser barrel, which transports water underneath the dam structure.
StrSWy	StrDam	Each record in this table contains information about a relief device at a dam, used to prevent overtopping during a large flood.
StrLev	S_Struc	Each record in this table contains information specific to a levee, such as type of levee.
StrRail	S_Struc	Each record in this table contains information about a top of rail shot.

See Figure N-6 for an entity relationship diagram of the tables for structures surveyed for detailed studies.

Draft

Figure N-6. Entity Relationship Diagram for Structures for Detailed Study



Attributes

A database dictionary for these tables can be found in N.3.4 . The dictionary lists the attributes, definitions, and data requirements.

Spatial File

Description

One spatial file with locational information also corresponds with the data table, S_Struc. Each structure is to be represented spatially by a single line. Each line should represent the primary characteristic of the structure.

- Each bridge should be represented by a single line that is aligned to the transportation centerline carried by the bridge.
- Each culvert should be represented by a single line that is aligned to the transportation centerline carried by the culvert.
- Each dam should be represented by a single line aligned to the centerline along the top of the dam.
- Each levee should be represented by a single line aligned to the top or crest of levee.

Naming Convention

The spatial files containing the locational information for the general structures will be named S_Struc and the extension appropriate for the file format. For example, the components of a shapefile would be named S_Struc.shp, S_Struc.dbf, S_Struc.shx, and S_Struc.prj.

Attributes

The spatial file for Structures must contain the following attributes.

Draft

Table N-19. Attributes for Spatial Files for Structures

Field Name	Data Type	Length	Description
STRUC_ID	Number		Primary key for table lookup. Assigned by table creator. This field links the spatial entity to the database table, S_Struc
STRTYP _LID	Number		Structure Type Lookup Identification. A code that provides a link to a valid entry from the D_SurvStrucTyp table.
STRUCT_NM	String	20	Structure Name. This is the name of the feature and the name that will be shown on the hardcopy FIRM. It is "UNKNOWN" if the structure is not named on FIRM and/or the name is unknown.
WTR_NM	String	100	Surface Water Feature Name. This is the formal name of the surface water feature associated with the structure, as it will appear on the hardcopy FIRM. This name should be populated in L_Wtr_Nm.
SOURCE_CIT	String	255	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_Struc table.

Draft

Survey Files

Description

A separate survey file must be submitted for all bridges, culverts, and dams. Survey files are not required for channels or levees.

Naming Convention

The filename for the survey file will be based upon the name of the structure, which is found in the ***StrucNm*** field in ***S_Struc*** table. However, the filename will use underscores to indicate spaces in the name of the structure. In a submission, each survey file must have a unique filename.

For example, SOMEWHERE_RD.TXT

The filename of the survey file for a structure must be populated in the ***SurveyFile*** field in the ***S_Struc*** table, in the record corresponding to that structure.

Attributes

The filename of the survey file for a structure must be populated in the ***SurveyFile*** field in the ***S_Struc*** table, in the record corresponding to that structure.

Digital Photographs

Description

A minimum of four digital photographs will be submitted for each bridge, culvert, and dam. The required aspects or view of the photographs include:

- Standing upstream of structure, looking downstream at structure (USF)
- Standing on or below the structure, looking upstream at the channel (USC)
- Standing on or below the structure, looking downstream at the channel (DSC)
- Standing downstream of structure, looking upstream at structure (DSF)

A minimum of two digital photographs will be submitted for each channel and levee. The required aspects or view of the photographs include:

- Standing at midpoint of the structure, looking upstream at the channel or levee (USC)
- Standing at midpoint of the structure, looking downstream at the channel or levee (DSC)

Naming Convention

The filename of the digital photograph will be based on the name of the structure (with underscores rather than spaces), an underscore, the aspect or view of the photograph, and the extension. In a submission, each digital photograph must have a unique filename.

For examples, SOMEWHERE_RD_USF.PNG
SOMEWHERE_RD_USC. PNG
SOMEWHERE_RD_DSC. PNG
SOMEWHERE_RD_DSF. PNG

Attributes

A record must be populated in the ***Photo*** table for each photograph. The filename of the photograph must be populated in the ***FileNm*** field in the ***Photo*** table, in the record corresponding to that photograph. In addition, a record must be populated in the ***L_StrPht*** table for each photograph. See N.3.4 for additional requirements for the attributes and data requirements of the photographs.

Digital Sketches

Description

All sketches that are prepared during the survey of a structure must be submitted in digital format. If a sketch is drawn on paper in the field, it must be scanned into digital format. Each sketch must be in a separate digital file.

Draft

Naming Convention

The filename of the digital sketch will be based on the name of the structure (with underscores rather than spaces), an underscore, "SK" and a number, and the extension. In a submission, each sketch files must have a unique filename.

For example, SOMEWHERE_RD_SK1.PNG

Attributes

A record must be populated in the ***Sketch*** table for each sketch. The filename of the sketch must be populated in the ***FileNm*** field in the ***Sketch*** table, corresponding to that sketch. In addition, a record must be populated in the ***L_StrSkt*** table for each sketch. See N.3.4 for additional requirements for the attributes and data requirements of the sketches.

[April 2004]

N.3.2.5 Structures for Limited Detailed Study

These deliverables are required whenever hydraulic structures have been surveyed to support Detailed Studies. They are also required if levees are shown on the FIRM, channels containing the flooding are shown on the FIRM, or any other structure that impacts the area's flood risk is shown on the FIRM.

- Database Tables
- Spatial Files
- Photographs

The following sections detail the requirements for each deliverable.

Draft

Database Tables

Description

The database will contain the following tables related to survey data for structures.

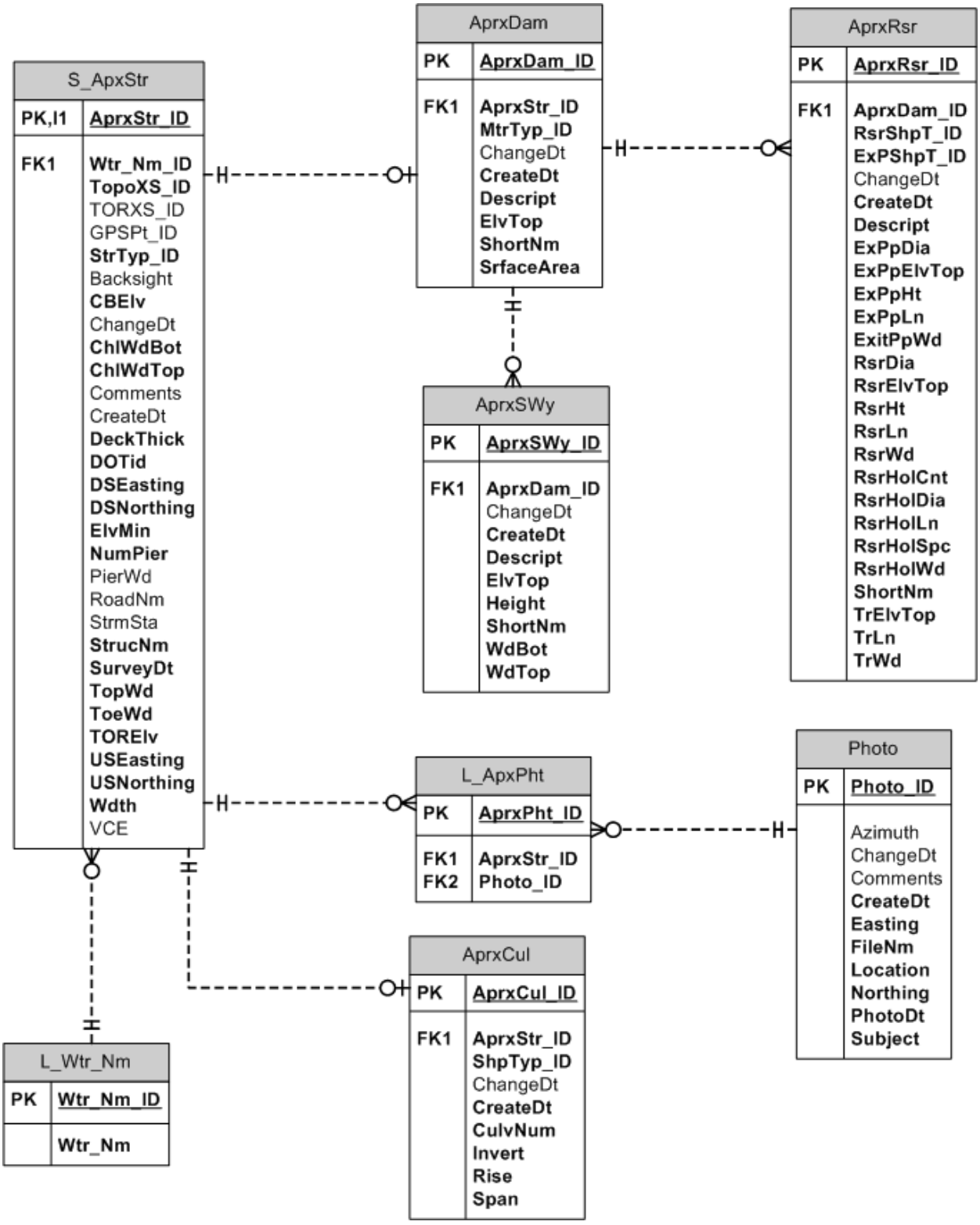
Table N-20. Tables for Structures

Table	Related Table	Description
S_ApxStr		The S_ApxStr table contains information about the hydraulic structures that have been surveyed within the study area in support of limited detailed studies.
AprxCul	S_ApxStr	Each record in this table contains information about one pipe, at a culvert crossing.
AprxDam	S_ApxStr	Each record in this table contains information specific to a dam.
AprxRsr	AprxDam	Each record in this table contains information specific to one riser barrel.
AprxSWy	AprxDam	Each record in this table contains information about a relief device at a dam
L_ApxPht	S_ApxStr and Photo	This table is a look up table for the photos of each structure.

See Figure N-7 for an entity relationship diagram of the tables for structures surveyed for limited detailed studies.

Draft

Figure N-7. Entity Relationship Diagram for Structures for Limited Detail Study



Attributes

A database dictionary for these tables can be found in N.3.4 . The dictionary lists the attributes, definitions, and data requirements.

Spatial File

Description

One spatial file with locational information also corresponds with the data table, S_ApxStr. Each structure is to be represented spatially by a single line. Each line should represent the primary characteristic of the structure.

- Each bridge should be represented by a single line that is aligned to the transportation centerline carried by the bridge.
- Each culvert should be represented by a single line aligned to the centerline of the main barrel.
- Each dam should be represented by a single line that is aligned to the transportation centerline carried by the culvert.

Naming Convention

The spatial files containing the locational information for the general structures will be named S_ApxStr and the extension appropriate for the file format. For example, the components of a shapefile would be named S_ApxStr.shp, S_ApxStr.dbf, S_ApxStr.shx, and S_ApxStr.prj.

Attributes

The spatial file for Structures must contain the following attributes.

Draft

Table N-21. Attributes for Spatial Files for Structures

Field Name	Data Type	Length	Description
APRXSTR_ID	Number		Primary key for table lookup. Assigned by table creator. This field links the spatial entity to the database table, S_ApproxStruc
STRUC_TYP	String	10	Structure Type: BRIDGE, CULVERT, DAM
STRUC_NM	String	20	Structure Name. This is the name of the feature and the name that will be shown on the hardcopy FIRM. It is "UNKNOWN" if the structure is not named on FIRM and/or the name is unknown.
WTR_NM	String	100	Surface Water Feature Name. This is the formal name of the surface water feature associated with the structure, as it will appear on the hardcopy FIRM. This name should be populated in L_Wtr_Nm.
SOURCE_CIT	String	255	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_ApxStr table.

Photographs

Description

A minimum of one digital photograph will be submitted for each bridge, culvert, and dam. The required aspects or view of the photographs include:

- Standing upstream of structure, looking downstream at structure (USF)

Naming Convention

The filename of the digital photograph will be based on the name of the structure (with underscores rather than spaces), an underscore, the aspect or view of the photograph, and the extension. In a submission, each digital photograph must have a unique filename.

For examples, SOMEWHERE_RD_USF.PNG

Attributes

A record must be populated in the ***Photo*** table for each photograph. The filename of the photograph must be populated in the ***FileNm*** field in the ***Photo*** table, in the record corresponding to that photograph. In addition, a record must be populated in the ***L_ApxPht*** table for each photograph. See N.3.4 for additional requirements for the attributes and data requirements of the photographs.

[April 2004]

N.3.3 Deliverables

N.3.3.1 Metadata

To facilitate the use of these data and the transfer of data files between users, the assigned Mapping Partner shall prepare and submit a metadata file with all digital data submittals. Only one metadata file is required for each submittal. However, in this one file, the assigned Mapping Partner must distinguish between the different origins of the various datasets included. The Metadata file shall follow the *Content Standard for Digital Geospatial Metadata (version 2.0)*, FGDC-STD-001-1998. Details of this standard are available at www.fgdc.gov.

The metadata file must include a description of the source material from which the data were derived and the methods of derivation, including all transformations involved in producing the digital files. The description shall include the dates of the source material and the dates of ancillary information used for update. The date assigned to a source must reflect the date that the information corresponds to the ground. If the assigned Mapping Partner does not know this date, then the Mapping Partner may use a date of publication and indicate as such. Each data source in the metadata file must be assigned a Source Citation Abbreviation as described in Subsection L.2.2.1.

The assigned Mapping Partner shall describe any database created by merging information obtained from distinct sources in sufficient detail to identify the actual source for each element in the file.

Because not all DFIRM database tables are included in every draft DFIRM digital data submittal, the Overview Description Section of the Entity and Attribute Information of the metadata file must include a list of all DFIRM database tables included in the submittal.

Portions of the file that are double underlined typically vary with each Mapping Partner's submittal. In addition, the Mapping Partner should modify or replace any other portions of the metadata file to fully document the data submitted.

