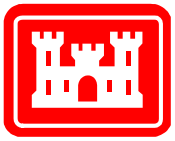
EM 1110-2-6055
27 February 2015



US Army Corps
of Engineers

ENGINEERING AND DESIGN

Inland Electronic Navigational Chart Engineering Manual

ENGINEER MANUAL

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
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Manual
No. 1110-2-6055

27 February 2015

Engineering and Design
INLAND ELECTRONIC NAVIGATIONAL CHART ENGINEERING MANUAL

1. Purpose. This manual provides technical and administrative guidance for development, production, publication, and maintenance of Inland Electronic Navigational Charts (IENCs).

2. Applicability. This manual applies to all USACE commands having responsibility for civil works navigation, dredging, flood risk management, multi-purpose water supply/control, coastal storm damage reduction, hurricane protection, and hydropower projects.

3. Distribution. This publication is approved for public release; distribution is unlimited.

4. Discussion. IENCs are digital cartographic products (i.e., electronic charts) of U.S. inland waterways that are distributed by the US Army Corps of Engineers (USACE) for the primary purpose of ensuring safety-of-navigation. IENCs apply to inland waterways that are maintained for navigation by USACE for shallow-draft vessels (e.g., maintained at a minimum depth of 14 feet or less). Generally, IENCs are produced for those commercially-navigable waterways which the National Oceanic and Atmospheric Administration (NOAA) does not produce Electronic Navigational Charts (ENCs). However, Special Purpose IENCs, which are further defined in this manual, may be produced in agreement with NOAA. The standards and procedures contained in this manual are intended to facilitate USACE-wide uniformity of IENC products and services, as well as to ensure consistency in the distribution of IENCs to outside users.

FOR THE COMMANDER:

WILLIAM H. GRAHAM
COL, EN
Chief of Staff

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CHAPTER 1

Introduction

1-1. Purpose. This manual provides technical and administrative guidance for development, production, publication, and maintenance of Inland Electronic Navigational Charts (IENCs). IENCs are digital cartographic products (i.e., electronic charts) of U.S. inland waterways that are distributed by the US Army Corps of Engineers (USACE) for the primary purpose of ensuring safety-of-navigation. IENCs apply to inland waterways that are maintained for navigation by USACE for shallow-draft vessels (e.g., maintained at a depth of 9-14 feet, dependent upon the waterway project authorization). Generally, IENCs are produced for those commercially-navigable waterways which the National Oceanic and Atmospheric Administration (NOAA) does not produce Electronic Navigational Charts (ENCs). However, Special Purpose IENCs, which are further defined in this manual, may be produced in agreement with NOAA. The standards and procedures contained in this manual are intended to facilitate USACE-wide uniformity of IENC products and services, as well as to ensure consistency in the distribution of IENCs to outside users.

1-2. Applicability. This manual applies to all USACE commands having responsibility to develop, produce, publish, update, or manage programs pertaining to IENCs in support of the Corps' civil works activities. The manual also applies to USACE commands which produce other types of electronic chart products that are distributed to outside users for the purpose of safety-of-navigation. In this manual these are defined as Special Purpose IENCs.

1-3. Distribution. This publication is approved for public release; distribution is unlimited.

1-4. References. Reference documents associated with the production and distribution of IENCs are listed in Appendix A. Also listed are relevant publications and standards issued by the International Hydrographic Organization (IHO). In addition, website addresses that can be used to obtain copies of these publications are also provided.

1-5. Scope of Manual. This manual serves as a technical guide for the development and maintenance of IENCs. This includes data collection, processing, and compilation for chart features and attributes. It also includes other associated procedures such as verification of IENC chart cells, publication of data products, as well as approval of special purpose IENCs. This manual only makes general reference to the data conversion process to produce IENCs. This manual should also be used for any development of waterway chart information or geographic information systems (GIS) for non-navigation uses, such as maintenance planning, environmental mitigation analysis, emergency response coordination, and waterway security planning.

1-6. IENC Program Overview.

a. USACE Districts have produced Navigation Chart Books for shallow-draft inland waterways for many years. In most cases, these books are the sole navigation chart product issued by a government agency, and are regarded as the official source of navigation charts. The Code of Federal Regulations and U.S. Coast Guard rules recognize USACE Navigation Chart Books as meeting chart carriage requirements for safety-of-navigation on inland waterways.

b. As the Global Positioning System (GPS) and powerful, low-cost computers became available in the mid-1990s, electronic chart systems (ECS) began to be used onboard various maritime and river vessels. An ECS is capable of displaying a vessel's real-time position on an electronic chart, with information from other sensors such as heading sensor or depth sounder. Such systems can automate many of the navigation functions, thereby reducing human error and freeing the vessel operator for other tasks. Accurate and up-to-date electronic charts with an appropriate level of content and accuracy are required to ensure the proper use of such systems.

c. In 1993, an AMTRAK train wreck that occurred near Mobile, Alabama was caused by a barge hitting the railroad bridge crossing at Big Bayou Canot. In investigating the cause and possible means to prevent this type of incident from occurring again, a recommendation of the National Transportation Safety Board (NTSB) was for the USACE to "Promote, in cooperation with the U.S. Coast Guard, the development and application of low-cost electronic charting navigation devices for inland rivers" (Class II, Priority Action; M-94-30). Further, the NTSB encouraged USACE to promote and develop electronic charts to help avoid allisions between vessels and fixed structures, primarily bridge supports. As a result, beginning in 2002, Congress appropriated funds for the Corps to develop and publish IENCs.

d. USACE now has a specific mission to produce IENCs for the Inland Waterway System. The USACE IENC program follows the Corps' Program Management Business Process that involves multiple districts, divisions and the Army Geospatial Center (AGC) for data collection, compilation, conversion to IHO S-57, quality assurance, publication, assessment of user needs and satisfaction, and refinement of the chart products to better serve navigation users.

e. For the foreseeable future, IENCs will be produced and published in addition to navigation Chart Books. The U.S. Coast Guard is responsible for deciding if IENCs might replace navigation Chart Books in the future. USACE Districts should refer to EP 1130-2-520 and EM 1110-2-1003 for guidance on Navigation Chart Books. Source data for IENCs should also satisfy most data needs associated with for chart books. Ideally, USACE Districts will eventually develop and use a common database that can be used to produce both products.

f. All IENC chart cells are published for free and open access, and are maintained with updates and modifications to ensure that IENCs meet changing waterway conditions and needs of users.

1-7. Use of Manual.

a. This manual shall be used as a technical guide for any activities associated with the development and maintenance of IENCs. Such activities include data collection, processing, and compilation for chart features and attributes. Activities shall also include verification of IENC chart cells and publication of data products. This also applies to the production of special purpose IENCs. This includes chart products for a specific need in a particular area that may have a limited life, and could deviate from the content specifications in this manual.

b. This manual only makes general reference to the data conversion process required to produce the highly-structured and specialized IENC format. Those performing this function should refer to the cited documents and consult with the Program Manager or Chart Data Center (see Chapter 3).

1-8. Mandatory Requirements. ER 1110-2-1150 (Engineering and Design for Civil Works Projects) prescribes that mandatory requirements be identified in engineer manuals. General requirements are provided in this section. Specific mandatory requirements are summarized at the end of each chapter.

a. Mandatory criteria are based on the following fundamental considerations:

(1) Ensure that IENCs contain accurate depictions of real-world and cartographic features.

(2) Consistent and uniform IENC products and product availability.

(3) Compliance with national and international electronic chart standards.

(4) Unambiguous representation of waterway conditions to navigation users and vendors of electronic chart systems.

(5) HQUSACE commitments to navigation users of the inland waterways.

b. Mandatory requirements in this manual reflect the USACE policy on performance-based specifications. This includes emphasis on accuracy, content, and consistency of the final product. Specific software or processing systems are not usually mandated, recognizing that various GIS and other geospatial processing software exist, and that new capabilities are continually being developed.

c. IENCs may be derived using data from other USACE waterway resource functions. This data includes hydrographic surveys for channel condition assessment, dredge payment, and structural inspection. Other functions include channel design, regulatory permits, and environmental monitoring. Some standards and procedures for use of IENC data may come from EMs for these or other functions, and are referenced in this manual.

d. Any USACE personnel who perceive conflicts between guidance in this manual and standards or procedures for other functions, or may have suggestions for more effective criteria and guidance for IENCs, are strongly encouraged to recommend modifications. See Proponency and Waivers section (Section 1.12).

1-9. Metrics. Both English and metric (SI) units are used in this manual.

1-10. Trade Name Exclusions. The citation or illustration in this manual of trade names of commercially-available survey products or software systems does not constitute official endorsement or approval of the use of such products.

1-11. Abbreviations and Terms. Terms and abbreviations used in this manual are explained in the Glossary.

1-12. Proponency and Waivers. The overall HQUSACE proponent for this manual is the Operations Division, Directorate of Civil Works. Coordination of technical development and compilation of the manual is performed by the Survey Engineering and Mapping Center of Expertise, (CEAGC-GSA). Comments, recommended changes, or waivers to this manual should be forwarded through MSC to HQUSACE (ATTN: CECW-CE).

CHAPTER 2

IENC Description and Structure

2-1. Purpose. This chapter covers the authority by which USACE IENCs are issued, the basic data structure, and the waterways included in IENC coverage. This chapter also explains the data content, structure, and data standards used to produce IENC products. Special Purpose IENCs that serve similar purposes as IENCs, but are not required to follow the same specifications and production process, are also explained

2-2. USACE Authorities. The USACE has been involved in the production of navigation chart products for various inland waterways for over 100 years. The Mississippi River Commission produced the comprehensive Mississippi River Surveys of 1883 and 1912 to support flow control and navigation. Until recently, these products were in the form of printed books conforming to the guidance contained in Engineer Pamphlet 1130-2-520. When produced in applicable format and maintained with updates, electronic versions of these charts enable the use of computer and positioning technology aboard vessels to increase safety and efficiency of navigation. Authority to produce these products is derived from Public Law, and from Congressional funding appropriations for the IENCs.

a. Public Law 85-480. Approved on 2 July 1958, this law authorizes the Chief of Engineers to "publish information pamphlets, maps, brochures, and other material on river and harbor, flood control, and other Civil Works activities, including related public park and recreation facilities under his jurisdiction, as he may deem to be of value to the general public." The Law further states, "Condition survey maps or charts, sold or otherwise distributed to the public, showing depths will specifically state the date or dates the surveys were made." The Public Law enables USACE to produce charts of inland waterways maintained for navigation. The Law also directs that such charts identify when any depth information was collected to avoid misinterpretation of bottom conditions.

b. House of Representatives Report 107-112, Energy and Water Development Appropriations Bill 2002. Funding was first authorized by Congress for USACE to produce and publish IENCs in the 2002 Civil Operation and Maintenance - Miscellaneous appropriation; "Inland Waterway Navigation Charts.—The Committee has provided $4,000,000 for the USACE to begin the process of making inland waterway navigation chart data available in electronic format. Electronic navigation chart data would enable towboats and other vessels to navigate more precisely, provide increased capability in poor visibility, and aid in the training of vessel operators." Appropriations in following years continued funding for IENC coverage for all major navigable waterways. More recently, funding has been provided to complete IENC coverage for the inland navigation system, and to begin an IENC updating/maintenance program.

2-3. Use of IENCs . The intended purpose of IENCs produced by the USACE, is to ensure safe and efficient navigation on major river/waterway systems in the US. IENC data is primarily used in Electronic Chart Systems (ECS) installed on vessels operating on inland waterways (e.g.,

towboats). IENCs are a crucial component of voyage planning and route monitoring. While the primary use is onboard operating vessels, they are also used ashore for operator training, Vessel Traffic Services, and as a mapping database for other value-added products and services.

2-4. Government Authorities and International Organizations. Two US federal government agencies and an international harmonization group have parallel roles/activities to the USACE IENC Program.

a. U.S. Coast Guard (USCG) has the responsibility of enforcing federal rules that ensure safety of navigation on coastal and inland waterways. The U.S. Code of Federal Regulations (CFR) requires paper charts produced by a Federal agency to be carried by self-propelled vessels involved in commerce. Such vessels are further defined as at least 65 feet overall length, carrying more than a number of passengers (as determined by the Secretary), or a towing vessel of more than 26 feet overall length and 600 horsepower. As such, there is an ongoing requirement to produce USACE paper charts. However, rule changes by the USCG in the near future may require the use of IENCs to meet carriage requirements for electronic chart systems. Such changes would further amplify the need for actively maintained and updated IENCs. The USCG also maintains fixed and floating aids to navigation, which are critical features specified in the IENC Encoding Guide (see Appendix A- References).

b. National Oceanic and Atmospheric Administration (NOAA) National Ocean Service produces 'maritime' paper charts and Electronic Navigational Charts (ENCs) for ocean, coastal, harbor and Great Lakes areas of the United States and territories. The ENCs are much more expansive in coverage than IENCs, and have navigational purpose scale ranges of 1:3,000,000 to 1:10,000. In contrast, IENCs scale ranges are from 1:5,000 to 1:10,000. NOAA ENCs usually cover waterways that support international maritime traffic and are therefore compliant with required international performance and data standards established by the International Maritime Organization (IMO) and the International Hydrographic Organization (IHO). IENCs are based on the same IHO S-57 standard as the 'maritime' ENCs (see Section 2-5), but also include real-world features for inland waterways and rivers that are not contained in the 'maritime' ENCs.

IENCs that are produced and maintained by USACE according to guidance in this manual are not intended to duplicate the coverage of 'maritime' ENCs produced by NOAA. Rather, in areas where the two chart products coincide, the boundaries are coordinated so that vessels can transit seamlessly between the two areas of coverage (i.e., no gaps or overlap). IENC chart features at such boundaries on the Lower Mississippi, Mobile and Atchafalaya Rivers, and the Illinois Waterway, must be coordinated between NOAA and the USACE. An exception to the coverage rule is a Special Purpose IENC, which may overlap, or even fully coincide with, a NOAA ENC, but the Special Purpose IENC provides information or enables a navigation function not possible with a 'maritime' ENC or IENC (see Section 2-8 for more information on Special Purpose IENCs).

c. International IENC Harmonization Group. Although there are some differences between the North American and inland waterways in other regions of the world, there are many more

similarities. As such, a European – North American IENC Harmonization Group was first established in 2004. Since that time, the IENC Harmonization Group (IEHG) has expanded, and now includes all regions of the world that have major river/inland waterway systems.

The main objective of IEHG is to develop and maintain harmonized standards for IENCs suitable for inland navigation that are based on the standards of the IHO for 'maritime' ENCs. Some of the key Guiding Principles of IEHG are:

(1) To agree upon specifications that are suitable for all known inland ENC data requirements for safe and efficient navigation worldwide, including Europe, North and South America, Russian Federation, and East Asia inland waterways.

(2) The framework for IENC standards is based on IHO S-57 (Edition 3.1), including:
'Maritime' ENC Product Specification (IHO S-57)
Object Catalogue (IHO S-57, Appendix A)
Use of Object Catalogue (IHO S-57, Appendix A)

(3) A minimum IENC Product Specification that includes mandatory requirements for safety-of-navigation on inland waterways, worldwide.

(4) Publication and maintenance of IENC Encoding Guide that provides guidance on recommended object classes, attributes, and attribute values for encoding IENC data.

An important activity of IEHG is to develop a basic standard that can be applied to any inland system in the world, while also accommodating unique objects and features needed for particular regions. As a result of IEHG efforts, USACE IENCs follow a standard based on IHO S-57 with modifications or additions, known as extensions.

The IEHG is recognized by IHO as a Non-Governmental International Organization (NGIO), and participates as an Observer at IHO meetings.

2-5. IHO S-57 based IENC Standard. The Corps has chosen to adopt the IENC 2.2 Product Specification, which is based upon the IHO S-57 specification for IENCs for several reasons:

(1) Users are familiar with the data content and display in electronic chart systems (ECS).

(2) Commercial ECS and chart readers are compatible with the standard.

(3) Development and maintenance software is readily available for production of the charts

(4) The standard has a robust and recognized structure for dissemination of chart updates and integration in user systems.

a. IHO S-57 is the international standard for the exchange of digital hydrographic data between national hydrographic offices, and for distribution of such data to manufacturers, mariners and other data users. The standard provides a data model that enables hydrographic offices to capture all the necessary information about real-world hydrographic or navigational features in a format that can be exchanged among independent parties. The primary data product produced according to IHO S-57 is an Electronic Navigational Chart (ENC). IHO S-57 defines the data model, data structure, general rules for data coding, feature object catalogue with attributes values, and product specifications. IHO S-57 was developed for maritime applications (e.g., oceans, coastal areas, approaches and ports).

The IENC 2.2 Product Specification for Inland ENC (IENC) is a set of specifications intended to enable ENC manufacturers to produce consistent IENC, and to use data efficiently in shipborne electronic charting applications. An IENC shall be produced in accordance with the regulations defined in:

(1) IENC 2.2 Product Specification for Inland ENC (or latest, approved edition).

(2) Associated Feature Catalogue for Inland ENC.

(3) Associated Encoding Guide for Inland ENC.

Differences between the IHO S-57 ENC and IENC 2.2 Product Specifications primarily involve relatively minor additions or extensions to the ‘Maritime’ ENC Specification. These extensions include additional feature objects that are unique to inland navigation, and changes in the product data files that allow for the use of these extensions. Examples include three additional Navigational Purpose fields: River (NR7), River Harbour (NR8), and River Berth (NR9).

Changes to the Feature Catalogue and Encoding Guide for Inland ENC’s include both the addition of new feature objects, some additional attribution for existing feature objects. Examples of these additions include the ‘lock wall’ and ‘guide wall’ feature objects. These are described in the Encoding Guide as a “Permanent structure bounding a lock and including guide walls.” An ’icebreaker’ is another feature object unique to the inland standard, and is described as “an often wedge-like structure used for protecting a bridge pier, dock, facility, etc. from floating ice or other debris.” Further explanation of these and other ‘extensions’ can be found in at the following link: http://ienc.openecdis.org/

The IHO has developed a new geo-spatial data standard (called S-100) that will eventually replace S-57. This new standard is expected to be able to accommodate more user themes, including inland waterways. The IEHG’s development of S-57 extensions will form the basis of the Inland ENC Register within the IHO S-100 Registry. However, most of these extensions have already been adopted by IEHG members, and are already being used in S-57 based IENCs.

Further information about the gradual transition from IHO S-57 to IHO S-100 is available on the IHO website: http://www.iho.org

b. IENC Display. Figure 2-1 shows a portion of an IENC as would typically be displayed by an ECS or chart viewer. The presentation shown is based on the IHO S-52 Colors and Symbols specifications for 'maritime' Electronic Chart Display and Information System (ECDIS). This includes colors, line weights, text orientation, and point feature symbols. Within the U.S., ECS vendors and users are not required to use a particular display standard, but for the purpose of overall consistency and familiarity, most ECS displays are based on the IHO S-52 colors and symbols. Currently, the IENC Program does not maintain nor specify a presentation standard for IENCs. Instead, this is left to the discretion of ECS vendors and users. If IENC carriage becomes mandatory in the U.S. for inland commercial vessels, USACE will coordinate with U.S. Coast Guard to establish recommendations or guidance on the proper display of IENCs and associated waterway information (e.g., River Information Overlay or AIS Application-Specific Messages) on ECS equipment.