[April 2004]

N.3.3.2 Hardcopy Deliverables

There are no hardcopy deliverables for submittal of inventory data.

[April 2004]

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N.3.3.3 Digital Deliverables

Transfer Media

Mapping Partners must submit files on one of the following electronic media, or via the internet:

- CD-ROM (preferred); or
- DVD; or
- Upload to Management Information Portal (MIP) (http://www.fema.gov)

As technology changes or in special situations, other media may be acceptable if coordinated with FEMA and the Mapping Partner receiving the data.

Files should not be compressed.

Data Format

Metadata

Each submittal of survey data must include one metadata file. See L2.2.1 and N.3.3.1 for additional information concerning metadata content and format.

Database

Each submittal will include only one database. The database must be a Microsoft Access 2000 database (mdb) or dBASE IV files. The filename for the database will be based upon the name of the study name. No spaces will be allowed in the filename. For example, FLOODUSA.MDB.

The Mapping Partner should refer to N.3.4 for the database dictionary.

Photographs

The photographs should be in color and must be submitted digitally. The file size of each photograph must not be any larger than 150 kilobytes. Table N-21 indicates the file formats acceptable for submittal of digital photographs.

Table N-22. File Formats for Photographs

Format	Extension	References
JPEG	JPG	Joint Photographics Experts Group
Bitmap	BMP	Microsoft Corporation
Portable Network Graphic	PNG	

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Spatial Files

Most spatial features can be stored in an ESRI shapefile or Open GML document, with the necessary attribute fields. Table N-22 indicates the file formats acceptable for data submittal.

Sketches

Each sketch must be in a separate digital file. The file size of each sketch file must not be any larger than 150 kilobytes. Table N-23 indicates the file formats acceptable for submittal of survey files.

Table N-23. File Formats for Sketches

Format	Extension	References
Portable document	PDF	See Adobe support: www.adobe.com
JPEG	JPG	Joint Photographics Experts Group
Portable Network Graphic	PNG	

Survey Files

The survey file must be an ASCII-formatted file.

Directory Structure and Folder Naming Conventions

An FDGC compliant metadata file will be placed in the "General" folder on the root directory of Disk1.

These directories must be located in the root directory of the disk(s). No sub-folders or sub-directories will be allowed under these directories. Data must be located in the appropriate directory, as follows. The ***General*** folder must be located on the first disk.

Database
- Database file(s)

General
- Metadata file

Photos
- All digital photographs

Sketches
- All digital sketches

Spatial
- Cross section spatial file (S_SXS)
- Elevation Reference Marks spatial file (S_ERM)

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- Structures for detailed study spatial file (S_Struc)
- Structures for limited study spatial file (S_ApxStr)
- High water marks spatial file (S_HWM)

Survey

- All survey files

Data Identification Requirements

All digital media submitted must be labeled with at least the following information:

- Mapping Partner name;
- Community name and state for which the FIS was prepared;
- Survey Data;
- Date of submission (formatted mm/dd/yyyy); and
- Disk [*sequential number*] of [*number of disks*].

[April 2004]

N.3.4 Database Dictionary

The dictionary details the tables and field attributes for a Microsoft Access 2000 or dBASE IV database submittal.

[April 2004]

Draft

Table N-24. Database Dictionary

Draft

AprxCul

Information about one pipe at a culvert crossing. (LDS)

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
AprxCul_ID	Long			Unique identifier for AprxCul.	Yes	Yes	
AprxStr_ID	Long			Foreign key to S_ApxStr.	Yes		
ShpTyp_ID	Long			Shape of culvert.	Yes		D_ShpTyp
ChangeDt	Data/Time			Date the record was last updated.			
CreateDt	Data/Time			Date the record was created.	Yes		
CulvNum	Long			Number of culverts.	Yes		
Invert	Double		1	Elevation at bottom of upstream pipe	Yes		
Rise	Double		1	Height or diameter of pipe.	Yes		
Span	Double		1	Width or span of pipe.	Yes		

AprxDam

Information specific to a dam (LDS)

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
AprxDam_ID	Long			Unique identifier for AprxDam.	Yes	Yes	
AprxStr_ID	Long			Foreign key to S_ApxStr.	Yes		
MtrTyp_ID	Long			Material type of dam.	Yes		D_MtlTyp
ChangeDt	Data/Time			Date the record was created.			
CreateDt	Data/Time			Date the record was created.	Yes		
Descript	Text	255		Description of the dam.	Yes		
ElvTop	Double		1	Elevation at the top of the dam.	Yes		
ShortNm	Text	30		Short name for the dam.	Yes		
SrfaceArea	Double		1	Surface area.	Yes		

AprxRsr

Riser barrel data. (LDS)

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
AprxRsr_ID	Long			Unique identifier for AprxRsr.	Yes	Yes	
AprxDam_ID	Long			Foreign key to AprxDam.	Yes		
RsrShpT_ID	Long			Shape of riser.	Yes		D_ShpTyp: ShpTyp_ID
ExPShpT_ID	Long			Shape of the exit pipe.	Yes		D_ShpTyp: ShpTyp_ID
ChangeDt	Data/Time			Date the record was last updated.			
CreateDt	Data/Time			Date the record was created.	Yes		
Descript	Text	255		Description of dam riser.	Yes		
ExPpDia	Double		1	Dimaeter of the exit pipe.	Yes		
ExPpElvTop	Double		2	Elevation at the top of the exit pipe.	Yes		
ExPpHt	Double		1	Height of the exit pipe.	Yes		
ExPpLn	Double		1	Length of the exit pipe.	Yes		
ExPpWd	Double		1	Width of the exit pipe.	Yes		
RsrDia	Double		1	Diameterter of riser.	Yes		
RsrElvTop	Double		2	Elevation at the top of the riser.	Yes		
RsrHt	Double		1	Height of riser.	Yes		
RsrLn	Double		1	Length of riser.	Yes		
RsrWd	Double		1	Width of riser.	Yes		
RsrHolCnt	Integer			Number of riser holes.	Yes		
RsrHolLn	Double		1	Length of riser holes.	Yes		
RsrHolSpc	Double		1	Spacing between riser holes.	Yes		
RsrHolWd	Double		1	Width of riser holes.	Yes		
ShortNm	Text	30		Short name for riser.	Yes		
TrElvTop	Double		2	Elevation at the top of trashrack.	Yes		
TrLn	Double		1	Length of the trashrack.	Yes		
TrWd	Double		1	Width of the trashrack.	Yes		

AprxSWy

A relief device at a dam, used to prevent overtopping during a large flood. (LDS)

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
AprxSWy_ID	Long			Unique identifier for AprxSWy	Yes	Yes	
AprxDam_ID	Long			Foreign key to AprxDam.	Yes		
ChangeDt	Data/Time			Date the record was last updated.			
CreateDt	Data/Time			Date the record was created.	Yes		
Descript	Text	255		Description of spilway.	Yes		
ElvTop	Double		2	Elevation at top of spillway.	Yes		
Height	Double		1	Height of spillway.	Yes		
ShortNm	Text	30		Short name for the spillway.	Yes		
WdBot	Double		1	Width at bottom of spillway.	Yes		
WdTop	Double		1	Width at top of spillway.	Yes		

D_ClsTyp

Type of closures required to operate levee.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
ClsTyp_ID	Long			Unique identifier for D_ClsTyp.	Yes	Yes	
ClsTypDes	Text	20		Type of closure: Sandbags, Stop logs, Floodgates, Combination, etc.	Yes		

Domain Values	
ClsTyp_ID	ClsTypDes
1	Combination
2	Floodgates
3	Other
4	Sandbags
5	Stop logs
6	None

Draft

D_DamTyp

Types of dams, such as Earthen or Roller Compacted Concrete.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
DamTyp_ID	Long			Unique identifer for D_DamTyp.	Yes	Yes	
DamTypDes	Text	20		Engineering descriptor: Concrete Arch, Masonory, Rubber, Timber Crib, RCC, Rockfill, Earthen, etc.	Yes		

Domain Values

DamTyp_ID	DamTypDes
1	Concrete Arch
2	Concrete Gravity
3	Earthfill
4	Masonry
5	RCC
6	Rockfill
7	Rubber
8	Timber Crib
9	Other
10	Unknown

Draft

D_DatTyp

Type of cross sections.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
DataTyp_ID	Long			Unique identifier for D_DatTyp.	Yes	Yes	
DataTypDes	Text	20		Describes different type of xsects: Field, TOR, Natural, etc.	Yes		

Domain Values	
DataTyp_ID	DataTypDes
1	Field
2	TOR

D_EmbTyp

Dam embankment types.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
EmbTyp_ID	Long			Unique identifier for D_EmbTyp.	Yes	Yes	
EmbTypDes	Text	20		Describes character of embankment: Earthen, RipRap, Concrete, Rabion, etc.	Yes		

Domain Values	
EmbTyp_ID	EmbTypDes
1	Concrete
2	Earthen
3	Gabion
4	RipRap
5	Other

Draft

D_LevTyp

Type of levees.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
LevTyp_ID	Long			Unique identifier for D_LevTyp.	Yes	Yes	
LevTypDes	Text	20		Type of levee: Levee & floodwall, Levee, Floodwall, Ring Levee, Road embankment, RR Embankment, etc.	Yes		

Domain Values	
LevTyp_ID	LevTypDes
1	Floodwall
2	Levee
3	Levee & floodwall
4	Ring levee
5	Road embankment
6	RR embankment
7	Other

D_HWLnTy

Types of high water mark lines.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
LnTyp_ID	Long			Unique identifier for D_HWLnTy.	Yes	Yes	
LnTypDes	Text	20		Type of line: mud, debris, etc	Yes		

Domain Values	
LnTyp_ID	LnTypDes
1	Mud
2	Debris

Draft

D_MtlTyp

Bed material types for structures.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
MtrTyp_ID	Long			Unique identifer for D_MtlTyp.	Yes		
MtrTypDes	Text	20		Type of material: Gravel, Silt, Clay, Earthen, Concrete, etc.	Yes		

Domain Values	
MtrTyp_ID	MtrTypDes
1	Gravel
2	Silt
3	Clay
4	Earthen
5	Concrete
6	Other
7	Unknown

D_PpTyp

Pipe inlet/outlet types.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
PpTyp_ID	Long			Unique identifier for D_PpTyp.	Yes	Yes	
PpTypDes	Text	20		Inlet or outlet type: Socket, Projecting from fill, Bell, etc.	Yes		

Domain Values	
PpTyp_ID	PpTypDes
1	Socket
2	Projecting from fill
3	Bell

Draft

D_ShpTyp
Shape types.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
ShpTyp_ID	Long			Unique identifier for D_ShpTyp.	Yes	Yes	
ShpTypDes	Text	20		Shape of feature: Circular, Box, Rectangular, Elliptical,	Yes		

Domain Values	
ShpTyp_ID	ShpTypDes
1	Circular
2	Box
3	Rectangular
4	Elliptical
5	Octagonal
6	Other
7	Trapezoidal
9	Unknown

Draft

D_SWyTyp

Types of spillways.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
SplTyp_ID	Long			Unique identifier for D_SWyTyp.	Yes	Yes	
SplTypDes	Text	20		Type of spillway: Auxiliary/Emergency, Service/Principal, etc.	Yes		

Domain Values	
SplTyp_ID	SplTypDes
1	Auxiliary/Emergency
2	Service/Principal
3	Other
4	Unknown

D_StrTyp

Types of surveyed structures.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
StrTyp_ID	Long			Unique identifier for D_StrTyp.	Yes	Yes	
StrTypDes	Text	20		Structure type: Bridge, Culvert, Dam, Levee, Channel, etc.	Yes		

Domain Values	
StrTyp_ID	StrTypDes
1	Bridge
2	Culvert
3	Dam
4	Levee

Draft

HWMWtnss

Witness associated with high water marks.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
Wtnss_ID	Long			Unique identifier for HWMWtnss.	Yes	Yes	
ChangeDt	Data/Time			Date the record was last updated.			
CreateDt	Data/Time			Date the record was created.	Yes		
WtnssNm	Text	60		Name of high water mark witness.	Yes		
Address	Text	255		Physical address of high water mark	Yes		
Phone	Text	20		Telephone number for high water mark witness.	Yes		

L_ApxPht

A look up table that links photos associated with structures surveyed for limited detail studies. Junction table between S_ApxStr and Photo.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
AprxPht_ID	Long			Unique identifier for ApprxStucPhoto.	Yes	Yes	
AprxStr_ID	Long			Foreign key to S_ApxStr.	Yes		
Photo_ID	Long			Foreign key to Photo.	Yes		

L_HWMPht

A look up table that links photos associated with high water marks. Junction table between S_HWM and Photo.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
HWMPht_ID	Long			Unique identifier for L_HWMPht.	Yes	Yes	
HWM_ID	Long			Foreign key to S_HWM.	Yes		
Photo_ID	Long			Foreign key to Photo.	Yes		

Draft

L_HWMSkt

A look up table that links sketches associated with high water marks. Junction table between S_HWM and Sketch.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
HWMSkt_ID	Long			Unique identifier for L_HWMSkt.	Yes	Yes	
HWM_ID	Long			Foreign key to S_HWM.	Yes		
Sketch_ID	Long			Foreign key to Sketch.	Yes		

L_StrPht

A look up table that stores links to field photos for each structure. Junction table between S_Struc and Photo.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
StrPht_ID	Long			Unique identifier for L_StrPht.	Yes	Yes	
Struc_ID	Long			Foreign key to S_Struc.	Yes		
Photo_ID	Long			Foreign key to Photo.	Yes		

L_StrSkt

A look up table that stores the links to field sketches for each structure. Junction table between S_Struc and Sketch.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
StrSkt_ID	Long			Unique identifier for L_StrSkt.	Yes	Yes	
Struc_ID	Long			Foreign key to S_Struc.	Yes		
Sketch_ID	Long			Foreign key to Sketch.	Yes		

Draft

L_Wtr_Nm

A lookup table that contains the name of the surface water feature shown on the Flood Insurance Rate Map (FIRM) and referenced throughout

L_XSPht

Stores links between photos and cross sections. Junction table between S_SXS and Photo.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
XSPht_ID	Long			Unique identifier for L_XSPht.	Yes	Yes	
XS_ID	Long			Foreign key to S_SXS.	Yes		
Photo_ID	Long			Foreign key to Photo.	Yes		

L_XSSkt

Stores links to field sketches for each structure. Junction table between S_SXS and Sketch.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
XSSkt_ID	Long			Unique identifier for L_XSSkt	Yes	Yes	
XS_ID	Long			Foreign key to S_SXS.	Yes		
Sketch_ID	Long			Foreign key to Sketch.	Yes		

Draft

Photo

Photos associated with structures, High Water Marks (HWM), etc.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
Photo_ID	Long			Unique identifier for Photo.	Yes	Yes	
Azimuth	Double			Horizontal angle of the bearing for the			
ChangeDt	Data/Time			Date the record was last updated.			
Comments	Text	255		Additional information about the photo.			
CreateDt	Data/Time			Date the record was created.	Yes		
Easting	Double		2	X-coordinate of standing position of photographer.	Yes		
FileNm	Text	255		Name of the photo file.	Yes		
Location	Text	255		A description of the geographic location where the picture was taken.	Yes		
Northing	Double		2	Y-coordinate of standing position of photographer.	Yes		
PhotoDt	Data/Time			The date that the picture was taken.	Yes		
Subject	Text	50		Description of feature or view.	Yes		

Draft

S_ApxStr

General data about structures surveyed for limited detailed studies (LDS).