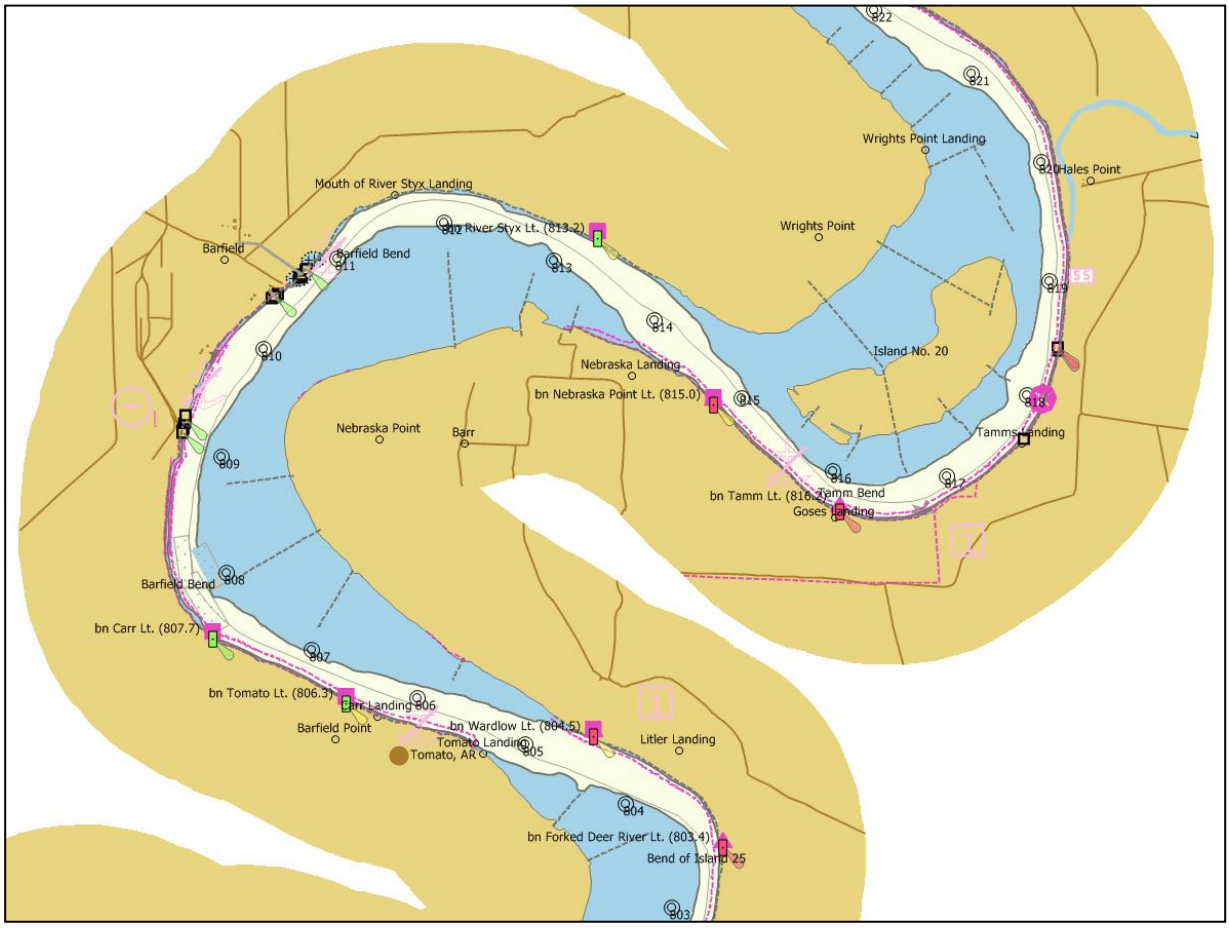


Figure 2-1. IENC display based on IHO S-52 Colours and Symbols Presentation Library.

c. Cell-based Structure. In order to facilitate the efficient processing of IENC data, the geographic coverage of a given usage is split into cells that generally conform to river Chart boundaries. In accordance with S-57 rules, each cell of data is contained in a physically separate, uniquely identified file on a transfer medium, known as a data set file. The geographic extent of each IENC cell was designated when the program began to ensure that each data set file contains no more than 5 Megabytes of data.

(1) Cells are rectangular (i.e., defined by 2 meridians and 2 parallels).

(2) The area within the cell which contains data is specified by data objects. These data objects, known as M_COVR, are specified in Sec. 2-6 of the IENC Encoding Guide (Appendix A -References), and are encoded by the Cell Producer.

(3) As specified by IHO S-57, the features within the cells do not overlap. This ensures that adjacent cells do not have duplicate or conflicting data.

(4) Point or line feature objects which are at the border of two IENCs are part of only one cell. They are put in the south or west cell (i.e., north and east borders of the cell are part of the cell, south and west borders are not). When a feature object exists in two or more cells its geometry is split at the cell boundaries and its complete attribute description is repeated in each cell.

(5) The naming convention for each IENC cell is CCPRCMMM.VVV, in which:

CC = international Producer Code; USACE = U3 (all IENCs)

P = navigational purpose; all IENCs have a purpose of “7”, which means navigating within inland waterways

RC = river code (see Table 2-2)

MMM = river mile at lower end of the cell

VVV = version of the base chart, beginning with “000”, “001” for the first update, “002”for the second update, etc.

d. Geometry. Edges of IENC cells are encoded using point-to-point fields only. Linear features are not encoded at a point density greater than 0.3 mm at compilation scale. The presentation of symbolized lines may be affected by line length. Therefore, the Cell Producer must be aware that splitting a line into numerous small edges may result in poor symbolization.

e. Horizontal and Vertical Datums. As specified in IHO S-57, all IENCs are horizontally referenced to the GPS reference ellipsoid/system WGS 84. Vertical datums use the water

surface or vertical datum recognized for the given region (see Section 3-6 and 3-7 for further information).

f. Units. The units for horizontal position are latitude and longitude, in decimal degrees. Linear measurements, such as depths and heights, which are encoded with features, are in meters. Note that linear measures can be referenced to and labeled with English units, but the encoded spatial values and attributes must remain metric. For example, the Project Depth contour used in IENCs is nine feet, which is the authorized navigable depth for most U.S. inland waterways. However, the encoded attribute value for Project Depth is 2.74 meters. Refer to the IENC Encoding Guide, Sec. 2-6 (see Appendix A-References) for further detail.

g. Updating. One useful aspect of S-57 data model is that it is designed to support incremental updates. The mechanism allows for the updating of individual constructs (records, fields and subfields) within the data. By using this mechanism, previously exchanged data can be brought up to date without the need for reissuing a complete new cell. Small (< 100kB) update messages can be distributed via the internet or hard media. Update messages can contain addition of new features, changes to existing features or the deletion of features.

2-6. IENC Encoding Guide. The IENC Encoding Guide is a document that helps to define the translation from real-world inland waterway features to the IHO S-57 model and structure. Developed and maintained by the IEHG, the Encoding Guide lists rules and provides guidance to ensure that consistent and uniform IENCs are produced, worldwide. It also provides considerable detail about the representation of real-world and cartographic features for an inland waterway in an IENC. For example, S-57 and the ENC Product Specification leave considerable discretion to the ENC producers on which features, or objects are used in a chart product. The IENC Encoding Guide specifies the objects and corresponding attributes to be used in IENCs. Any USACE or contractor office involved in field data collection, data collection from other sources, data compilation, conversion to IENC format, quality assurance or quality control, coordination with other federal agencies, interface with end users, or management of such efforts should refer to the Figure 2 of the IENC Encoding Guide for the proper structure and definition of IENCs (see Appendix A-References).

a. Data Model. IHO S-57, with additional IENC Encoding Rules, enables any feature to be consistently encoded and displayed without the standard becoming too cumbersome or constantly changing. S-57 specifies object classes such as Shoreline Construction, Depth Area, Land Area, and Buildings; and attributes such as Nature of Construction, Depth Value, Nature of Surface, and Object Name to represent real-world features. For example, an approximate area where a submerged cable is known to exist could be represented by Object Class PIPARE (Pipe Area), with attributes PRODCT (Product - oil, gas, water, or chemical) and RESTRN (Restriction - anchoring prohibited). The Encoding Guide specifies rules for use of object classes and attributes to represent 151 real-world or cartographic features for inland waterways. Figure 2-2 shows a sample page for a particular feature in the Encoding Guide. The top of the graphic has the Category (in this example: Ports, Waterways) and Sub-category (Locks, Barrages, Exceptional Navigational Structures), followed by the feature name (Lock Wall) with

the feature definition. The “Graphics” column shows a photo of a representative real-world object, a representation on a paper chart (can be from any country), and a rendering of the feature as typically displayed in an ECS (see figure 2-2). The “Object Encoding” column specifies the Object Class(s) to represent the feature followed by the permitted attributes, with further information in the “Encoding Instructions” column. Specification codes used in the description page include:

Usage: single letter after the feature name and preceding the attributes:

M, mandatory – feature or attribute is required; real-world feature assumed to exist in all IENCs (see Section 2-6b for further information)

O, optional – feature or attribute should be included if data is available and the information can reasonably be maintained.

C, conditional – feature or attribute is required if defined conditions within the Encoding Guide are met.

Geometric Primitive: single letter after the Object Class name:

P, point.

L, line.

A, area.

Regional Application: 2-letter designation denoting that the information applies solely to a particular region or continent:

US, United States (applies to all USACE IENCs)

EU, European Union

RU, Russian Federation

BR, Brazil

b. IENC Features. Table 2-1 lists all the features from the international Encoding Guide that are used in USACE IENCs. Other features in the EG apply to other regions or other countries. Note that all features in Table 2-1 apply to an IENC if the real-world feature exists. Thus, for purposes of producing and maintaining an IENC, no features in Table 2-1 are optional, as may be indicated in the Encoding Guide, even though other countries may opt for fewer features. Exceptions to Table 2-1 must be given by the IENC Program Management Office.

G - Ports, Waterways

G.4 Locks, Barrages, Exceptional Navigational Structures

G.4.7 Lock Wall (O)

Permanent structure bounding a lock and including guide walls.

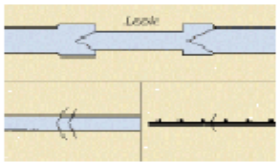
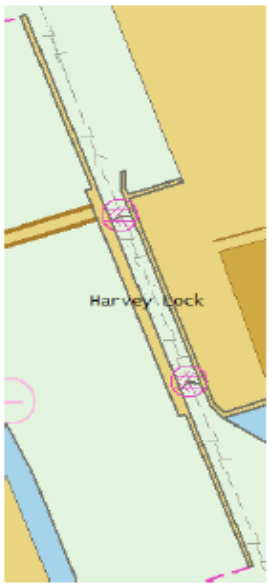
Graphics	Encoding Instructions	Object Encoding
Real World  *Chart Symbol*  *IENC Symbolization* 	A) The SLCONS object must be coincident with a LNDARE object. B) Multiple NATCON can be used, as in different materials for the lock wall and guide wall.	<u>Object Encoding</u> Object Class = slcons(L, A) (M) catslc = [18 (lock/guidewall] (O) NATCON = [1 (masonry), 2 (concreted), 3 (loose boulder), 6 (wooden), 7 (metal)] (M) SCAMIN = [EU: 22000; US: 45000] (C) SORDAT = [YYYYMMDD] (C) SORIND = (Refer to Section B, General Guidance)

Figure 2-2. Sample Feature Specification in the Encoding Guide

IENC Meta Information

Meta Features
- Data Coverage
- Data Quality
- Navigation System of Marks
- Vertical Datum
- Nautical Publication Information

Natural Features

Hydrology
- Canal (non-navigable)
- Rivers (non-navigable)
- Water Area Name
- Lake

Topography
- Land Area
- Land Region
- Rock Wall
- Shoreline

Vegetation
- Vegetation

Cultural Features

Settlements, Buildings, Political Boundaries
- Built-up Areas
- Buildings of Navigational Significance
- International Boundaries & National Limits (Administration Area)

Airfields, Railways, Roads
- Airport
- Railway
- Road

Other Cultural Features
- Silo / Storage Tank

Landmarks
- Conspicuous Landmark

Ports, Waterways

Bridges, Tunnels, Overhead Obstructions
- Bascule Bridge
- Fixed Bridge
- Lift Bridge
- Suspension Bridge
- Swing Bridge
- Tunnel
- Overhead Cable
- Overhead Pipe
- Pylons, Piers, and Bridge, Cable, Pipeline Support
- Foot Bridge / Catwalk

Hydraulic Structures in General
- Dyke / Levee
- Fence / Floodwall
- Groin
- Ground Sill
- Revetment
- Training Wall

Installations
- Boat Ramp
- Bunker / Fueling Station
- Conveyor
- Crane
- Dock / Wharf
- Dry Dock
- Floating Dock
- Fender
- Landing Stage, Pontoon
- Mooring Facility
- Federal Mooring Facility
- Permanently Moored Vessel or Facility
- Slipway
- Landing Steps, Ladders
- Ice Breaker

Locks, Barrages, Exceptional Navigational Structures
- Arrival Point
- Dam / Barrier
- Lock Basin
- Lock Basin Part
- Lock Gate
- Lock or Lock & Dam Name
- Lock Wall

Depths

Depths in Fairways and Areas
- Fairway Depth / Project Depth
- Low / High Water Range (Drying Height)
- Shallow Depth
- Unsurveyed Area

Depth Contours
- Depth Contour

Depth References
- Depth Indicator
- Vertical Clearance Indicator
- Waterway Gauge

Rocks, Wrecks, Obstructions

Rocks
- Rocks

Wrecks
- Wrecks

Obstructions
- Obstruction

Table 2-1. Features in an IENC

Offshore Installations
Submarine Cables
- Submarine Cable
- Submarine Cable Area

Submarine Pipelines
- Submarine Pipeline
- Submarine Pipeline Area

Tracks, Routes
Tracks
- Navigation Line
- Sailing Line / Recommended Track
- Two-way Route Part
- Waterway Axis
- Ferries
- Cable Ferry
- Free Moving Ferry
- Swinging Wire Ferry

Supplemental Navigation References
- Distance Mark Along Waterway Axis
- Distance Mark Ashore

Areas, Limits
Anchorage Areas and Berths
- Anchorage Area
- Anchorage Berth
- Berth without Transshipment / Fleeting Areas
- Transshipment Berth

Restricted Areas
- Restricted Area

Caution Areas
- Caution Area

Miscellaneous Areas / Limits
- Communication Area
- River Surveillance Area
- Section of Limited Depth
- Section of Limited Width
- Turning Basin

Lights
Light Structures
- Bridge Light
- Minor Light
- Leading Light
- Directional Light
- Sector Light

Buoys, Beacons and Daymarks, Notice Marks
Buoys
- Buoy at Bifurcation of Channel
- Buoy at Bridge Pillar
- Buoy Marking Danger Point
- Cardinal Buoy
- Lateral Buoy
- Safe Water Buoy
- Stalling Buoy
- Swinging Axial Buoy
- Swinging Lateral Buoy
- Isolated Danger Buoy

Beacons & Daymarks
- Day Mark
- Landmark Beacon
- Radar Beacon, RACON
- Spring Flood Beacon
- Isolated Danger Beacon

Notice Marks
- Notice Marks
- Notice Marks on Bridges
- Wreck Pontoon

IALA Maritime Buoyage System
- Special Purpose Buoy IALA

Services
Signal Stations
- Traffic Signal Station - Bridge Passage
- Traffic Signal Station - Lock

Small Craft Facilities
Marinas and Other Facilities
- Marina
- Small Craft Facility

Table 2-1. Features in an IENC (continued)

c. IENC Producer Codes. The IHO S-57 ENC Product Specification includes information about the data producer. This information is contained in the "Producer Code", which is a 2-character acronym and corresponding integer value. The IHO codes for Hydrographic agencies which produce ENC data are contained in IHO S-62 (currently Edition 2.1, June 2005). This register contains the codes for official ENC data producers. USACE produces IENCs under the U3 producer code.

The new IHO S-100 Registry provides the capability for non-Hydrographic agency S-57 data producers to register their own Producer Code: http://registry.iho.int/s100_gi_registry. USACE has registered 3U (internally coded as: 16206) as "U.S. Army Corps of Engineers - Channel Condition Data." Thus publication using the 3U code designates that navigational data, not charts, were created by USACE. These data are produced in the Inland ENC 2.1 encoding standard.

2-7. IENC Coverage. Table 2-2 lists all waterways in the USA that are covered by IENCs, including the corresponding District and Area of Responsibility. The list included all inland waterways that that are actively maintained by the Districts for navigation. If there are any changes to District Navigation Programs (e.g., new waterways authorized and funded or existing programs de-funded), then the list of IENC waterways may change. Any such changes must be coordinated with the IENC Program Manager.

2-8. Special Purpose IENCs. Electronic chart products developed for a specific need or a particular user may be developed with some deviation from the specifications presented in this manual.

a. Development – Special Purpose IENC can be produced to meet various requirements:

(1) A specific request by navigation users (e.g., harbor charts to support port authorities, charts to delineate non-navigable area due to low power lines for a particular vessel).

(2) For temporary or urgent need (e.g., display of dredged areas for extremely low water conditions).

(3) A supplement to NOAA Charts in dredged areas or channels where shoaling are frequent and dynamic (e.g. Columbia River or Mississippi River at the Gulf).

(4) As a pilot product to test new features or data structures (e.g., additional bathymetric contours to show more channel information).

b. These charts may contain features or attributes not in the IENC Encoding Guide (e.g., tenths of river miles, detailed port facilities/conveyors/cranes) but which are beneficial for the purpose developed. Similar to published IENCs, Special Purpose IENCs would follow the International Hydrographic Office S-57 ENC Specifications, but could deviate from the IENC Encoding Guide (see Appendix A-References), the established cell boundaries (see Chapter 4),

or the maintenance and quality assurance process. Special Purpose IENCs must be clearly distinguished from official published IENCs, and should use the 3U Producer Code.

c. Dissemination. Dissemination to any users outside of USACE or their contractors must be approved by the IENC Program Manager.

WATERWAY	RIVER CODE	USACE DISTRICT
Allegheny	AG	Pittsburgh
Alabama	AL	Mobile
Arkansas	AR	Little Rock, Tulsa
Atchafalaya	AT	New Orleans
Black Warrior	BW	Mobile
Clinch	CL	Nashville
Cumberland	CR	Nashville
Green	GR	Louisville
Illinois Waterway	IL	Rock Island, St. Louis
Kanawha	KA	Huntington
Kaskaskia	KK	St. Louis
Lower Mississippi	LM	Memphis, Vicksburg, New Orleans
Missouri	MO	Kansas City, Omaha
Monongahela	MN	Pittsburgh
Ohio River	OH	Louisville, Huntington, Pittsburgh
Ouachita	OU	Vicksburg
Red	RR	Vicksburg
Tennessee River	TN	Nashville
Tenn-Tom	TT	Mobile
Tombigbee	TB	Mobile
Upper Mississippi	UM	St. Louis, Rock Island, St. Paul
White River	WH	Memphis

Table 2-2. USA Waterways with IENC Coverage

2-9. 'Special Purpose' River Chart Data. River chart data based on IHO S-57 but not conforming to the IENC Encoding Guide are not considered an 'official chart" in terms of ensuring safety of navigation. However, 'special purpose' river chart data may be produced as a "test chart" or provisional charts for vendor evaluation. For any 'special purpose river chart, the naming convention for each cell is 3UPRCMMM.VVV, in which:

3U = international Producer Code; USACE = (U3 is used for official IENCs)

P	=	navigational purpose; may have purpose code other than “7”
RC	=	river code (see Table 2-2)
MMM	=	river mile at lower end of the cell
VVV	=	version of the base chart, beginning with “000”, “001” for the first update, “002”for the second update, etc.

CHAPTER 3

IENC Data Collection

3-1. Purpose. This chapter provides general guidance on planning and performing feature collection surveys that are required for developing IENCs. Guidance is provided on methods for feature collection and accuracy requirements. Some examples of projects performed by various Districts are provided in Appendix E (IENC District QA Chart Documentation Sheet).

3-2. Frequency of Data and Updates. IENC features should be updated as often as data and resources permit, in order to maintain accuracy and usefulness to end users.

a. This updating and maintenance process is necessary since features may:

(1) shift (e.g., depth contours)

(2) be removed (e.g., a buoy or daymark)

(3) be added (e.g., new wrecks or obstructions)

(4) have changed attributes (e.g., the name of a new owner of a dock or wharf).

b. Table 3-1 lists the minimum frequency at which each IENC feature should be reviewed for possible changes, and subsequent update to or replacement of the corresponding IENC cell. Data sources for feature review within each District include channel maintenance and dredging functions, regulatory and permit functions, flood risk mitigation functions, and any other branch or section that could have current information on any IENC feature. Most features are updated by the District that is responsible for producing the IENC cell.