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
AprxStr_ID	Long			Unique identifier for S_ApxStr.	Yes	Yes	
Wtr_Nm_ID	Long			Foreign key to L_Wtr_Nm. Surface water feature name.	Yes		
TopoXS_ID	Long			Foreign key to S_SXS. Natural ground cross section at structure.	Yes		
TORXS_ID	Long			Foreign key to S_SXS. Top of road cross section.			
GPSPt_ID	Long			GPS point identification.			
StrTyp_ID	Long			Structure type.	Yes		D_StrTyp
Backsight	Double		2	Backsight rod reading to VCE	Yes		
CBElv	Double		2	Average channel bank elevation.	Yes		
ChangeDt	Data/Time			Date the record was last updated.			
ChlWdBot	Double		1	Width at the bottom of channel.	Yes		
ChlWdTop	Double		1	Width at the top of channel.	Yes		
Comments	Text	255		Additional information, notes, etc.			
CreateDt	Data/Time			Date the record was created.			
DeckThick	Double		2	Deck thickness. (Note: Only bridges have deck thickness.)	Yes		
DOTid	Text	40		ID or name assigned by DOT of respective state.	Yes		
DSEasting	Double		2	X-coordinate at downstream face.	Yes		
DSNorthing	Double		2	Y-coordinate at downstream face.	Yes		
ElvMin	Double		2	Minimum elevation at structure.	Yes		
PierWd	Double		1	Average width of piers. (Note: Only bridges have piers.)			
RoadNm	Text	100		Road name.			
StrmSta	Double		2	Distance along stream where structure intersects stream.			
StrucNm	Text	50		Structure Name. This is the name of the feature and the name that will be shown on the hardcopy FIRM. It is "UNKNOWN" if the structure is not named on FIRM and/or the name is unknown.	Yes		
SurveyDt	Data/Time			Date of survey.	Yes		
TopWd	Double		1	Top width of channel at structure.	Yes		
ToeWd	Double		1	Toe width of channel at structure.	Yes		
TORElv	Double		2	Maximum top of road elevation at structure	Yes		
USEasting	Double		2	X-coordinate at upstream face.	Yes		
USNorthing	Double		2	Y-coordinate at upstream face.	Yes		
VCE	Double		2	Elevation of vertical control point.			
Wdth	Double		1	Hydraulic distance from one edge of structure to the other, parallel to stream.	Yes		

S_HWM

Information About High Water Marks (HWM).

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
HWM_ID	Long			Unique identifier for S_HWM.	Yes	Yes	
Wtr_Nm_ID	Long			Foreign key to L_Wtr_Nm. Surface water feature name.	Yes		
LnTyp_ID	Long			Type of line.	Yes		D_HWLnTy
Wtnss_ID	Long			Foreign key to HWMWtnss table.	Yes		
ChangeDt	Data/Time			Date the record was last updated.			
Comments	Text	255		Other information about the high water mark: Notes, comments, assumptions, etc.			
CreateDt	Data/Time			Date the record was created.	Yes		
Easting	Double		2	X-coordinate.	Yes		
Elev	Double		2	Elevation of water mark.	Yes		
Freq	Text	20		Frequency of the storm event.			
HWMNm	Text	50		Name of high water mark.	Yes		
IntrviewDt	Data/Time			Date of high water mark witness interview.	Yes		
Location	Text	100		Location of the high water mark	Yes		
Northing	Double		2	Y-coordinate.	Yes		
ResLngth	Text	20		How long a witness has lived at a particular residence.			
EventDt	Data/Time			Date of the storm.	Yes		
StormNm	Text	50		Name of storm.			
SurvPrmt	Yes/No			Do the surveyors have permission to survey? Yes/No.	Yes		

Draft

S_Struc

General data about surveyed structures for detailed studies.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
Struc_ID	Long			Unique identifier for S_Struc.	Yes	Yes	
ERM_ID	Long			ERM_ID of benchmark, provides link to spatial file S_ERM.	Yes		
Wtr_Nm_ID	Long			Foreign key to L_Wtr_Nm. Surface water feature name.	Yes		
StrTyp_ID	Long			Type of structure.	Yes		D_StrTyp
MtrBedT_ID	Long			Bed material.	Yes		D_MtlTyp: MtrTyp_ID
MtrFllT_ID	Long			Fill material.	Yes		D_MtlTyp: MtrTyp_ID
ChangeDt	Data/Time			Date the record was last updated.			
CLEasting	Double		2	Easting or X-coordinate of centerline	Yes		
CLNorthing	Double		2	Northing or Y-coordinate of centerline station.	Yes		
CLOffset	Double		2	Offset in feet from an adjacent structure on the same stream (for multiple openings).			
CLStation	Double		2	Cross section station, in profile view, along structure of intersection of structure and stream centerline.	Yes		
Comments	Text	255		General comments or notes.			
Contractor	Text	50		Firm or agency who built the structure.			
CreateDt	Data/Time			Date the record was created.	Yes		
Designer	Text	50		Designer of the structure.			
InvertDS	Double		2	Lowest point in stream, under structure on downstream side.	Yes		
InvertUS	Double		2	Lowest point in stream, under structure on upstream side.	Yes		
Lngth	Double		2	Distance from beginning of structure to end. Measured perpendicular to stream for bridges, culverts and dams. Measured along crest of levee or centerline of	Yes		
Orient	Text	20		Looking upstream or downstream.	Yes		
PlansLocal	Text	100		Where structure construction plans are located.			
RlHtAvg	Double		1	Average rail height.	Yes		
Skew	Double			Angle of structure, if not perpendicular to stream.	Yes		
StrmSta	Double		2	Distance along stream where structure intersects stream.	Yes		
StrucNm	Text	20		Field Name of the structure.	Yes		
SurveyDt	Data/Time			Date and time when survey was performed.	Yes		
SurveyFile	Text	255		Path and file name of survey text file.	Yes		
Wdth	Double		1	Hydraulic distance from one edge of structure to the other, parallel to stream.	Yes		
YrBuilt	Integer			Year the structure was built.			

S_SXS

General information about a surveyed cross section.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
XS_ID	Long			Unique identifier for S_XSect.	Yes	Yes	
Struc_ID	Long			Foreign key to S_Struc.	Yes		
DataTyp_ID	Long			Cross section or data type.	Yes		D_DatTyp
Wtr_Nm_ID	Long			Foreign key to L_Wtr_Nm. Surface water feature name.	Yes		
ERM_ID	Text	25		Elevation reference point of cross section.	Yes		
ChangeDt	Data/Time			Date the record was last updated.			
CLStation	Double		2	Cross section station at intersection of cross section and stream centerline.	Yes		
CLEasting	Double		2	X-coordinate at stream crossing.	Yes		
CLNorthing	Double		2	Y-coordinate at stream crossing.	Yes		
Comments	Text	255		General comments or notes.			
CreateDt	Data/Time			Date the record was created.	Yes		
Invert	Double		2	Lowest elevation in cross section.	Yes		
Location	Text	255		Description of location.	Yes		
Orient	Text	20		Looking upstream or downstream.	Yes		
StreamSta	Double		2	Distance along stream.	Yes		
SurveyDt	Data/Time			Date and time of field survey.	Yes		

Draft

Sketch

Sketches associated with structures, High Water Marks (HWM), etc.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
Sketch_ID	Long			Unique identifier for Sketch.	Yes	Yes	
ChangeDt	Data/Time			Date the record was last updated.			
Comments	Text	255		Additional information about the sketch.			
CreateDt	Data/Time			Date the record was created.	Yes		
FileNm	Text	255		File path for the location of the sketch.	Yes		

StrBrdg

Information specific to a bridge, such as abutment stations.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
Brdg_ID	Long			Unique identifier for StrBrdg.	Yes	Yes	
Struc_ID	Long			Foreign key to S_Struc.	Yes		
AbtmntStaL	Double		2	Left station of abutment, input from survey data.	Yes		
AbtmntStaR	Double		2	Right station of abutment, input from survey data.	Yes		
AbtmntTyp	Text	20		Type of abutment, user defined.	Yes		
ChangeDt	Data/Time			Date the record was last update.			
CreateDt	Data/Time			Date the record was created.	Yes		
DeckThick	Double			Measurement from top of road to bottom of bridge.	Yes		
FillStaL	Double		2	Station of left toe of fill.	Yes		
FillStaR	Double		2	Station of right toe of fill.	Yes		
SideSlopeL	Double		2	Slope of left fill station.	Yes		
SideSlopeR	Double		2	Slope of right fill station	Yes		

StrLChrd

Low steel survey shots taken at bridges (bottom of superstructure).

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
LCord_ID	Long			Unique identifier for StrLChrd.	Yes	Yes	
Brdg_ID	Long			Foreign key to StrBrdg.	Yes		
ChangeDt	Data/Time			Date the record was last updated.			
Comments	Text	255		General comments.			
CreateDt	Data/Time			Date the record was created.	Yes		
Easting	Double		2	X-coordinate.	Yes		
Elev	Double		2	Feet above sea level.	Yes		
Northing	Double		2	Y-coordinate.	Yes		
Station	Double		2	Cross section station.	Yes		

Draft

StrPr

Information on bridge piers, such as pier width and shape.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
Pier_ID	Long			Unique identifier for StrPr.	Yes	Yes	
Brdg_ID	Long			Foreign key to StrBrdg.	Yes		
FndTyp_ID	Long			Type of pier support.	Yes		D_FndTyp
ShpTyp_ID	Long			Shape of pier.	Yes		D_ShpTyp
CapHt	Double		1	Height of pier cap.	Yes		
CapTopElv	Double		2	Elevation at top of cap.	Yes		
ChangeDt	Data/Time			Date the record was last updated.			
CLStation	Double		2	Station at centerline of pier (referencing profile view of structure).	Yes		
ColmnCount	Integer			Number of columns of piers occuring at one station.	Yes		
Comments	Text	255		Notes, comments, assumptions, etc.			
CreateDt	Data/Time			Date the record was created.	Yes		
FootTopElv	Double		2	Elevation at top of footing.	Yes		
FootWd	Double		1	Width of pier footer.	Yes		
Wdth	Double		1	Width of pier.	Yes		

Draft

StrCulPp

Information about one pipe at a culvert crossing.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
CulPp_ID	Long			Unique identifier for StrCulPp.	Yes	Yes	
Struc_ID	Long			Foreign key to S_Struc.	Yes		
CulShp_ID	Long			Cross sectional shape of culvert.	Yes		D_ShpTyp
MtrTyp_ID	Long			Pipe material.	Yes		D_MtlTyp
InTyp_ID	Long			Type of inlet.	Yes		D_PpTyp: PpTyp_ID
OutTyp_ID	Long			Type of outlet.	Yes		D_PpTyp: PpTyp_ID
ChangeDt	Data/Time			Date the record was last updated.			
CLStation	Double			Centerline station of pipe	Yes		
Comments	Text	255		General comments about the culvert pipe.			
CreateDt	Data/Time			Date the record was created.	Yes		
InvertDS	Double		2	Elevation at bottom of downstream pipe opening	Yes		
InvertUS	Double		2	Elevation at bottom of upstream pipe opening	Yes		
PipeLn	Double		1	Length of pipe.	Yes		
Rise	Double		1	Height or diameter of pipe.	Yes		
Wdth	Double		1	Width or span of pipe.	Yes		

Draft

StrDam

Information specific to a dam, such as embankment type or location of a drain valve.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
Dam_ID	Long			Unique identifier for StrDam.	Yes	Yes	
Struc_ID	Long			Foreign key to S_Struc.	Yes		
DamTyp_ID	Long			Type of dam.	Yes		D_DamTyp
EmbTyp_ID	Long			Type of embankment.	Yes		D_EmbTyp
ChangeDt	Data/Time			Date the record was last updated.			
CreateDt	Data/Time			Date the record was created.	Yes		
DamHt	Double		1	Height of Dam.	Yes		
EmbankCls	Text	20		Embankement classification.			
EmbankSlpe	Double		2	Slope of embankement.			
FloodElv	Double		2	Estimated 100-year flood elevation.			
FloodVol	Double		2	Estimated 100-year flood volume retained.			
HazClass	Text	20		User assigned classification.			
NormalArea	Double		2	Area of pool at normal water surface elevation.			
NWSElv	Double		2	Normal water surface elevation (level pool elevation).	Yes		
TopDamElv	Double		2	Elevation at top of dam.	Yes		
ValveEast	Double		2	X-coordinate of valve.			
ValveNorth	Double		2	Y-coordinate of valve.			