3-3. Data from Existing Sources. Source data to produce or update IENC cells come from various sources, including field and hydrographic surveys. However, other chart-related information may be obtained in conjunction with other USACE programs involved in investigation, engineering, construction and maintenance activities on navigable waterways. Important information may also be provided by USCG for fixed and floating aids-to-navigation, and from geospatial data holdings of other agencies. The availability of these types of source data should be checked and verified before new data is collected or field survey activities are proposed in Program Formulation. Typical data sources include the following:

Review Frequency	Feature	Encoding Guide Reference
Weekly	Buoys	O.1.5,10
	Beacons	O.2.1,2,5
	Lights	N.1.1-5
Quarterly	Depth Information	I.1.5,6
	Project Depth Contour	I.2.1
	Wrecks	J.2.1
	Obstructions	J.1.1, J.3.1
Bi-Annual	Restricted and Caution Areas	M.1.1,3, M.2.1, M.3.1
Annual	Arrival Points	G.4.1
	Boat Ramp	G.3.1
	Ferry Route	L.2.2
	Fleeting Area	M.1.3
	Meta Objects	C.1.1-8
	Mooring Facilities	G.3.12,14
	Revetments	G.2.5,6
	Sailing Line	L.1.2
	Shoreline Facilities	G.3.3,23
	Submerged Utilities	K.1.1-2, K.2.1-2
	Docks/Wharves/Marinas	G.3.5
Annual+ *Note: Districts should use own discretion on change frequency based on local conditions*	Buildings/Roads/Railroads/Airports	E.1.1-3, E.2.1-2
	Cables and Supports	G.1.8-10
	Bridges	G.1.1-6
	Hydraulic Structures	G.2.1,2,7
	Locks and Dams	G.4.2-7
	Marine Fenders	G.3.8
	Pipelines and Supports	K.2.1-2, G.1.10
	Political Boundaries	E.1.3
	River Mile Marker	L.3.2
	Tanks	E.3.1

Table 3-1. Minimum frequency IENC cells should be reviewed for possible changes.

a. USACE Business Functions. USACE activities that most commonly produce geospatial data useful to IENCs are hydrographic surveys for dredging or channel condition assessment. When such surveys are performed, the survey should be evaluated to determine if depth contours have changed or if new obstructions exist. If changes are sufficient to merit a chart update, the data should be directed into the IENC update process. District IENC personnel are advised to take advantage of opportunistic data collection and coordinate with survey functions to collect data and check above-water

features, such as wrecks, obstructions, or shoals to verify existence of hydrographic daymarks, dikes, submarine pipelines (end locations), and shoreline features.

b. USCG - Local Notices to Mariners (LNMs). Official information about changes to fixed and floating aids to navigation, and changing waterway conditions, are published through USCG LNMs. When such information affects an IENC feature, then the IENC cell must be updated. District offices supporting IENCs shall monitor all LNMs and update the corresponding IENC cells.

c. National Spatial Data Infrastructure (NSDI). Data holdings from other federal, state and local agencies should always be searched for data and information that could be useful to IENCs. District PDT members shall check the NSDI Geospatial One Stop at Geodata.gov prior to beginning any IENC program funded data collection. See EM 1110-1-2909 (Chapter 7) for further guidance on NSDI data files and metadata.

3-4. Field Data Collection. Field data collection for IENCs typically involves hydrographic or topographic surveys or photogrammetric mapping. Any such data collection activity must follow the standards and procedures in the corresponding Engineer Manual listed in Appendix A (Reference Documents).

a. Hydrographic Surveys. These surveys are performed to establish project depths in the navigation channel, and to determine or verify locations of wrecks or other submerged obstructions. The nine-foot contour, which is the authorized depth for inland waterways, must be derived and provided to the Cell Producer. Nine-foot contours outside the maintained channel (side-sloughs, neighboring areas in tributaries) are useful and should be collected and processed, as resources and time permit. When possible, IENC PDT members should leverage other hydrographic survey activities for dredging and channel condition assessment. IENC funds might be used to extend the survey project area, survey obstructions, or obtain derived features specifically needed for IENCs. See EM 1110-2-1003 (Hydrographic Surveying) for guidance on hydrographic surveys.

b. Topographic Survey. This type of survey is performed to collect data on most above-water IENC features within or near the water line. Although some easy-to-use hand-held GPS devices can provide high accuracies, any feature with a horizontal accuracy of three meters or less (1σ) should be collected by personnel knowledgeable of survey procedures and references. Preferably, topographic data collection is performed on a survey boat equipped with a laser range device, high-accuracy GPS and a necessary motion compensation system. Such a platform enables rapid and less costly surveys of fixed objects in and near the river. Appendix D-1(IENC History File) describes such a system in the sample work order. See EM 1110-1-1005 (Topographic Surveying) for guidance on topographic surveys.

c. Photogrammetric Mapping. Aerial photogrammetry is typically used to collect large or linear features that are not within view of the waterway. Such features would include buildings and structures of navigational significance, roads, railroads, levees. Other features, such as waterline and fixed objects within the river, could be derived from photogrammetric mapping if the procedure produces the necessary accuracy. Photogrammetry is an effective method to survey most IENC features in initial development of an IENC cell. However, due to the high cost, IENC PDT members should particularly seek to leverage aerial data collection efforts with other business functions in the District. See EM 1110-1-1000, Photogrammetric Mapping, for guidance on aerial photogrammetry and mapping.

3-5. Positional Accuracy. Horizontal accuracies for IENC features are shown in Table 3-2. These accuracies ensure that IENCs are useful products for safety and efficiency of navigation, and can be obtained with familiar and commonly-available survey systems and procedures. Features into which commercial vessels come into close proximity, and which operators must carefully avoid, have the highest accuracy values of 1-2 meters. Such features require particular attention during surveys to achieve required accuracies. Surveyors also must ensure that a sufficient number of points are collected on a particular feature to provide an accurate outline in the IENC.

3-6. Horizontal Datum. Because IENCs are derived from the IHO S-57 standard, all data coordinates must be referenced to the WGS84 geographic (latitude, longitude) coordinate system. However, in the US, and particularly USACE Civil Works construction projects, the majority of the survey data is collected in relation to the NAD83 datum. Since the differences between these two datums (WGS84 and NAD83) are small (less than 1 meter), data collected in the NAD83 datum can be assumed to be WGS84, in most cases. Data gathered from older sources that are in NAD27 must be converted to NAD83 before use in an IENC. Data collected or gathered from sources that are in state plane coordinate systems must be converted to geographic (latitude, longitude) for inclusion in an IENC. Reference EM 1110-1-1005, Chapter 5, for further information on horizontal datums and coordinate systems.

3-7. Vertical Datums and Depth Reference. The vertical reference for all features with height or depth values must follow the guidance in EM1110-1-1005 (Section 4-3). The guidance for inland river areas and controlled river pools applies to nearly all IENCs. The exceptions are any IENCs in areas with tidal influence (e.g., may apply to some waterways in New Orleans and Mobile Districts). Such IENCs should be referenced to the Mean Lower Low Water Tidal Datum for height and depth values. For all other waterways, local river datums should be referenced to NAVD 88 or the District should have a plan for compliance. However, IENCs must first be consistent with the vertical datum used on the corresponding navigation project, if compliant with EM1110-1-1005.

As resources permit, use of IENC funds and resources may be used in coordination with navigation project initiatives to convert to NAVD 88.

3-8. Attributes. Attributes or supporting information for each feature, follow specific structures and are described in the Encoding Guide. The description sheet for each feature lists the attributes under the Object Encoding column, with any related guidance under Encoding Instructions. Note that the Mandatory (M), Conditional(C), and Optional (O) designations for attributes apply to IENCs.

Feature Name	**Geometry** (**P**oint, **L**ine, **A**rea)	**Horizontal Accuracy (1σ) meters**	**Horizontal Accuracy (2σ) meters**
Airport	P, A	10	20
Arrival Point	P, L, A	2.5	5
Below Project Depth Area	L, A	2.5	5
Boat Ramp	P, L, A	2.5	5
Bridge	P, L, A	1	2
Building	P, A	10	20
Buoy (lateral)	P	2.5	5
Buoy (wreck marker)	P	2.5	5
Canal	L, A	5	10
Dam	P, L, A	1	2
Day Beacon	P	5	10
Dike/Wing Dam/Bendway Weir/Navigation Weir	P, L, A	1	2

Table 3-2. Horizontal Accuracies for IENCs

Feature Name	**Geometry** (**P**oint, **L**ine, **A**rea)	**Horizontal Accuracy (1σ) meters**	**Horizontal Accuracy (2σ) meters**
Dock/Wharf	P, L, A	2.5	5
Ferry Crossing	L, A	2.5	5
Fleeting Area	A	2.5	5
Hulks	P, A	2.5	5
Ice Breaker	P, L, A	2	4
Land Area	P, L, A	2.5	5
Levee	L	2.5	5
Light	P	5	10
Lock Chamber	A	1	2
Lock Gate	L	1	2
Lock guide-wall	P, L, A	1	2
Lock Name	A	5	10
Lock Walls	L	1	2
Marina	A	5	10
Marine fender	P, L, A	2.5	5
Mooring Facility	P, L, A	2.5	5

Table 3-2. Horizontal Accuracies for IENCs (continued)

Feature Name	**Geometry** (**P**oint, **L**ine, **A**rea)	**Horizontal Accuracy (1σ) meters**	**Horizontal Accuracy (2σ) meters**
Navigation Aid Support	P	5	10
Overhead Cable	L	2.5	5
Overhead Pipe	L	2.5	5
Project Depth Area	L, A	2.5	5
Project Depth Contour	L	2.5	5
Railroad	L	5	10
Range Lines	L	2	4
Restricted Area	A	2.5	5
Revetment; Above Waterline	A	2	4
Revetment; Below Waterline	A	2	4
River (not commercially navigable)	L, A	5	10
River Gauge	P	2	4
River Mile	P	5	10
Road	P, L, A	5	10
Sailing Line	L, A	2	4
Shore Line (fixed)	L	2.5	5

Table 3-2. Horizontal Accuracies for IENCs (continued)

Feature Name	**Geometry** (**P**oint, **L**ine, **A**rea)	**Horizontal Accuracy (1σ) meters**	**Horizontal Accuracy (2σ) meters**
Sounding	P	2	4
Storage Tank	P, A	5	10
Submerged Cable	L	2	4
Submerged Crossing Area of Uncertainty	A	2	4
Submerged Pipe (see also Submerged Crossing Area of Uncertainty)	P, L	2	4
Support Pier: Bridge	P, A	2	4
Support Pier: Tower for Overhead Pipeline	P, A	2	4
Text Name (land): point, landing, island, bar, towhead, dike field, etc.	P, A	10	20
Text Name (water): bend, chute, cut-off, harbor, etc.	P, A	10	20
Urban Area	P, A	10	20
Water Intake Area of Uncertainty required when Water Intake used	A	3	6
Water Intake	P, L	3	6
Wreck	P, A	2	4

Table 3-2. Horizontal Accuracies for IENCs (continued)

Generally, District IENC Team members should plan to collect all ‘Optional’ attributes as time and resources permit. Guidance is provided for attributes and attribute values that apply to a specific country or region. Any US designation applies specifically to IENCs, and any other designation such as EU (European Union) does not apply to IENCs. If an

attribute or value has no regional designation, then the information applies to IENCs. Attribute values are of three forms and must be followed as specified:

a. Structured: A fixed format with a specified number of characters. For example, a date for SORDAT follows the numeric format YYYYMMDD.

b. Enumerated: An alphanumeric code from a list values. For example, the commodity in storage tanks or pipelines is identified by PRODCT and uses one or a combination of the following values; 1 (oil), 2(gas), 3(water), 7(chemical), or 22(grain).

c. Text: Any alphanumeric text that reasonably describes the attribute. For example, OBJNAM and INFORM can use any name or phrase, unless otherwise specified in the Encoding Guide, to provide a name or basic information about the feature. The text for these attributes should not exceed 15 characters. If more information is needed to describe the feature, TXTDSC should be used (see 4-9).