Draft

StrRsrBrl

Riser barrel data, such as size and trash rack information.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
RsrBrl_ID	Long			Unique identifier for StrRsrBrl.	Yes	Yes	
Dam_ID	Long			Foreign key to StrDam.	Yes		
ShpTyp_ID	Long			Shape of riser.	Yes		D_ShpTyp
MtrTyp_ID	Long			What the riser is made from.	Yes		D_MtlTyp
ChangeDt	Data/Time			Date the record was last updated.			
CLStation	Double		2	Station where riser barrel is located.	Yes		
Comments	Text	255		Notes, comments, etc.			
CreateDt	Data/Time			Date the record was created.	Yes		
ElvBase	Double		2	Elevation at the bottom of the riser barrel.	Yes		
ElvTop	Double		2	Elevation at the top of riser barrel.	Yes		
Lngth	Double		1	Length of the riser barrel.	Yes		
TrElvTop	Double		2	Elevation at top of trashrack.	Yes		
TrHt	Double		1	Height of trashrack.	Yes		
TrLn	Double		1	Length of trashrack.	Yes		
TrWd	Double		1	Width of trashrack.	Yes		
Wdth	Double		1	Width of the riser barrel.	Yes		

Draft

StrOrfc

Information on size and number of similar orifices clustered together on a riser barrel.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
RsrOrfc_ID	Long			Unique identifier for StrOrfc.	Yes	Yes	
RsrBrl_ID	Long			Foreign key to StrRsrBrl.	Yes		
ShpTyp_ID	Long			Shape of orifice.	Yes		D_ShpTyp
ChangeDt	Data/Time			Date the record was last updated.			
CLElv	Double		2	Elevation at center of orifice.	Yes		
Comments	Text	255		Notes, comments, etc.			
CreateDt	Data/Time			Date the record was created.	Yes		
Diameter	Double		1	Diameter of orifice.	Yes		
Height	Double		1	Height of orifice.	Yes		
OrfcCount	Integer		1	Number of same size orifices at a given elevation.	Yes		
Wdth	Double		1	Width of orifice.	Yes		

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StrOtlPp

Pipe(s) at the bottom of a riser barrel, which transport water underneath the dam structure.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
RsrOtl_ID	Long			Unique identifier for StrOtlPp.	Yes	Yes	
RsrBrl_ID	Long			Foreign key to StrRsrBrl.	Yes		
InTyp_ID	Long			Type of inlet.	Yes		D_PpTyp
OutTyp_ID	Long			Type of outlet.	Yes		D_PpTyp
MtrTyp_ID	Long			Pipe material.	Yes		D_MtlTyp
ShpTyp_ID	Long			Type of pipe shape.	Yes		D_ShpTyp
ChangeDt	Data/Time			Date the record was last updated.			
CLStation	Double		2	Centerline station where outlet pope is located.	Yes		
Comments	Text	255		General comments or notes.			
CreateDt	Data/Time			Date the record was created.	Yes		
Diameter	Double		1	Diameter of outlet pipe.	Yes		
Height	Double		1	Height of outlet pipe.	Yes		
InvertDS	Double		2	Elevation at downstream invert of outlet	Yes		
InvertUS	Double		2	Elevation at upstream invert of outlet pipe.	Yes		
Lngth	Double		1	Length of outlet pipe.	Yes		
Wdth	Double		1	Width of outlet pipe.	Yes		

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StrSWy

A relief device at a dam, used to prevent overtopping during a large flood.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
Spllway_ID	Long			Unique identifier for StrSWy.	Yes	Yes	
Dam_ID	Long			Foreign key to StrDam.	Yes		
SplTyp_ID	Long			Type of spillway.	Yes		D_SWyTyp
ChangeDt	Data/Time			Date the record was last updated.			
CLStation	Double		2	Centerline station of spillway.	Yes		
Comments	Text	255		General comments or notes.			
CreateDt	Data/Time			Date the record was created.	Yes		
Depth	Double		1	Depth of spillway from top to bottom.	Yes		
ElevCrest	Double		2	Elevation at crest of spillway.	Yes		
ElevTop	Double		2	Elevation at top of spillway.	Yes		
SideslopeL	Double		2	Slope of left side of spillway.			
SideslopeR	Double		2	Slope of right side of spillway.			
WdthBtm	Double		1	Width at the bottom of spillway.	Yes		
WdthTop	Double		1	Width at top of spillway.	Yes		

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StrLev

Information specific to a levee.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
Levee_ID	Long			Unique identifier for StrLev.	Yes	Yes	
Struc_ID	Long			Foreign key to S_Struc.	Yes		
ClsTyp_ID	Long			Type of closures required to operate structure.	Yes		D_ClsTyp
LevTyp_ID	Long			Type of levee.	Yes		D_LevTyp
Accredit	Text	50		Accreditation or verification: Meets FEMA policy - FEMA, credited prior to FEMA's policy - PRIOR, or certified by another Federal agency as providing 100-year protection - FEDERAL	Yes		
ArProtec	Text	50		Area of protected area in square miles	Yes		
Bank	Text	1		Side of channel on which structure is located, when looking downstream: Left - L, or right - R	Yes		
ChangeDt	Data/Time			Date the record was last updated.			
CreateDt	Data/Time			Date the record was created.	Yes		
FreeBoard	Double		1	Minimum freeboard of structure.	Yes		
HasFailed	Yes/No			Have failures occurred? Yes/No.	Yes		
IsOpPlan	Yes/No			Is there an approved operational plan? Yes/No.	Yes		
IsMaint	Yes/No			Is there a FEMA-approved maintenance plan? Yes/No.	Yes		
Protect	Double		1	Exceedence frequency in years that flood structure was designed to protect against	Yes		
ProtectLU	Text	1		Area protected by structure is primarily developed - D, or undeveloped - U	Yes		
SideSlope	Double		2	Average side slope	Yes		
SurveyDt	Data/Time			Date and time when survey was performed.	Yes		
TopElv	Double		2	Average top elevation of levee.	Yes		

StrRail

Surveyed top of rail shots.

Field	Data Type	Length	Decimal Places	Description	Required	PK	Domain Table
Rail_ID	Long			Unique identifier for StrRail.	Yes	Yes	
Struc_ID	Long			Foreign key to S_Struc.	Yes		
ChangeDt	Data/Time			Date the record was last updated.			
CreateDt	Data/Time			Date the record was created.	Yes		
Elev	Double		2	Elevation at top of rail.	Yes		
Height	Double		1	Height of rail.	Yes		
Station	Double		2	Cross section station of rail.	Yes		

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N.4 Hydrology Submittal Standards

N.4.1 Overview

The goal of this section is to describe the format and type of hydrologic data expected by FEMA for new riverine flood insurance studies. The objective is to archive the hydrologic data in a database so that these data can be revised and used with minimum effort in future flood insurance studies or map revisions. New techniques such as digital terrain analysis, geospatial database management, and digital hydrologic and hydraulic models make it possible to protect the data investment and make these data available for reuse in existing and future studies to a much greater extent than in the past.

As described in Appendix C, *Guidance for Riverine Flooding Analyses and Mapping*, there are three broad categories of hydrologic procedures used in the National Flood Insurance Program (NFIP): flood frequency analyses for gaged streams using Bulletin 17B, Guidelines For Determining Flood Flow Frequency (Interagency Advisory Committee on Water Data, 1982); regional regression equations for ungaged streams, generally those developed by the U.S. Geological Survey (http://water.usgs.gov/software/nff.html); and rainfall-runoff models for ungaged streams that utilize rainfall data to estimate flood discharges. Within the category of rainfall-runoff models, the HEC-1 and HEC-HMS models developed by the U.S. Army Corps of Engineers (USACE), Hydrologic Engineering Center (HEC), are used most frequently in the NFIP. In addition to the two USACE models, FEMA presently accepts hydrologic results from over a dozen other rainfall-runoff models (http://www.fema.gov/fhm/en_hydro.shtm) and it is likely that new models will be added in the future. Considering the widely varying data requirements for these models, initial efforts to archive the hydrologic data will concentrate on a minimum data set required to describe the hydrologic procedures.

In recent years, pre- and post-processors have been developed that automate the application of hydrologic models and provide links to Geographic Information Systems (GIS), hydraulic models and floodplain mapping procedures. Some examples of pre- and post processor systems that implement rainfall-runoff models include the Watershed Modeling System (WMS) developed by Brigham Young University, the Modular Modeling System (MMS) developed by the U.S. Geological Survey, BASINS developed by the Environmental Protection Agency, and the Watershed Information System (WISE) developed by Watershed Concepts. These automated systems create input and output files that can be easily archived.

Using FEMA acceptable hydrologic modeling methods, such as flood frequency analyses for gaged streams, application of regional regression equations or a rainfall-runoff model, the Minimum Required Data Set is described in detail in this section and includes the following items:

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- A geo-referenced/projected hydrologic link network. Typically this will be the same as the stream channel network.
- A geo-referenced point data set showing the locations of computed discharges and the design discharges obtained from the hydrologic analysis that can be converted to a FIS Discharge Summary Table.
- Input and output files for an approved hydrologic model where used (see http://www.fema.gov/fhm/en_hydro.shtm for an updated list of these models).
- A series of database tables summarizing key data.
- A design hydrology report.
- A geo-referenced /projected polygon feature class of watershed areas contributing runoff to the stream channel network, subdivided into the subcatchments, if utilized for hydrologic modeling.
- Optional geospatial data sets and database tables utilized for parameter calculation.

A detailed description of each of these data requirements is provided in the body of this section. Because of the frequent use of applications such as HEC-1 and HEC-HMS that utilize a design rainfall event and the Natural Resources Conservation Service runoff curve number and time of concentration approach, these data are requested in the tables described in this section. Additional tables will be added in the future to capture data from other methods as well.

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N.4.2 Requirements

N.4.2.1 Data Files

These deliverables are required for a hydrology submittal.

- Database Tables
- Spatial Files
- Hydrology Model Input and Output Files

Most spatial features can be stored in an ESRI shapefile or Open GML document, with the necessary attribute fields. Other domain and hydrologic results tables will be populated in Dbase IV format or Microsoft Access. All spatial data must be geo-referenced and elevation data must include datum information.

Database tables and spatial data sets needed for hydrologic submittal are provided in Table N-25.

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Table N-25. Hydrology Database and Spatial Data

Table Name	Description
HydroModel	A database table. The highest level representation of a hydrology model. Contains important information on geometry and results files.
HydroNode	A spatial data set consisting of points showing the locations of computed discharge values.
HydroLink	A spatial data set showing the hydrologic connectivity network.
HydroBasin	A spatial data set consisting of polygons depicting basin boundaries.
HydroResult	A database table. Identifies one or more flood events per model at each point of the HydroNode spatial data.
WtrName	A database table. A lookup table of stream names.
HydroEvent	A database table. A lookup table of flood events.
HydroGage	A point spatial file of flow and precipitation gage locations. Required if utilized for calibration, regression, or frequency analysis.
HydroSoil	A polygon spatial file of soils. Required if utilized for model parameterization.
HydroLanduse	A polygon spatial file of landuse classifications. Required if utilized for model parameterization.
HydroImpervious	A polygon spatial file of impervious areas. Required if utilized for model parameterization.
HydroEquation	A database table. Lookup table of regression equations. Required if regression analysis utilized.
HydroNodeParam	A database table. Used for storing regression equation parameter values. Required if regression analysis is utilized.
D_HydroParam	A domain table. Used for storing regression equation parameter types. Required if regression analysis is utilized.
HydroTC	A linear spatial file of time of concentration calculations. Required if utilized for rainfall runoff model parameterization.
HydroCNResult	A data table. Contains curve numbers for subbasins. Required if utilized for rainfall runoff model parameterization.
HydroCNLookup	A database table. Lookup of curve numbers by soil and landuse. Required if utilized for rainfall runoff model parameterization.
HydroStormInfo	A database table. Describes precipitation patterns. Required if utilized for rainfall runoff model parameterization.
HydroStormCurve	A database table. Used for storing DDF and IDF curves. Required if utilized for rainfall runoff model parameterization.

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Depending on the scope of work, the mapping partner may develop a new hydrologic model with all the associated input files, may modify an existing model developed for the effective flood insurance study or a related study, or simply utilize an existing model or adopt the effective flood discharges. Table N-2 describes the minimum required data sets for each study approach and the three hydrologic modeling approaches described earlier, watershed model, regression equations and gage analysis. If existing models are not available in digital format, the hardcopy output from the model or analysis should be scanned into a PDF file.

Table N-26. Minimum Required Data Sets*

	Watershed Model	Regression Analysis	Gage Analysis
New Model	**Spatial File:** • HydroBasin • HydroNode • HydroLink **Table:** • HydroModel • HydroResult • HydroEvent • WtrName	**Spatial File:** • HydroNode • HydroLink **Table:** • HydroModel • HydroResult • HydroEvent • WtrName • HydroEquation • HydroNodeParam • D_HydroParam	**Spatial File:** • HydroNode • HydroLink • HydroGage **Table:** • HydroModel • HydroResult • HydroEvent • WtrName
Modification of existing model	**Spatial File:** • HydroNode • HydroLink **Table:** • HydroModel • HydroResult • HydroEvent • WtrName	**Spatial File:** • HydroNode • HydroLink **Table:** • HydroModel • HydroResult • HydroEvent • WtrName • HydroEquation • HydroNodeParam • D_HydroParam	**Spatial File:** • HydroNode • HydroLink • HydroGage **Table:** • HydroModel • HydroResult • HydroEvent • WtrName
Reference an existing model	**Spatial File:** • HydroNode • HydroLink **Table:** • HydroModel • HydroResult • HydroEvent • WtrName	**Spatial File:** • HydroNode • HydroLink **Table:** • HydroModel • HydroResult • HydroEvent • WtrName • HydroEquation • HydroNodeParam • D_HydroParam	**Spatial File:** • HydroNode • HydroLink • HydroGage **Table:** • HydroModel • HydroResult • HydroEvent • WtrName

*Additional data sets (such as HydroLanduse) are still required if utilized.

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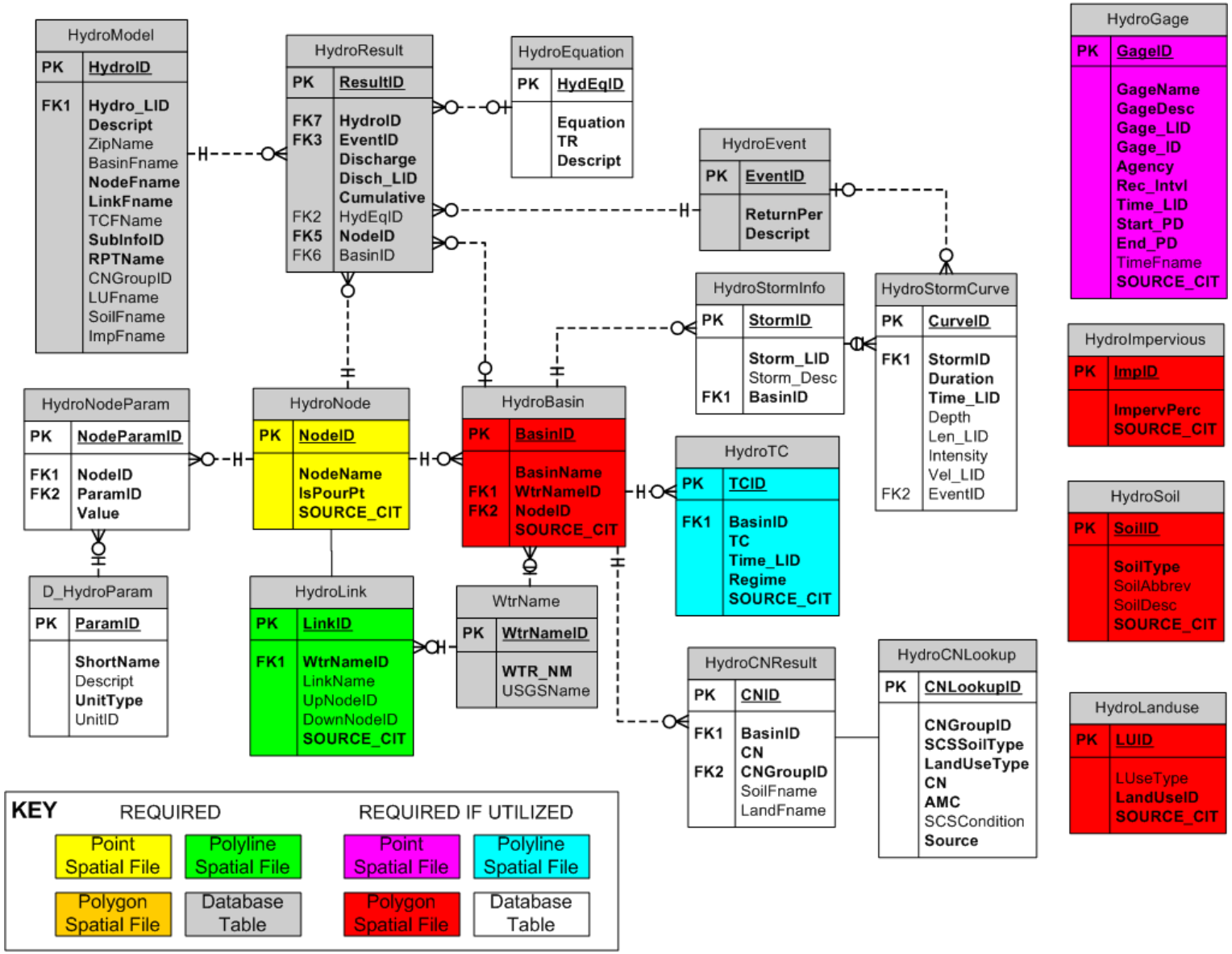
Figure N-8. Entity Relationship Diagram for Hydrology



N.4.2.2 Required Hydrologic Data

HydroModel Table

The HydroModel table is a database table. It is required for all types of hydrologic analyses. This table identifies the model(s) and hydrologic result file(s) related to a particular watershed.

The HydroModel table contains the following attributes:

Table N-27. HydroModel Table

Field	Type	Length	Required?	Descr
HydroID	Long		Yes	Primary key for table. AutoNumber field.
Hydro_LID	Long		Yes	A foreign key to the D_Hydro domain table
Descript	Text	255	Yes	Model description
ZipName	Text	255	No	Path and filename of a compressed hydrologic model including inputs and outputs
BasinFname	Text	255	No	Path and filename of HydroBasin spatial file
NodeFname	Text	255	Yes	Path and filename of HydroNode spatial file
LinkFname	Text	255	Yes	Path and filename of HydroLink spatial file
TCFname	Text	255	No	Path and filename of HydroTC spatial file
SubInfoID	Long		Yes	Foreign key to Submittal_Info table.
RPTName	Text	255	Yes	Path and filename of the design hydrology report
CNGroupID	Long		No	Foreign key to HydroCNLookup table used to identify a set of curve numbers.
LUFname	Text	255	No	Path and filename of HydroLandUse spatial file
SoilFname	Text	255	No	Path and filename of HydroSoil spatial file
ImpFname	Text	255	No	Path and filename of HydroImpervious spatial file

HydroNode Spatial File

The HydroNode spatial file is required for all types of hydrologic analyses. Each point in this spatial data can have computed discharge values (in HydroResult table) associated with it, when paired with a HydroModel. The points must lie on the stream centerlines as shown in the HydroLink spatial data set. HydroNodes can represent subbasin pour points or HydroLink confluences.

The HydroNode spatial file contains the following attributes:

Table N-28. HydroNode Spatial File

NodeID	Long		Yes	Primary key for table.
NodeName	Text	255	Yes	Description of the location. This information will be included in the FIS text.
IsPourPt	Boolean		Yes	Nodes can be either basin pour points or confluences
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

HydroLink Spatial File

The HydroLink spatial file(s) is required for all types of hydrologic analysis. This data set is used as the base for delineation of basin boundaries and identification of discharge locations. The features in the HydroLink spatial file connect HydroNodes and follow the profile baseline. All link segments are to be drawn upstream to downstream, and must not be multi-part shapes.

The HydroLink attribute table contains the following information:

Table N-29. HydroLink Spatial File

Field	Type	Length	Required?	Description
LinkID	Long		Yes	Primary key for table.
WtrNameID	Long		Yes	A foreign key to the WtrName table.
LinkName	Text	255	No	An optional identification string for each reach
UpNodeID	Long		No	A foreign key to the HydroNode table. The upstream node of a link.
DownNodeID	Long		No	A foreign key to the HydroNode table. The downstream node of a link.
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

The following diagram illustrates the proper placement of HydroNodes and HydroLinks. Note that HydroNodes are required at basin pour points and confluences.

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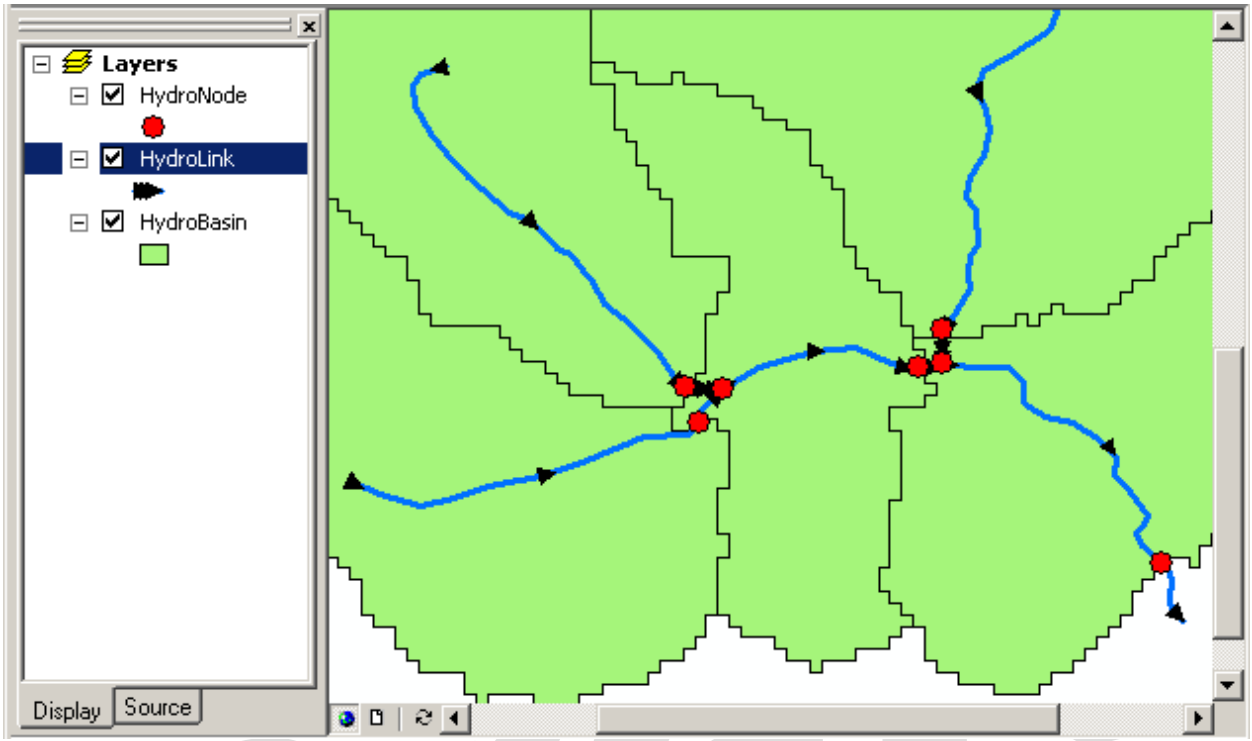
Figure N-9. Placement of HydroNodes and HydroLinks



HydroBasin Spatial File

The HydroBasin spatial file is required whenever basins have been utilized for hydrologic analyses. Basins must have only one part, and cannot self-intersect (must be simple). Adjacent basins should not overlap or have gaps between them. Each basin must overlay a corresponding stream segment in the HydroLink spatial data set, and must have a HydroNode representing the pour point.

The HydroBasin spatial file contains the following attributes:

Table N-30. HydroBasin Spatial File

Field	Type	Length	Required?	Description
BasinId	Long		Yes	Primary key for table.
BasinName	Text	100	Yes	An alpha-numeric name
WtrNameID	Long		Yes	A reference to WtrName table.
NodeID	Long		Yes	A foreign key to the HydroNode table.
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

HydroResult Table

The HydroResult table is a database table. It is required for all types of hydrologic analyses. This table identifies one or more flooding events associated with a node in the HydroNode table. A typical example would be 4 records for a 10-year, 50-year, 100-year and 500-year flood, corresponding to one particular method/model.

The HydroResult table contains the following attributes:

Table N-31. HydroResult Table

Field	Type	Length	Required?	Description
ResultID	Long		Yes	Primary key for table.
HydroID	Long		Yes	A reference to HydroModel.
EventID	Long		Yes	A reference to HydroEvent, which identifies the return period for this result.
Discharge	Double		Yes	Calculated discharge.
Disch_LID	Text	11	Yes	A foreign key to the D_Discharge_Units domain table.
Cumulative	Boolean		Yes	Specifies whether this result is for a subbasin discharge or a cumulative discharge.
HydEqID	Long		No	A reference to HydroEquation table.
NodeID	Long		Yes	A reference to HydroNode table.
BasinID	Long		No	A reference to HydroBasin table.

WtrName Table

The WtrName table is a database domain table. It is required for all types of hydrologic analyses. This table identifies the unique list of stream names used in the submittal.

The WtrName table contains the following attributes:

Table N-32. WtrName Table

Field	Type	Length	Required?	Description
WtrNameID	Long		Yes	Primary key for table.
WTR_NM	Text	255	Yes	Unique alpha-numeric name (i.e. Crooked Creek)
USGSName	Text	255	No	USGS unique stream name identifier

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HydroEvent Table

The HydroEvent table is a database table. It is required for all types of hydrologic analyses. This table identifies flooding events used in HydroModels.

The HydroEvent table contains the following attributes:

Table N-33. HydroEvent Table

Field	Type	Length	Required?	Description
EventID	Long		Yes	Primary key for table. AutoNumber field.
Return Per	Integer		Yes	The recurrence interval of the event in years (i.e. 10, 27, 100)
Descript	Text	32	Yes	Brief description of flood event (i.e. 10-year or Hurricane Hugo)

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N.4.2.3 Other Hydrologic Data

HydroGage Spatial File

The HydroGage spatial file is a spatial file that is used to locate precipitation and flow gages. It is required if it is utilized for calibration, regression, or frequency analysis.