3-9. Text Descriptions. Some features in the Encoding Guide specify TXTDSC attributes to provide additional information that doesn't fit in the other structured attributes. The TXTDSC attribute for the corresponding feature specifies the name of the TXTDSC file that contains the additional information. The naming structure for each TXTDSC file is AARRMMMXNN.EXT where:

AA	=	2-character producer code; U3 for all IENCs
RR	=	2 character river code (see Table 2-2)
MMM	=	3- digit river mile, 000-999, of the corresponding feature
X	=	tenth of river mile; preceding decimal point implied; use zero if river mile known only to nearest mile
NN	=	01-99; unique identifier for text file at the particular river mile. For example, if three TXTDSC files exist at the same river mile, 01, 02, and 03 would be used. N may also be used for tracking purposes.
EXT	=	3-character file extension for either Hypertext Metafile, HTM, or ASCII text, TXT.

For example, the naming of text file for Ohio River IENC U35OH001 at mile 6.2 would be: U3OH006201.HTM.

A sample TXDSC file for U3OH006201.HTM is shown in Figure 3-1 Sample TXTDSC file:

Emsworth Lock and Dam Information	
Mile 6.2	
Land Access Bank	Right Descending Bank
Lockage Size	110’ x 600’
Lift	36 ft
Pool Elevation	718 ft
Sill Elevation	Upper 17.4 / Lower -9.6
Safe Operating Limit	Tail Water at 58.0 ft
Communications (VHF)	MB 12 / 16
	Call Sign: WUG-312
Phone	412-766-6213
	412-766-8640
Cell; Lock Control House	412-451-8743
Lock Master	412-451-8744
Nearest Town	Pittsburgh, PA

Figure 3-1 Sample TXTDSC file

3-10. Images. Photos or graphic representations can provide very helpful visual representations of some features. At a minimum, all bridges across navigation channels must have a PICREP (pictorial representation). The PICREP attribute for the corresponding feature specifies the name of the PICREP file that contains the image. The naming structure for each PICREP file is AARRMMMXNN.EXT where:

AA = 2-character producer code; U3 for all IENCs
RR = 2 character river code (see Table 2-2)
MMM = 3- digit river mile, 000-999, of the corresponding feature X = tenth of river mile; preceding decimal point implied; use zero if river mile known only to nearest mile
NN = 01-99; unique identifier for text file at the particular river mile. For example, if three PICREP files exist at the same river mile, 01, 02, and 03 would be used. NN may also be used for tracking purposes.
EXT = 3-character file extension, JPG, which designates JPEG raster format used for IENC PICREPs

Example naming of a picture and illustration for a bridge over the Ohio River at Mile 0.8 would be U3OH000801.JPG. All PICREP images for IENCs should use the following specifications:

Format = JPEG
Size = 800 X 600 pixels
Resolution = 300 pixels/inch

Type = TrueColor (24 bit)
JPEG Quality Factor = 50%

A sample PICREP image for a bridge at Mile 0.8 on the Ohio River shown in Figure 3-2.

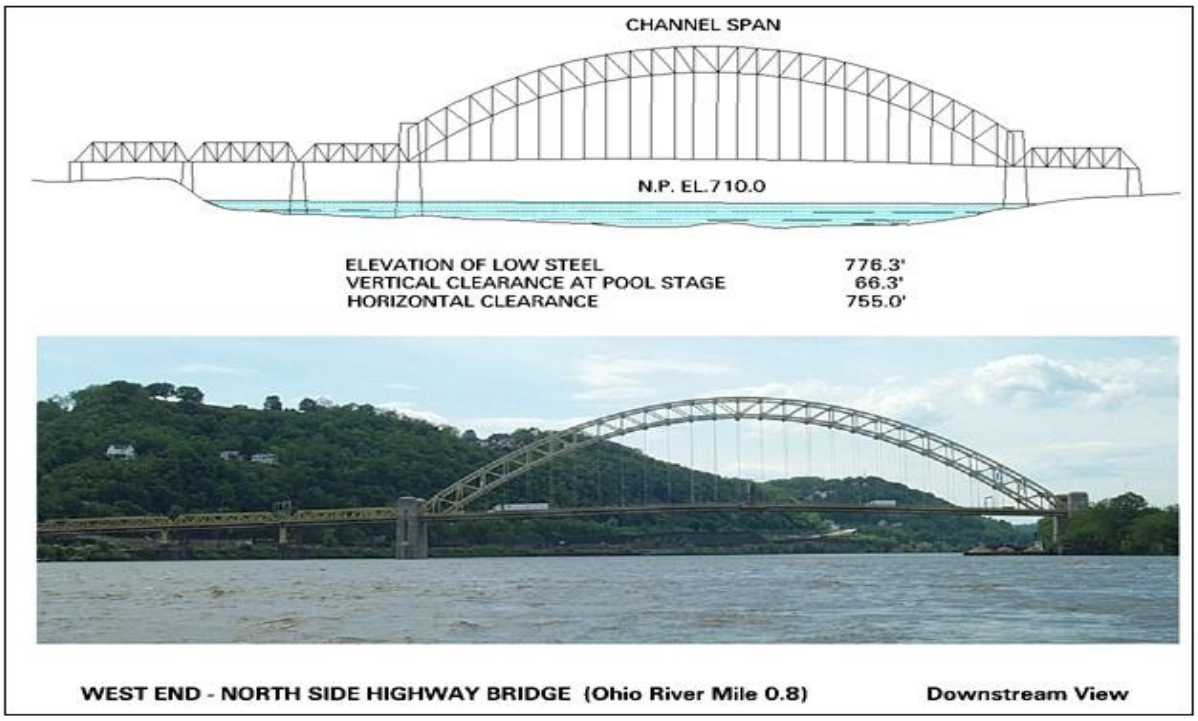


Figure 3-2. Example PICREP image.

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CHAPTER 4

IENC Compilation, Production and Maintenance

4-1. Purpose. This chapter provides general guidance on the required steps to compile Inland Electronic Navigational Chart (IENC) source data, and how these data are transformed into an IENC. Chart production requires collection of source data from USACE Districts, data preparation, and submittal to the chart producing entity prior to chart integration. Chart maintenance consists of regular data collection and data submissions that are required to keep chart information current. Critical to the IENC process is the role that USACE Districts play in regard to data preparation and quality assurance. USACE has defined a documented workflow process to ensure source data flow control, source metadata control, data review, documented updates, quality assurance, defined levels of review, and 100% traceable audit trail for source application. The following sections describe the various steps and the methods that are used to compile, produce and maintain IENCs. Technology, software tools, and government/contractor-support tasking can vary and are subject to change. However, the basic philosophy of maintaining a controlled and auditable workflow is fundamental to the charting process.

4-2. The IENC Data Process. An overview of the IENC production process is shown in Figure 4-1. Its primary focus is highlighting the specific roles of the USACE Districts, Quality Assurance Manager and the Chart Producer, and how they interact. The process begins with source data collection and submission. It is then followed by data evaluation, IENC, data compilation, IENC cell production, quality assurance and ends with final IENC publication. The remaining sections of this chapter follow the process shown in Figure 4-1.

a. The main components of the overall process include:

(1) Source Data Collection and Transmission

(2) Source Data Evaluation

(3) Data Compilation

(4) IENC Chart Production

(5) Quality Assurance

(6) IENC Publication

b. The primary objectives of this process are to:

(1) Obtain data that originates with experts who are knowledgeable about the charted waterway.

(2) Provide format, accuracy, and content checks that are performed by independent and sometimes redundant parties.

(3) Produce or update IENC charts in conformance with a specific encoding structure by experts with specialized IENC knowledge and software tools.

(4) Perform regular Quality Assurance to minimize data errors.

(5) Produce and publish IENCs on a timely and reliable schedule to facilitate public or private dissemination and use.