The HydroGage spatial file contains the following attributes:

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Table N-34. HydroGage Spatial File

GageID	Long		Yes	Primary key for table.
GageName	Text	100	Yes	An alpha-numeric name
GageDesc	Text	255	Yes	Information describing the location of the gage (i.e. Black River at I-95)
Gage_LID	Text	11	Yes	Foreign key to D_Gage domain table.
Gage_ID	Text	25	Yes	Gage Identification. Assigned by the agency maintaining the gage.
Agency	Text	150	Yes	Agency. Name of agency maintaining the gage.
Rec_Intvl	Text	11	Yes	Recording Interval. Recording interval for the gage.
Time_LID	Text	11	Yes	Recording Interval Time Unit Lookup Identification. A code that provides a link to a valid entry from the D_Time_Units table. This attribute establishes the unit of measure of the recording interval.
Start_PD	Date/Time	8	Yes	Start Period. This value is the start of the earliest period of record used in the gage analysis.
End_PD	Date/Time	8	Yes	End Period. This value is the end of the latest period of record used in the gage analysis.
TimeFname	Text	255	No	Path and filename of database file with time series data (i.e. USGS WATSTORE-formatted peak discharge file, WDM files for HSPF, etc.)
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

HydroSoil Spatial File

The HydroSoil spatial file is a polygon spatial file of soil types. It is required if utilized for model parameterization. Soil polygons must have only one part, and cannot self-intersect (must be simple). Adjacent soils should not overlap or have gaps between them.

The HydroSoil spatial file contains the following attributes:

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Table N-35. HydroSoil Spatial File

Field	Type	Length	Required?	Description
SoilID	Long		Yes	Primary key for table.
SoilType	Text	20	Yes	Soil Type (dependent on classification system utilized – to be referenced in metadata.)
SoilAbbrev	Text	20	No	Abbreviation (i.e. Ch, Wg, Chcr)
SoilDesc	Text	100	No	Example: "Watauga Silty Clay Loam"
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

HydroLanduse Spatial File

The HydroLanduse spatial file is a polygon spatial file of landuse classifications. It is required if utilized for model parameterization. Landuse polygons must have only one part, and cannot self-intersect (must be simple). Adjacent landuses should not overlap or have gaps between them.

The HydroLanduse spatial file contains the following attributes:

Table N-36. HydroLandUse Spatial File

Field	Type	Length	Required?	Description
LUID	Long		Yes	Primary key for table.
LUseType	Text	100	No	Unique alpha-numeric name (i.e. Industrial, Residential Half-Acre, etc.).
LandUseID	Text	20	Yes	Land use ID based on a classification system. The classification system must be specified in metadata.
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

HydroImpervious Spatial File

The HydroImpervious spatial file is a polygon spatial file of impervious areas. It is required if utilized for model parameterization. Impervious areas must have only one part, and cannot self-intersect (must be simple). Adjacent areas should not overlap.

The HydroImpervious spatial file contains the following attributes:

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Table N-37. HydroImpervious Spatial File

Field	Ty	Leng	Decimal Places		Description
ImpID	Long			Yes	Primary key for table.
ImpervPerc	Double		2	Yes	Percent of impervious areas in the polygon
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

HydroTC Spatial File

The HydroTC spatial file is a linear spatial file representing Time of Concentration flowpaths. It is required if utilized for rainfall runoff model parameterization. Time of Concentration polylines must have only one part, and cannot self-intersect (must be simple). TCs are associated to a basin, and there can be one or more TCs per basin, if the engineer wishes to divide the overall path into channel, swale and overland parts.

The HydroTC spatial file contains the following attributes:

Table N-38. HydroTC Spatial File

Field	Type	Length	Decimal laces	Required?	Description
TCID	Long			Yes	Primary key for table.
BasinID	Long			Yes	A foreign key to the HydroBasin table.
TC	Double	5	2	Yes	Time of concentration (time is by segment, not total for a basin).
Time_LID	Text	11		Yes	Foreign key to D_Time_Units domain table
Regime	Text	10		Yes	Flow regime (i.e. Channel, Swale, Lake, Overland, Pipe, etc.)
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

HydroEquation Table

The HydroEquation table is a database table used to store basic regression equations utilized in regression analysis. It is required whenever basic regression equations are used in the modeling process. Variable names used in regression equations should correspond to parameter ShortNames in D_HydroParam.

The HydroEquation table contains the following attributes:

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Table N-39. HydroEquation Table

Field	Type	L	Required?	D
HydEqID	Long		Yes	Primary key for table. AutoNumber field.
Equation	Text	255	Yes	Textual depiction of equation (i.e. Q10 = 622*DA^0.75)
TR	Double		Yes	Recurrence interval.
Descript	Text	50	Yes	Details about the equation (2000 NC Regression Equations).

HydroNodeParam Table

The HydroNodeParam table is a database table used to store parameter values at nodes utilized in regression analysis. It is required whenever regression equations are used in the modeling process.

The HydroNodeParam table contains the following attributes:

Table N-40. HydroNodeParam Table

Field	Type	Required?	Description
NodeParamID	Long	Yes	Primary key for table. AutoNumber field.
NodeID	Long	Yes	Foreign key to HydroNode.
ParamID	Long	Yes	Foreign key to D_HydroParam.
Value	Double	Yes	Value for this parameter at this node.

D_HydroParam Table

The D_HydroParam table is a domain table used to store a list of node parameters utilized in regression analysis. It is required whenever regression equations are used in the modeling process. A sample domain table is included, but D_HydroParam is designed to expand as the user's needs expand, so this is not a comprehensive list.

The D_HydroParam table contains the following attributes:

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Table N-41. D_HydroParam Table

Field	Type	Length	Required?	De
ParamID	Long		Yes	Primary key for table. AutoNumber field.
ShortName	Text	255	Yes	Name of parameter. Used in regression equation.
Descript	Double		No	Details about this parameter.
UnitType	Text	10	Yes	Type of unit. Used to specify which domain table the UnitID field references. Values are "Time", "Length", "Velocity", "Volume", "Area", "None". The corresponding domain tables are D_Time_Units, D_Length_Units, D_Velocity_Units, D_Volume_Units, D_Area_Units, and none.
UnitID	Text	11	No	Foreign key to corresponding domain table.

Table N-42. Sample Domain Values

ParamID	ShortName	Descript	UnitType	UnitID
1	DA	Drainage Area	Area	1000
2	BDF	Basin Development Factor	None	
3	Slope	Main Channel Slope	None	
4	AvgBasinElev	Average Basin Elevation	Length	1010

HydroCNResult Table

The HydroCNResult table is a database table used for describing SCS curve numbers used in models such as HEC-1 and HEC-HMS. It is required if utilized for rainfall runoff model parameterization.

The HydroCNResult table contains the following attributes:

Table N-43. HydroCNResult Table

Field	Type	Length	Required?	Description
CNID	Long		Yes	Primary key for table. AutoNumber field.
BasinID	Long		Yes	A foreign key to HydroBasin.
CN	Double		Yes	Calculated SCS curve number.
CNGroupID	Long		Yes	A foreign key to the HydroCNLookup table.
SoilFname	Text	255	No	The name and path of the soils spatial file used to calculate these results.
LandFname	Text	255	No	The name and path of the landuse spatial file used to calculate these results.

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HydroCNLookup Table

The HydroCNLookup table is a database table that relates various combinations of soil and landuse types, to provide an appropriate curve number. It is required if curve numbers are utilized.

The HydroCNLookup table contains the following attributes:

Table N-44. HydroCNLookup Table

Field	Type	Length	Required?	Description
CNLookupID	Long		Yes	Primary key for table. AutoNumber field.
CNGroupID	Long		Yes	Used to identify a set of Curve Number lookups
SCSSoilType	Text	2	Yes	SCS Hydrologic Soil Type (A, B, C, D)
LandUseType	Text	24	Yes	Landuse name
CN	Double		Yes	SCS curve number established for this landuse / soil combination
AMC	Integer		Yes	Antecedent moisture condition (1,2 or 3)
SCSCondition	Text	50	No	Example: "Open Space – Fair condition"
Source	Text	255	Yes	"SCS TR-55", etc.

HydroStormInfo Table

The HydroStormInfo table is a database table that is useful for describing precipitation distributions used in the hydrologic analysis. It contains basic descriptions of precipitation patterns. It is required if utilized for rainfall runoff model parameterization.

The HydroStormInfo table contains the following attributes:

Table N-45. HydroStormInfo Table

Field	Type	Length	Required?	Description
StormID	Long		Yes	Primary key for table. AutoNumber field.
Storm_LID	Text	11	Yes	Storm Type Lookup Identification. A code that provides a link to a valid entry from the D_Storms table. This attribute establishes the storm type.
Storm_Desc	Text	254	No	Storm Description. Brief text description/note for the storm.
BasinID	Long		Yes	A foreign key to the HydroBasin table.

HydroStormCurve Table

The HydroStormCurve table is a database table that is useful for describing precipitation data used in the hydrologic analysis. It accommodates descriptions of Depth-Duration-Frequency

(DDF) and Intensity-Duration-Frequency (IDF) relationships, as well as durations of design storms and precipitation patterns of historical storms. It is required if utilized for rainfall runoff model parameterization.

The HydroStormCurve table contains the following attributes:

Table N-46. HydroStormCurve Table

Field	Type	Length	Required?	
CurveID	Long		Yes	Primary key for table. AutoNumber field.
StormID	Long		Yes	Storm Identification. A code that provides a link to a valid entry from the HydroStormInfo table.
Duration	Text	11	Yes	Duration. Duration of precipitation event. The duration is that of a design or historical storm, or of a point on a DDF or IDF curve.
Time_LID	Text	11	Yes	Duration Unit Lookup Identification. A code that provides a link to a valid entry from the D_Time_Units table. This attribute establishes the unit of measure of the corresponding duration entry.
Depth	Double		No	Precipitation Depth. This field is populated only if entering data for a DDF curve.
Len_LID	Text	11	No	Precipitation Depth Unit Lookup Identification. . A code that provides a link to a valid entry from the D_Length_Units table. This attribute establishes the unit of measure for the precipitation depth. This field is populated only if a precipitation depth is entered.
Intensity	Double		No	Rainfall intensity. This field is populated only if entering data for an IDF curve.
Vel_LID	Text	11	No	Rainfall Intensity Unit Lookup Identification. A code that provides a link to a valid entry from the D_Velocity_Units table. This attribute establishes the unit of measure for precipitation intensity. This field is populated only if precipitation intensity is entered.
EventID	Long		No	A foreign key to HydroEvent table.

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N.4.3 Deliverables

N.4.3.1 Metadata

To facilitate the use of these data and the transfer of data files between users, the assigned Mapping Partner shall prepare and submit a metadata file with all digital data submittals. Only one metadata file is required for each submittal. However, in this one file, the assigned Mapping Partner must distinguish between the different origins of the various data sets included. The Metadata file shall follow the *Content Standard for Digital Geospatial Metadata (version 2.0)*, FGDC-STD-001-1998. Details of this standard are available at www.fgdc.gov.

The metadata file must include a description of the source material from which the data were derived and the methods of derivation, including all transformations involved in producing the digital files. The description shall include the dates of the source material and the dates of ancillary information used for update. The date assigned to a source must reflect the date that the information corresponds to the ground. If the assigned Mapping Partner does not know this date, then the Mapping Partner may use a date of publication and indicate as such. Each data source in the metadata file must be assigned a Source Citation Abbreviation as described in Subsection L.2.2.1.

The assigned Mapping Partner shall describe any database created by merging information obtained from distinct sources in sufficient detail to identify the actual source for each element in the file.

Because not all database tables are included in every draft digital data submittal, the Overview Description Section of the Entity and Attribute Information of the metadata file must include a list of all database tables included in the submittal.

Portions of the file that are double underlined typically vary with each Mapping Partner's submittal. In addition, the Mapping Partner should modify or replace any other portions of the metadata file to fully document the data submitted.

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N.4.3.2 Hardcopy Deliverables

Supplemental information may be delivered in hardcopies.

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N.4.3.3 Digital Deliverables

Transfer Media

Mapping Partners must submit files on one of the following electronic media, or via the internet:

- CD-ROM (preferred); or
- DVD; or
- Upload to Management Information Portal (MIP) (http://www.fema.gov)

As technology changes or in special situations, other media may be acceptable if coordinated with FEMA.

Data Directory Structure and Folder Naming Conventions

An FDGC compliant metadata file will be placed in the "General" folder on the root directory of Disk1.

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The Mapping Partner is required to submit the input and output files for any study using detailed hydrologic models such as HEC-1 or HEC-HMS. If the data that was used to estimate the hydrologic parameters is available, it should be submitted as well.

Models are organized by watershed, with all model files in the "Simulations" folder and support spatial files in the "Spatialfiles" folder. Database files are stored in a "Database" folder, by watershed. Data must be located in the appropriate directory, as follows.

\General

- Metadata file
- Hydrology design report in PDF format

\Hydrology Models\Databases

- Database file(s)

\Hydrology Models\"Watershed Name"\Simulations

- Model input and output files by watershed

\Hydrology Models\"Watershed Name"\Spatialfiles

- Spatial files by watershed

Data Identification Requirements

All digital media submitted must be labeled with at least the following information:

- Mapping Partner name;
- Community name and state for which the FIS was prepared;
- Hydrologic Data;
- Date of submission (formatted mm/dd/yyyy); and
- Disk [*sequential number*] of [*number of disks*].

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N.5 Hydraulics Submittal Standards

N.5.1 Overview

The development of a hydraulic model to provide water surface elevations for floodplain mapping requires a significant investment in time and resources to obtain and process topographic survey data including cross section and bridge surveys. Recent developments in digital terrain and geospatial database management technology make it possible to protect this investment for existing and future projects to a much greater extent than was possible in the past. This appendix describes the format and type of hydraulic data to be provided to FEMA for new riverine flood insurance studies.

At the current time, FEMA accepts ten one-dimensional steady flow, nine one-dimensional unsteady flow, and four two-dimensional steady/unsteady flow hydraulic models for the delineation of floodplains and two models specifically developed for the delineation of floodways for any location within the United States. In addition, there are three models that have been developed for specific geographic locations that have been approved for use by FEMA.

If the past is any indication of future trends, new-generation hydraulic models (with significantly different data requirements) will be added to the FEMA list in the future. Considering the widely varying data requirements for these models, the FEMA database for supporting hydraulics must be flexible.