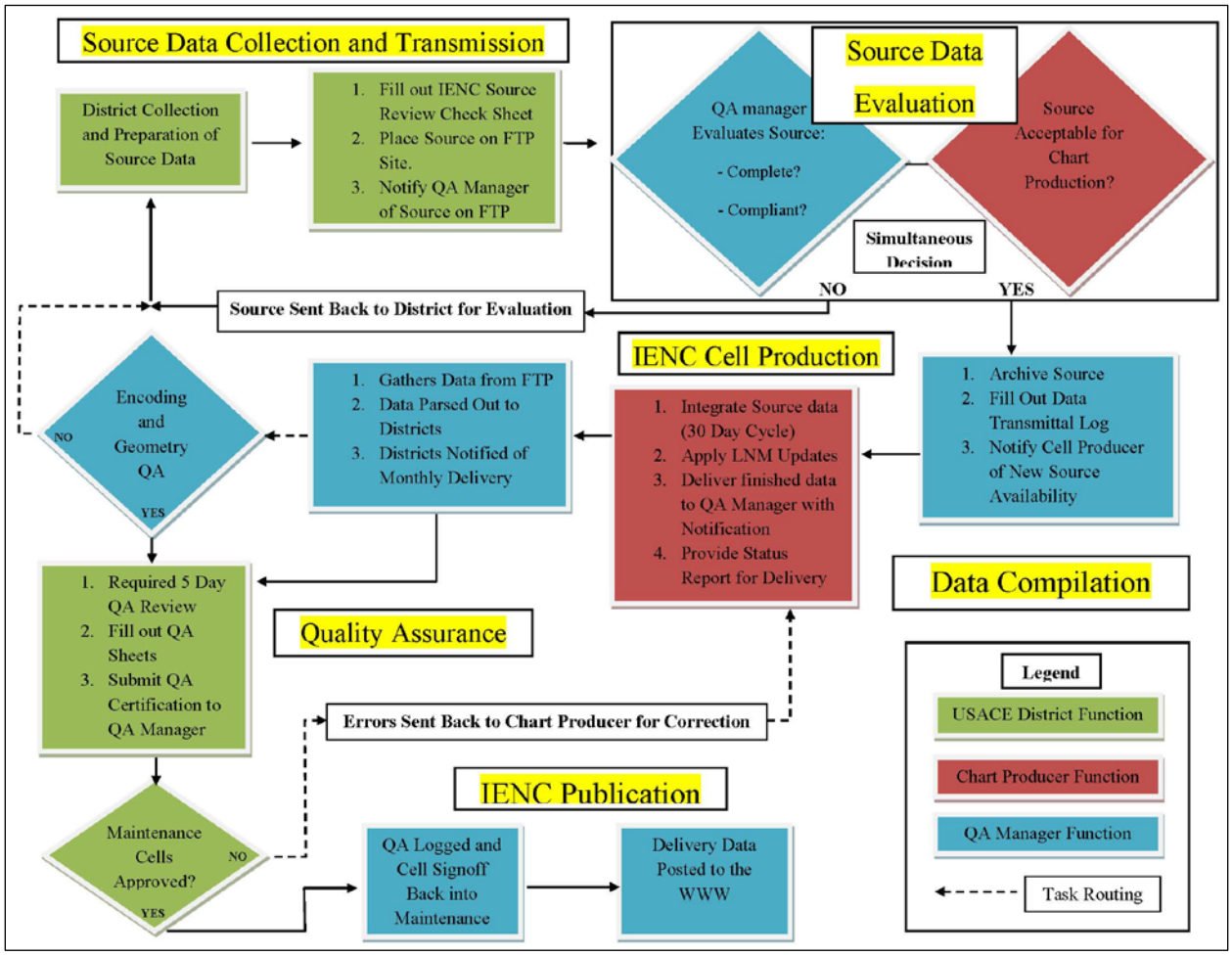

Figure 4-1. The USACE IENC Production Process

4-3. USACE IENC Process Roles. Critical to the process of IENC creation and maintenance is for all participants in the process to understand their respective roles. This section highlights the responsibilities of the primary participants that are involved in the IENC production process. The functional roles are defined in three categories: USACE Districts, Quality Assurance

Manager, and Chart Producer. The roles listed are independent of each other, and describe what is required by each participant.

4-3-1. USACE Districts.

a. USACE Districts are responsible for routine chart maintenance. This includes, but is not limited to, the collection and compilation of digital source data to maintain changing depth information and shoreline feature/facility information. USACE Districts should ensure that all source data are correct and compliant with *IENC Encoding Guide* (see Appendix A) prior to submission. The current *IENC Encoding Guide* is used to provide detailed guidance on what is required to produce a consistent, uniform Inland ENC. It defines how features are transformed into classes, attributes and attribute values. The USACE is presently using Inland ENC Encoding Guide – Ed. 2.2.0. Information on the current edition of the USACE Encoding Guide is contained in Appendix A-References.

b. When USACE Districts are confident that source data are accurate and compliant, the data are delivered to the Quality Assurance (QA) Manager who is currently at the Army Geospatial Center (AGC). Data are first evaluated by Districts and then logged into the *IENC District Source Metadata and Check Sheet* (Appendix B). Once complete, the digital source and *IENC District Source Metadata and Check Sheet* are transferred to the QA Manager via established FTP as well as a notification to the QA Manager that there are new source data to be processed.

c. USACE Districts are required to perform QA on all delivered charts from the Chart Producer on a monthly basis adhering to the established maintenance cycle. The specifics on this process are highlighted in Section 4.9, USACE District Quality Assurance Requirements. This includes a QA review within five days of the maintenance delivery and QA Certification correspondence back to the QA Manager once the review is completed. The sheet used for QA correspondence is the *IENC District QA Chart Documentation Sheet* (see Appendix E).

4-3-2. Quality Assurance Manager.

a. The Quality Assurance Manager function is currently at the U.S. Army Geospatial Center. The person holding this role is to perform these tasks separate from the other required USACE District functions. The QA Manager is required to have regular correspondence with USACE Districts and the Chart Producer regarding any issues discovered with source data or products.

b. The QA Manager is responsible for deciding if new source is complete and accurate when submitted from the USACE Districts. The QA Manager will review the *IENC District Source Metadata and Check Sheet* (Appendix B), provided by the USACE Districts, and if source is satisfactory, it will be transferred from the QA Manager to the Chart Producer by electronic means (FTP). If source is not satisfactory, it is sent back to the originating District for

correction or verification of completeness. A District source resubmission will be required to enter the data as an official source submission. The QA Manager evaluates if the new data is complete and accurate after resubmission.

c. The QA Manager is responsible for the archival of any new source delivered from a USACE Districts. Next, the QA Manager needs to complete the *Data Transmittal Log* (see Appendix F) before transferring new source to the Chart Producer. The *Data Transmittal Log* serves as a traceable record of source submitted to the Chart Producer.

d. The QA Manager is responsible for the distribution of all monthly maintenance cycle deliveries to USACE Districts to begin their QA process. This is handled via FTP transfer of the new data to USACE Districts coupled with a notification to begin the QA process. The notification typically is done by e-mail and includes an *IENC Maintenance Status Report* (see Appendix C) showing which charts need to have QA performed by USACE Districts. This report lists all charts in maintenance, editions and if updates were applied. Also listed is the date the charts are cleared through regarding U.S. Coast Guard Local Notices to Mariners weekly updates.

e. The QA Manager is required to keep a log of all QA responses from Districts during the monthly cycle in order to ensure that the process is running continually. Districts are required to supply QA Sheets back to the QA Manager and the QA Manager is then responsible for archiving them and sending forward any discrepancies to the Chart Producer for correction. Small source change recommendations are placed in the *Data Transmittal Log* (Appendix F*)* by the Chart Producer.

f. The QA Manager is required to perform separate and independent QA on charts delivered during the monthly maintenance cycle. This will typically include data verification to other known sources, versioning, checks for feature consistency and cartographic completeness for the chart. Any discrepancies discovered should be sent to the responsible USACE District or the Chart Producer for rectification. Records shall be kept on this process by the District and the Chart Producer.

g. The QA Manager will maintain all IENC data for public distribution. This is usually performed using a web service (Server) dedicated only to the distribution of IENC charts. The process is a continual updating process driven by regular monthly deliveries from the Chart Producer.

4-3-3. Chart Producer.

a. The Chart Producer is responsible for final production of the IENC. Once correct and accurate data are delivered to the Chart Producer, the implementation process begins. Software capable of producing IENC charts is required to create and insert features during any maintenance cycle. If there are issues with submitted source, it is the role of the Chart Producer

to resolve them. This is done through the QA Manager or through direct USACE District contact. Data are to be included in the IENC charts through a 30-day maintenance cycle.

b. During each monthly maintenance cycle, the Chart Producer needs to conduct weekly evaluations of the USCG's Local Notices to Mariners (LNMs) to determine if any information is relevant to the alteration of existing data within the IENC's. This can take the form of aids-to-navigation and general information of concern to the mariner. All relevant information from these LNMs can be included in IENC's as S-57 feature representations. The Chart Producer is to include information from USCG LNM Sections I, II, III, VII and VIII, which are further explained in Section 4.11.

c. Once data are compiled and created by the Chart Producer, the finished delivery products need to be transferred to the QA Manager for archiving and dissemination to USACE Districts. This is the genesis of the regular monthly maintenance cycle. The new data, *IENC Maintenance Status Report* (Appendix C) and supporting *History Files* all need to be included in the delivery package. Chart History Files need to be supplied with every chart delivered from the Chart Producer. An example History File may be examined in Appendix D-1.

4-4. Source Data Structure/ Background. This section explains the data structuring, topological structuring, generalization, and data buffer guidelines to be employed in the data assembly stage. These preparation steps are necessary for the preparation of new source data for inclusion by the Chart Producer.

a. IENC Encoding Guide. The IENC Encoding Guide (see Appendix A -References) contains the content and structuring specification document for USACE IENCs. It defines the relationship between real-world features and their encapsulation based on the IHO S-57–based IENC Product Specification. In defining how real-world features should be coded as IHIO S-57-based objects, Group 1 and Group 2 features for each IENC chart are defined. Group 1 and Group 2 objects are specifically defined in the IHO S-57 - (ENC Product Specification), p. 11-12. Group 1 objects refer to the area covered by a metadata object M_COVR with CATCOV = 1 that is totally covered by a set of geo-objects of type area that do not overlap each other. The features comprising this coverage are depth areas, dredge areas, floating docks, permanently moored vessels, land areas, landing stages and uncharted water areas. Group 2 objects are all other features that are not Group 1 objects. These are usually point, line, and area objects. The collective area of Group 1 objects is typically referred to as the IENC's Skin of the Earth (SOE) object (see Fig. 4-2).

Figure 4-2. Skin-of-the-earth objects (based on IHO S-57).

b. Data Structuring. The IHO S-57 standard defines the structuring (Group 1 and Group 2 objects) of the electronic chart data. The electronic chart systems that use the IENC data require that the IHO S-57-based data be encoded to the standard to ensure the correct display of feature content. Most CADD/GIS software packages do not store data using this data model. As such, the spatial data must be manipulated to conform to the S-57-based standard using commercial IENC creation software packages.

c. Data Buffer. For navigational purposes, the information extending 1000 meters from the bankline is considered important for IENC information. Data outside this area are not considered significant to navigation on the rivers with IENC coverage. Source data outside the coverage area will typically be clipped by the Chart Producer.

(1) Size of Data Buffer. The IENC data buffer should extend 1,000 meters landward, perpendicular to each bankline. This defines the area extent for data compilation outside the waterway.

(2) Data Buffer Guidelines. The data buffer zones can automatically be created using CADD/GIS tools. Data outside of the buffer zone can be removed from the IENC production environment by the Chart Producer. No data can overlap the buffer zone boundary. CADD/GIS tools can be used to clip data at the buffer zone limit, or the operator can manually clip the overlapping data. Very small roadway/railway line segments near the buffer limit can be removed. In some cases the buffer zone must be manually adjusted to include features that do

have navigational significance (e.g., levees, landmarks, towers, and buildings of navigational significance).