The Minimum Required Data Set, which is described in detail in the body of this appendix, includes the following items:

- A georeferenced/projected stream channel network, which is used for floodplain mapping.
- A georeferenced line data set showing the locations of cross sections used for the computation of water surface profiles for one-dimensional models, or a DTM file of water depths or other appropriate file structure for two-dimensional models.
- A georeferenced line data set showing preliminary floodway, 100-year and 500-year boundaries, where calculated.
- Input and output files for an approved hydraulic model (an updated list of these models can be obtained from http://www.fema.gov/fhm/en_hydra.shtm).
- All geospatial data sets utilized for parameter calculation without further processing (e.g. a spatial file of n-value polygons but not the land use polygons that they are based upon).
- An FIS narrative report
- A series of database tables summarizing key data.
- Some additional geo-spatial and database tables are required if utilized; i.e. overbank distances are used in certain models such as HEC-RAS and HEC-2.

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N.5.2 Requirements

N.5.2.1 Data Files

These deliverables are required for a hydraulics submittal.

- Database Tables
- Spatial Files
- Hydraulic Models

Most spatial features can be stored in an ESRI shapefile or Open GML document, with the necessary attribute fields. Other domain and hydraulic results tables will be populated in dBASE IV format or Microsoft Access.

The database tables and spatial files used in a hydraulics submittal are shown below.

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Table N-47. Hydraulics Tables and Spatial Data

Table Name	Description
HydraModel	A database table. The highest level representation of a hydraulic model. Contains important information on geometry and results files.
StreamCntrLine	A spatial data set showing the centerlines of the stream network. Used for backwater models such as HEC-RAS.
HydraCrossSection	A linear spatial file of cross sections.
S_Stn_Start	Spatial file that describes the point where a riverine model starts. See Appendix L.
HydraFloodResult	A database table. Stores flood elevations and discharges for a cross section.
HydraEvent	A database table. Identifies flood events.
WtrName	A database table. A lookup table of stream names.
HydraMapping	A linear spatial file containing preliminary floodway boundaries, 100-year and 500-year flood boundaries
S_BFE	A linear spatial file containing "work map" BFEs.
Stream Profiles	A CAD drawing file containing stream profiles. Used in the FIS narrative.
Floodway Data Tables	Microsoft Word documents used in the FIS narrative.
HydraFlowPath	A linear spatial file that can represent streams and/or more complicated features like bridges, culverts, dams, pipes or trapezoid channels.
HydraJunction	A point spatial file that identifies confluences or transition points along a stream.
HydraXsPt	A database table for detailed profile calculations.
HydraNvalue	A polygon spatial file used to assign roughness coefficients.
S_Ovrbnkln	A linear spatial file used for measuring overbank flow distances. See Appendix L.

Depending on the scope of work, the mapping partner may develop a new hydraulic model with all the associated input files, may modify an existing model developed for the effective flood insurance study or a related study, or simply utilize an existing model or adopt the effective flood elevations. Table N-2 describes the minimum required data sets for each study approach and the two primary hydraulic modeling approaches: backwater models (i.e. HEC-RAS) or network models (i.e. SWMM and ICPR). If existing models are not available in digital format, the hardcopy output from the model or analysis should be scanned into a PDF file.

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Table N-48. Minimum Required Data Sets by Model Type

Hydraulic Study Type	Backwater Model	Network Model
New Model, Modified FEMA Model, or Capture of a FEMA Model	**Spatial File:** • StreamCntrLine • HydraCrossSection • S_Stn_Start **Table:** • HydraModel • HydraFloodResult • HydraEvent • WtrName **Work Map Products:** • HydraMapping • S_BFE • Stream Profiles • Floodway Data Tables	**Spatial File:** • StreamCntrLine • HydraCrossSection • S_Stn_Start • HydraFlowPath • HydraJunction **Table:** • HydraModel • HydraFloodResult • HydraEvent • WtrName **Work Map Products:** • HydraMapping • S_BFE • Stream Profiles • Floodway Data Tables

Figure N-10 is a schematic view of the relational database files required for the minimum hydraulic submittal. A detailed description of each of these data requirements is provided in the body of this section.

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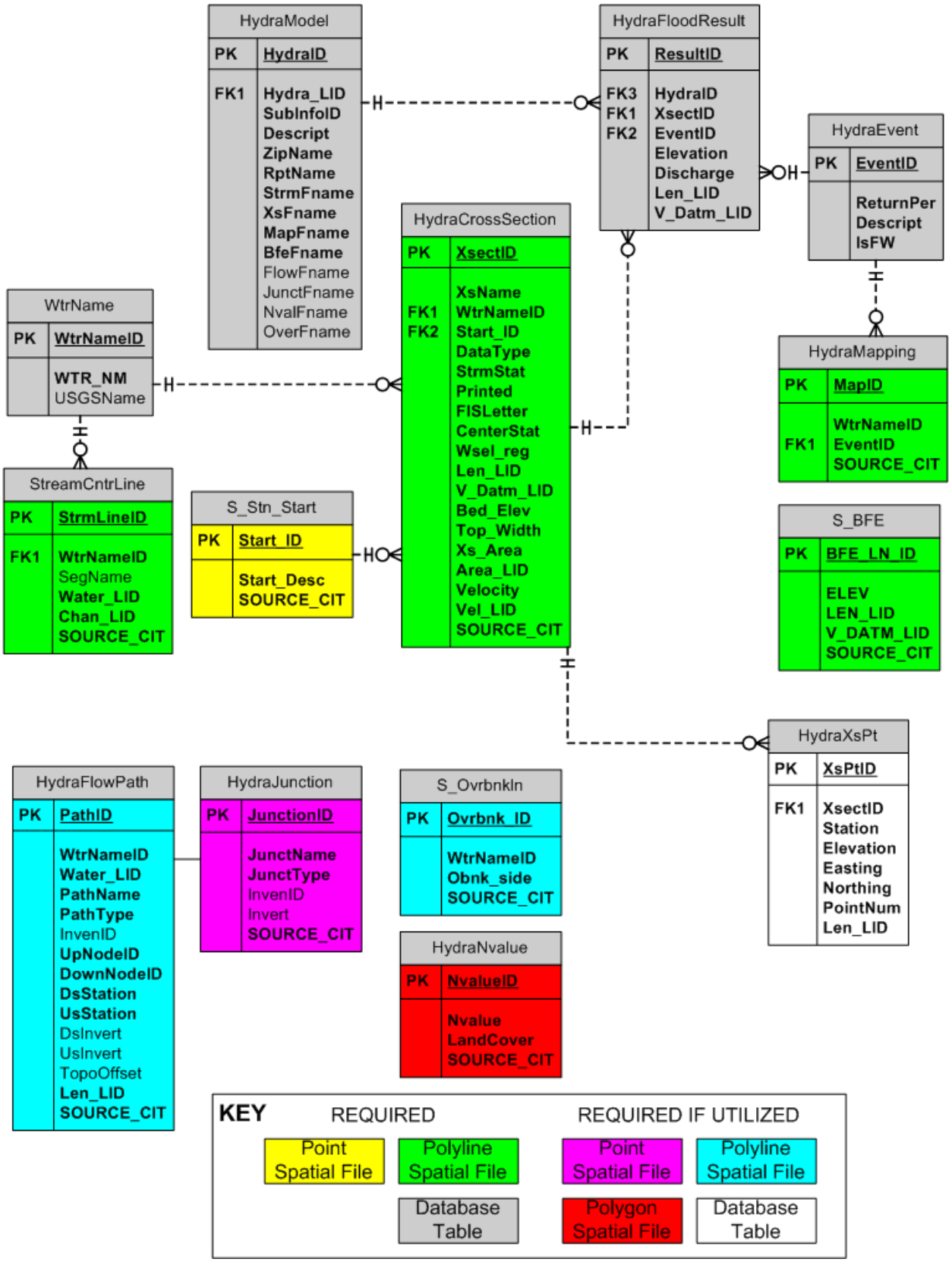
Figure N-10. Entity Relationship Diagram for Hydraulics



N.5.2.2 Required Hydraulic Data

HydraModel Table

The HydraModel table is a database table. It is required for all types of hydraulic analyses. This table identifies the models used for the floodplain delineation study.

The HydraModel table contains the following elements:

Table N-49. HydraModel Table

Field	Type	Leng	Required?	Description
HydraID	Long		Yes	Primary key for table
Hydra_LID	Long		Yes	A foreign key to D_Hydra. See Appendix L.
SubInfoID	Long		Yes	Foreign key to Submittal_Info table.
Descript	Text	255	Yes	Model description
ZipName	Text	255	Yes	Path and filename of a compressed hydraulic model including inputs and outputs
RptName	Text	255	Yes	Path and filename of the FIS narrative report
StrmFname	Text	255	Yes	Path and filename of StreamCntrLine spatial file
XsName	Text	255	Yes	Path and filename of HydraCrossSection spatial file
MapFname	Text	255	Yes	Path and filename of HydraMapping spatial file
BfeFname	Text	255	Yes	Path and filename of S_BFE spatial file
FlowFname	Text	255	No	Path and filename of HydraFlowPath spatial file
JunctFname	Text	255	No	Path and filename of HydraJunction spatial file
NvalFname	Text	255	No	Path and filename of HydraNvalue spatial file
OverFname	Text	255	No	Path and filename of S_Overbnkln spatial file

StreamCntrLine Spatial File

The StreamCntrLine spatial file(s) is required for locating all cross-sections and for referencing the data from the hydrologic study. This data set is used as the base for locating cross-section alignments and for the location of discharge locations. Stream centerlines should not be multi-part or self-intersecting. Streams should be drawn upstream to downstream, and connected endpoint to endpoint with adjacent streams.

The StreamCntrLine attribute table contains the following information:

Table N-50. StreamCntrLine Spatial File

Field	Type	Length	Required?	Description
StrmLineID	Long		Yes	Primary key for table
WtrNameID	Long		Yes	A foreign key to the WtrName table
SegName	Text	255	No	An optional identification string for each reach
Water_LID	Text	11	Yes	A foreign key to the D_Water_Typ table. See Appendix L.
Chan_LID	Text	11	Yes	A foreign key to the D_Chan_Rep table. See Appendix L.
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

HydraCrossSection Spatial File

The HydraCrossSection spatial file is required for models that utilize cross sections. This file will not be submitted for two-dimensional models that do not employ cross sections for simulating water surfaces. Cross sections are associated to one stream flow path and must intersect that flow path at only one point. Stream station is used to match these sections to the hydraulic results table, so there must be a one-to-one match with the results. All cross sections must be drawn left to right facing downstream. Multi-part shapes are not allowed.

Where submitted, the HydraCrossSection spatial file contains the following elements:

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Table N-51. HydraCrossSection Spatial File

			Decimal Places		
XsectID	Long			Yes	Primary key for table
XsName	Text	100		Yes	Unique alpha-numeric name
WtrNameID	Long			Yes	A foreign key to the WtrName table.
Start_ID	Text	11		Yes	A foreign key to the S_Stn_Start.
DataType	Text	12		Yes	"Top of Road" or "Natural"
StrmStat	Numeric	12	2	Yes	Distance along the stream.
Printed	Boolean			Yes	Is the section printed on a FIRM panel?
FISLetter	Text	3		Yes	Example: B, AQ
CenterStat	Numeric	9	2	Yes	The cross section station used in the model that corresponds to the intersection point of the stream and cross section.
Wsel_reg	Numeric	8	2	Yes	Regulatory flood elevation that matches floodway data table and profile.
Len_LID	Text	11		Yes	A foreign key to the D_Length_Units table (see Appendix L).
V_Datm_LID	Text	11		Yes	A foreign key to the D_V_Datum table (see Appendix L).
Bed_elev	Numeric	8	2	Yes	Stream bed elevation, from profile.
Top_Width	Numeric	9	2	Yes	Floodway width, used in floodway data table.
Xs_Area	Numeric	10	2	Yes	Underwater cross section area used in floodway data table.
Area_LID	Text	11		Yes	A foreign key to the D_Area_Units table (see Appendix L).
Velocity	Numeric	8	2	Yes	Mean velocity, used in the floodway data table.
Vel_LID	Text	11		Yes	A foreign key to the D_Vel_Units table (see Appendix L).
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

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S_Stn_Start Spatial File

The S_Stn_Start spatial file(s) is required. These points indicate the reference point that was used as the origin for distance measurements along streams and rivers. See Appendix L for more information.

The S_Stn_Start attribute table contains the following information:

Table N-52. S_Stn_Start Spatial File

Field	Type	Length	Req	Description
Start_ID	Text	11	Yes	Primary key for table
Start_Desc	Text	254	Yes	Description of the location of the station starting point. For example, "Feet upstream of Mecklenburg County line".
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

HydraFloodResult Table

The HydraFloodResult table is a database table. It is a required table that is used to store one or more flood elevations and discharges per cross section.

The HydraFloodResults table contains the following elements:

Table N-53. HydraFloodResult Table

Field	Type	Length	Decimal Places	Required?	Description
ResultId	Long			Yes	Primary key for table
HydraID	Long			Yes	A foreign key to the HydraModel table
XsectID	Long			Yes	A foreign key to the HydraCrossSection spatial file
EventId	Long			Yes	A foreign key to the HydraEvent table
Elevation	Numeric	8	2	Yes	Flood elevation
Discharge	Numeric	9	1	Yes	Discharge in cfs
Len_LID	Text	11		Yes	A foreign key to the D_Length_Units table (see Appendix L).
V_Datm_LID	Text	11		Yes	A foreign key to the D_V_Datum table (see Appendix L).

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HydraEvent Table

The HydraEvent table is a database table. It is required for all types of hydraulic analyses. This table defines a list of modeled floods.

The HydraEvent table contains the following elements:

Table N-54. HydraEvent Table

Fi	Type	Length	Decimal Places		Description
EventId	Long			Yes	Primary key for table. AutoNumber field.
ReturnPer	Numeric	6	1	Yes	The recurrence interval of the event in years (i.e. 10, 26.5, 100)
Descript	Text	32		Yes	Brief description of flood event (i.e. 10-year or Hurricane Hugo)
IsFW	Boolean			Yes	Identifies a floodway simulation

WtrName Table

The WtrName table is a database domain table. It is required for all types of hydraulic analyses. This table identifies the unique list of stream names used in the submittal.

The WtrName table contains the following attributes:

Table N-55. WtrName Table

Field	Type	Length	Required?	Description
WtrNameID	Long		Yes	Primary key for table.
WTR_NM	Text	255	Yes	Unique alpha-numeric name (i.e. Crooked Creek)
USGSName	Text	255	No	USGS unique stream name identifier

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N.5.2.3 Work Map Products

Work map products are used to assist in quality control of the hydraulic models. Some items listed below, such as HydraMapping and S_BFE will also be part of a subsequent Mapping Submittal, with any necessary modifications. Stream profiles and floodway data tables are direct products of a hydraulic model, so they are incorporated into the Hydraulics DCS.

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HydraMapping Spatial File

The HydraMapping spatial file is a linear spatial file submittal. It contains preliminary floodway, 100-year and 500-year boundaries that are a pre-cursor to the final maps. Because the "EventID" is an attribute of each line, it is possible to store flood boundaries for storms other than the 100-year and 500-year.

The HydraMapping spatial file contains the following elements:

Table N-56. HydraMapping Spatial File

Field	Type	Length	Required	Description
MapID	Long		Yes	Primary key for table
WtrNameID	Long		Yes	A foreign key to WtrName table
EventID	Long		Yes	A foreign key to HydraEvent table
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

S_BFE Spatial File

The Base Flood Elevation (BFE) spatial file is required for any digital data where BFE lines will be shown on the corresponding Flood Insurance Rate Map (FIRM). Normally, if there are any riverine AE zones, BFE lines are required.

The S_BFE spatial file contains information about the BFEs within a study area, as well as locational information. BFE lines indicate the rounded whole-foot water-surface elevation of the 1-percent-annual-chance flood. See Appendix L for more information.

The S_BFE spatial file contains the following attributes:

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Table N-57. S_BFE Spatial File

Field	Type	Length	Decimal Places	Required?	Description
BFE_LN_ID	Text	11		Yes	Primary key for table. Assigned by table creator.
ELEV	Numeric	13	2	Yes	Base Flood Elevation. The rounded, whole foot elevation of the 1-percent-annual-chance flood.
LEN_LID	Text	11		Yes	Length Unit Lookup Identification. See D_Length_Units table (Appendix L)
V_DATM_LID	Text	11		Yes	Vertical datum lookup identification. A foreign key to the D_V_Datum table (see Appendix L).
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

Stream Profiles

Stream profiles are used in the FIS narrative, and are a direct product of a hydraulic model. The NSP provides tools to convert HEC-RAS and HEC-2 models to AutoCAD DXF files. These DXF files can be imported into a template AutoCAD drawing file (DWG), and edited for content.

For the Hydraulics DCS, all stream profiles will be submitted as AutoCAD DWG files, named "StreamName_Profile.dwg". These files are to be located in the "Profiles" folder on the submitted CD or DVD. See Appendix J for more information.

Floodway Data Tables

Floodway Data Tables are used in the FIS narrative, and are a direct product of a hydraulic model. These tables are required to be submitted in a Microsoft Word format, named "StreamName_FWDT.doc". These files are to be located in the "FWDTs" folder on the submitted CD or DVD. A template document is available for download from the internet.

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N.5.2.4 Required If Utilized

HydraFlowPath Spatial File

The HydraFlowPath spatial file is required for hydraulic models other than HEC-RAS and HEC-2, such as SWMM or ICPR. Flow paths can be associated to one or more HydraModels. All flow paths must be drawn upstream to downstream. Multi-part shapes are not allowed.

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HydraFlowPath can also be used to store modeling base lines, similar to S_Profil_Basln (see Appendix L), when the stream centerline differs from the model baseline.

The HydraFlowPath spatial file contains the following attributes:

Table N-58. HydraFlowPath Spatial File

Field	Type	Length	Decimal Places	Required	Description
PathId	Long			Yes	Primary key for table.
WtrNameId	Long			Yes	Foreign key to WtrName table.
Water_LID	Text	11		Yes	A foreign key to the D_Water_Typ table. See Appendix L.
PathName	Text	255		Yes	Unique alphanumeric identifier (i.e. CC-1).
PathType	Text	15		Yes	"Stream", "Structure", "Pipe", "Simple Channel"
InvenID	Long			No	A foreign key to an inventory table (only used for non-stream path types).
UpNodeID	Long			Yes	Foreign key to HydraJunction table.
DownNodeID	Long			Yes	Foreign key to HydraJunction table.
DsStation	Numeric	12	2	Yes	Distance measured from a prominent location, such as a confluence or county line.
UsStation	Numeric	12	2	Yes	Distance measured from a prominent location, such as a confluence or county line.
DsInvert	Numeric	8	2	No	Downstream thalweg elevation.
UsInvert	Numeric	8	2	No	Upstream thalweg elevation.
TopoOffset	Numeric	4	1	No	For "Stream" path types, this is the average difference between the true thalweg and the lowest profile elevation derived from the terrain. Useful for limited detail studies. Example: True thalweg is 98.2, Topo Invert = 100, so TopoOffset = -1.8.
Len_LID	Text	11		Yes	A foreign key to the D_Length_Units table (see Appendix L).
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

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HydraJunction Spatial File

The HydraJunction spatial file is required for hydraulic models other than HEC-RAS and HEC-2, such as SWMM or ICPR. Junctions are associated to a particular HydraFlowPath. These junctions can represent confluences of streams, or a transition point between a stream and a structure. Junctions can also represent more detailed inventory, such as manholes or curb inlets.

The HydraJunction spatial file contains the following elements:

Table N-59. HydraJunction Spatial File

Field	Type	Length	Decimal Places	Required?	Description
JunctionId	Long			Yes	Primary key for table.
JunctName	Text	50		Yes	Unique alphanumeric identifier (i.e. A-201).
JunctType	Text	50		Yes	"Transition", "Manhole", "Curb Inlet", "Slab Inlet", "Junction Box", "Pipe Junction"
InvenID	Long			No	Foreign key to an inventory table. Not used for junctions on most models (HEC-RAS and HEC-2)
Invert	Numeric	8	2	No	Lowest elevation at junction
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

HydraXsPt Table

The HydraXsPt table is a database table. It can be used to store intermediate terrain profiles, which are typically used as a major part of a cross section definition in a HEC-RAS or HEC-2 model. This database table is required for any modeling approaches that do not store 3-d cross section geometries explicitly in the model inputs. HEC-RAS and HEC-2 models store this information in geometry files, so the terrain profiles are not required for those model types.

The HydraXsPt table contains the following elements:

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Table N-60. HydraXsPt Table

Field	Type	Length	Decimal Places	Required?	Description
XsPtID	Long			Yes	Primary key for table.
XsectID	Long			No	Foreign key to the HydraCrossSection table.
Station	Numeric	8	2	Yes	Distance from start of section to profile point
Elevation	Numeric	8	2	Yes	Elevation
Easting	Numeric	12	2	Yes	X-coordinate
Northing	Numeric	12	2	Yes	Y-coordinate
PointNum	Long			Yes	Useful for ordering points when there is a vertical step. Integer values.
Len_LID	Text	11		Yes	A foreign key to the D_Length_Units table (see Appendix L).

HydraNvalue Spatial File

The HydraNvalue spatial file is made up of polygons. It is required when utilized for calculating the distribution of the roughness coefficients along the cross sections.

The HydraNvalue Spatial File contains the following elements:

Table N-61. HydraNvalue Spatial File

Field	Type	Length	Decimal Places	Description
NvalueId	Long			Primary key for table. AutoNumber field.
Nvalue	Numeric	5	3	Manning's n-value. Usually a number between 0.01 and 0.20.
LandCover	Text	50		A brief description of the land cover, i.e. (short grass, boulders, dense brush, fine silty clay, etc.)
SOURCE_CIT	Text	11		Abbreviation used in the metadata file when describing the source information.

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S_Ovrbnkln Spatial File

The S_Ovrbnkln spatial file is a linear spatial file submittal. This spatial file contains features representing the overbank flow distances between two adjacent cross sections. HEC-2 and HEC-RAS models require this information, when the overbank distances are not equal to the distances measured along the stream centerline.

The S_Ovrbnkln spatial file contains the following attributes:

Table N-62. S_Ovrbnkln Spatial File

Field	Type	Length	Required	Description
Overbnk_ID	Text	11	Yes	Primary key for table
WtrNameID	Long		Yes	A foreign key to WtrName table
Obnk_side	Text	1	Yes	"L" or "R", indicates Left or Right
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

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N.5.3 Deliverables

N.5.3.1 Metadata

To facilitate the use of these data and the transfer of data files between users, the assigned Mapping Partner shall prepare and submit a metadata file with all digital data submittals. Only one metadata file is required for each submittal. However, in this one file, the assigned Mapping Partner must distinguish between the different origins of the various data sets included. The Metadata file shall follow the *Content Standard for Digital Geospatial Metadata (version 2.0)*, FGDC-STD-001-1998. Details of this standard are available at www.fgdc.gov.

The metadata file must include a description of the source material from which the data were derived and the methods of derivation, including all transformations involved in producing the digital files. The description shall include the dates of the source material and the dates of ancillary information used for update. The date assigned to a source must reflect the date that the information corresponds to the ground. If the assigned Mapping Partner does not know this date, then the Mapping Partner may use a date of publication and indicate as such. Each data source in the metadata file must be assigned a Source Citation Abbreviation as described in Subsection L.2.2.1.

The assigned Mapping Partner shall describe any database created by merging information obtained from distinct sources in sufficient detail to identify the actual source for each element in the file.

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Because not all DFIRM database tables are included in every draft DFIRM digital data submittal, the Overview Description Section of the Entity and Attribute Information of the metadata file must include a list of all DFIRM database tables included in the submittal.

Portions of the file that are double underlined typically vary with each Mapping Partner's submittal. In addition, the Mapping Partner should modify or replace any other portions of the metadata file to fully document the data submitted.

{April 2004]

N.5.3.2 Hardcopy Deliverables

Supplemental information may be delivered in hardcopies.

{April 2004]

N.5.3.3 Digital Deliverables

Transfer Media

Mapping Partners must submit files on one of the following electronic media, or via the internet:

- CD-ROM (preferred); or
- DVD
- Upload to Management Information Portal (MIP) (http://www.fema.gov)

As technology changes or in special situations, other media may be acceptable if coordinated with FEMA.

Data Directory Structure and Folder Naming Conventions

An FDGC compliant metadata file will be placed in the "General" folder on the root directory of Disk1.

The Mapping Partner is required to submit the input and output files for any study using detailed hydraulic computer models such as HEC-2 or HEC-RAS. If the data that was used to estimate the hydraulic parameters is available, it should be submitted as well.

Models are usually organized by stream, with all model files in the "Simulations" folder and support spatial files in the "Spatial Files" folder. One set of database tables is stored in a "Hydraulic Databases" folder, for all streams. Data must be located in the appropriate directories, as follows.

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\General

- Metadata file
- Hydraulics design report in PDF format

\Hydraulic Models\"Stream Name"\Simulations

- Model input and output files by stream

\Hydraulic Models\"Stream Name"\Spatial Files

- Spatial files by stream

\Hydraulic Databases

- Database file(s)

\Profiles

- CAD profile(s) by stream ("StreamName_profile.dwg")

\FWDTs

- Microsoft Word floodway data tables by stream ("StreamName_fwdt.doc")

Data Identification Requirements

All digital media submitted must be labeled with at least the following information:

- Mapping Partner name;
- Community name and state for which the FIS was prepared;
- Hydraulic Data;
- Date of submission (formatted mm/dd/yyyy); and
- Disk [*sequential number*] of [*number of disks*].

{April 2004]

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N.6 References

Federal Emergency Management Agency, FEMA April 2004, *Data Capture Guidelines*. *[Preliminary Draft]*

Federal Emergency Management Agency, FEMA April 2003, Appendix A, *Guidelines and Specifications for Flood Hazard Mapping Partners*.

Federal Emergency Management Agency, FEMA April 2003, Appendix C, *Guidance for Riverine Flooding Analyses and Mapping, Guidelines and Specifications for Flood Hazard Mapping Partners*.

Federal Emergency Management Agency, FEMA April 2003, Appendix L, *Guidelines and Specifications for Flood Hazard Mapping Partners*.

Federal Geographic Data Committee, FGDC-STD-001-1998. *Content Standard for Digital Geo-spatial Metadata (version 2.0),* FGDC, c/o USGS, Reston, VA
http://www.fgdc.gov/metadata/metadata.html

Interagency Advisory Committee on Water Data, 1982, Guideline For Determining Flood Flow Frequency, Bulletin 17B of the Hydrology Subcommittee, Office of Water Data Coordination, U.S. Geological Survey, Reston, Virginia, 183 p.

U.S. Department of the Army, Corps of Engineers, USACE 1990, Hydrologic Engineering Center, *HEC-1 Flood Hydrograph Package, User's Manual*, Davis, CA.

U.S. Department of the Army, Corps of Engineers, USACE 2001, Hydrologic Engineering Center, *HEC-RAS, River Analysis System, User's Manual*, Version 3.0, Davis, CA.

U.S. Department of the Army, Corps of Engineers, USACE 2001, Hydrologic Engineering Center, *Hydrologic Modeling System, HEC-HMS, User's Manual*, Version 2.1, Davis, CA.

Watershed Concepts, November 2003, *Guidelines and Specifications for Collecting Survey Data for Flood Insurance Studies*, Greensboro, North Carolina. http://www.watershedconcepts.com/

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