4-5. Source Data Collection and Transmission. Following initial IENC creation, regular source updates by USACE Districts are important in terms of maintaining current information within the IENCs. This section outlines the procedures necessary for proper source data collection by USACE Districts, and submission to the designated Chart Producer. This includes specific focus on data submission procedures, data archiving, delivery timeline, and supporting metadata sheets.

a. Source data are very specific to the geographic area of coverage, although data structure must always follow the current IENC Encoding Guide upon submission. Source data is typically collected through field procedures or collected from other digital sources, and then processed by the USACE Districts prior to submission. IENC source is posted where it can be retrieved, evaluated, and integrated into IENC format by the Chart Producer.

b. After the source data are determined, the District must submit the IENC District Source Metadata and Check Sheet (Appendix B) with the data for integration. This sheet was designed to give the Chart Producer a detailed description of the source that was submitted and how each feature should translate into IHO S-57 data. The form also serves to make the providers of the data more aware of potential data problems they may encounter with the source data. Data submitters (USACE Districts) are required to provide metadata regarding their data, particularly in situations where new shoreline, raw survey source, channel areas and land areas might potentially impact the existing SOE of an IENC chart. Such information is critical for the Chart Producer to implement the correct topology, feature structure and data attribution.

4-6. Data Compilation. The QA manager will review, organize and archive source data prior to delivery to the Chart Producer for integration. This step serves as a “flow-control” mechanism and detects any omissions or data issues prior to final submission. It also provides the QA Manager the ability to archive all source data that was submitted by Districts.

a. The IENC Data Transmittal Log (Appendix F) contains nine elements which convey information regarding any new source data being sent to the Chart Producer. These elements assist the Chart Producer in understanding data types, format and where they originated. The Data Transmittal Log elements are:

(1) Transmittal Number – This is a unique identifier generated by the QA Manager for each new source submission and is formatted with three elements: IENC / calendar year / sequentially numbered elements. This element is assigned in sequential order beginning with 001. An example entry would be: IENC-12-XXX. When new source is passed from the QA Manager to the Chart Producer, each data element in that delivery, regardless of number of features, will receive this unique identifier. This number is known as the Source Transmittal Number. This number is encoded by the Chart Producer into each S-57 feature’s Source Indication (SORIND)

field. The Source Transmittal Number allows every feature to be historically tracked to determine data's integration timeframe, contributing District and type of data if necessary. The identifier also provides a permanent traceable record of any submitted source by a USACE District. The numbering sequence for the Transmittal Number should begin with a new cycle that starts at the beginning of each calendar year.

(2) Data Source - This column is where the QA Manager places a short description of the submitted data . The content and format of this text is up to the QA Manager and should always closely describe what data has been submitted.

(3) District QA Document Source Change – This column is for a "Yes or No' answer to whether the data being submitted are specifically from a District's monthly QA sheet. If it is not, or if data was transmitted via FTP, then the value should be "No". A "Yes" indicates a change originating from a QA Sheet.

(4) Date – This column is for the date the data were transmitted to the Chart Producer.

(5) Requesting District – The District submitting data is indicated in this column.

(6) Requestor – This column is reserved for the name of the USACE District IENC team member who is submitting the data. The name is provided so a POC is established and can be contacted in case there are source integration questions from the the QA manager or Chart Producer.

(7) Submitted By/To – This column indicates "Who" transmitted the source data to the Chart Producer. This is typically the QA Manager.

(8) Delivery Date – This is the maintenance delivery cycle date suggested by the QA Manager for when the data will be implemented. The format usually coincides with the next regular delivery cycle date from the Chart Producer, or could be longer depending on the source amount.

(9) Special Notes - This column is reserved for special notes of delivery or circumstances that may impact the final date of delivery for the source data. SOE changes will typically impact actual IENC delivery date due to implementation times.

b. Notification. The QA Manager will notify the Chart Producer through e-mail that there are new data to be integrated and indicate the data path for electronic retrieval. This e-mail is considered the "official" notification message along with the new transmittal log containing the new entry. All contributing Districts will be notified concurrently when their source has properly been submitted as a transaction record.

c. The USACE District Source Submission Summary:

(1) Source submission from a USACE District can occur at any time.

(2) District notifies the Chart Center that new source has been submitted and provides completed IENC Source Review Checklist with Metadata Sheet (Appendix B) to the QA Manager.

(3) QA Manager retains archived copy of source and fills out Data Transmittal Log (Appendix F).

(4) QA Manager notifies chart producer of new source, provides Data Transmittal Log (Appendix F) and provides data retrieval information from FTP location for the Chart Producer.

(5) Monthly source integration timeline begins with chart producer (see Figure 4-1).

4-7. Source Data Evaluation. Once source data are delivered from USACE Districts, an evaluation is performed by the QA Manager and the Chart Producer to detect any issues with the new source. There are two main steps required for the IENC data at this point, QA Manager Data Evaluation and Chart Producer Data Evaluation. Both evaluations can be concurrent.

a. QA Manager Source Data Evaluation. The QA Manager is responsible for evaluating the data for blatant errors or inconsistencies prior to submission to the Chart Producer. This is performed by evaluating the source data in relevant software to determine if projection, topology, file structure, and attribution are acceptable with the data. If data are acceptable, then notification to the Chart Producer can occur. If the data are not acceptable to the QA Manager, the submitting District should be notified and instructed on how to correct the erroneous data. This will require a timely resubmission by the District after corrections have been made to the source. All required submission forms are still required

b. Chart Producer Source Data Evaluation. Once data has been officially submitted by the QA Manager, the Chart Producer has the responsibility to evaluate the data for blatant errors or inconsistencies as mentioned above. These are evaluations of projections, topology, file structure, and attributions and are performed using relevant evaluation software. If errors are discovered, the Chart Producer must contact the QA Manager to indicate that there are issues with the data, and that the data needs to be corrected by the District. The Chart Producer may also contact the District that originally submitted the data to achieve a quicker resolution. If data requires correction or reconfiguration, they are routed back to the District, through the QA Manager, for correction and resubmission. Source transmittal numbers in the Data Transmittal Log (Appendix F) will stay the same for any source resubmission.

4-8. Overall Quality Assurance Process. This section provides a general overview of what is expected from USACE Districts, the QA Manager once the Chart Producer has completed a routine monthly maintenance cycle.

a. All monthly data deliveries of features from the Chart Producer shall be released to the QA Manager on the 30th day of each normal delivery month (or other previously arranged delivery date). Once the charts are received by the QA Manager and parsed out to the USACE Districts via FTP, a formal e-mail notice will be sent to each USACE District indicating that the newly delivered data are ready for initial Quality Assurance checks and eventually final USACE District acceptance.

b. Each USACE District with delivered charts will then retrieve their IENC charts and supporting data from the designated FTP download site. Each District's FTP folder will include an updated History.xls file (Appendices D-1to D-4) for each chart that contains sections with discrepancies, source application, update applications (Local Notice to Mariners) and a compiler/reviewer section upon download. The history file serves as a recorded history of applied changes to charts.

c. The History.xls file is currently defined by four specific sections: IENC Metadata, IENC Source Application, Compiler Reviewer, and Discrepancy Report.

d. IENC Metadata (Appendix D-1) – This section defines basic chart metadata – Chart number, River name, USACE owner District and mileage reaches for each individual IENC chart. In addition, it lists chart editions numbers, update numbers and when updates by the Chart Producer occurred.

e. IENC Source Application (Appendix D-2) – This section specifically documents each individual source change which occurs to each chart for the current delivery month as well as since the chart was placed into maintenance with the Chart Producer. Every time a feature is added or altered within a monthly maintenance cycle, the corresponding SORIND (Source Indication) field must be updated by the Chart Producer to reflect these changes. This tab of the history report is where USACE Districts will turn to retrace all source changes which need to have quality assurance performed on them during every delivery cycle.

f. Compiler/Reviewer (Appendix D-3) – This section serves as a record for signoff from the Chart Producer on new source applications and signoff from USACE Districts when QA work is completed within a review cycle. Each party is required to indicate when work was completed. Once each party has signed off on the document, the chart is officially returned back into maintenance with the Chart Producer.

g. Discrepancy Report (Appendix D-4) – This section is for the Chart Producer to indicate potential errors in the chart or major inconsistencies that have been found during regular

maintenance reviews. USACE Districts should consult this tab periodically to address any problems listed by the Chart Producer.

h. The appropriate download directory structure to retrieve maintenance charts is outlined below. Also, in each District's download directory, there will be a document called IENC Maintenance Status Report (Appendix C) that highlights which charts have data delivered that month, edition/update changes, source applied and general chart maintenance notes.

i. Districts have up to five business days to perform QA, and accept or reject delivered data by submitting the IENC District QA Chart Documentation Sheet (Appendix E) to the Chart Center. USACE Districts are required to include one QA sheet for each chart reviewed. During these typical delivery cycles, each USACE District is allowed 5 business days to review their data and when notice of acceptance has been provided to the QA Manager (email), the next 5 days will be used by the QA Manager to complete standard monthly requirements for internal QA. Details are provided in Section 4-10. The QA Manager will then post the IHO S-57 data and other digital formats on a public server for distribution.

j. Districts shall perform internal QA using IHO S-57 capable software or a preferred freeware viewer. Some examples include Caris Easy View 4.0, Fugawi View ENC, NavPak Demo, HYPACK, ESRI S-57 Viewer or SeeMyDENC by SevenCs. These viewers can be retrieved from the individual vendor's websites or downloaded via links from the IENC website – www.agc.army.mil/echarts/index.html

k. As a primary responsibility, Districts QA personnel should verify the implementation of delivered source when applicable, and validate recent Local Notice to Mariners changes (Section I, Section II, Section III, Section VII and Section VIII) made by the Chart Producer during the current delivery cycle. Information in Sections I and VII of the Local Notices to Mariners will need to be evaluated for content in the M_NPUB layer of the S-57 chart itself. This is an additional information layer with nautical information from Sections I and VII - Information of "general" concern to river mariners." Districts should verify that TXTDSC field of the M_NPUB document was populated with relevant warning information as indicated from these sections for each chart.

l. After ten days, the chart will go back into continual maintenance for the next monthly cycle with the Chart Producer. Concurrently, if no comments are provided back to QA Manager from the Districts within the allotted time (QA Sheets), the final phase of QA will proceed by the QA Manager and data will then be posted for the public. The QA Manager needs to ensure District compliance with this measure to make this process routine and to make sure corrections are applied to charts

4-9. USACE District Quality Assurance Requirements.

a. Districts will receive electronic notification of monthly chart availability from Chart Center. The precise data location on FTP will always be indicated, but normally it is in the appropriate USACE District folder.

b. Download charts from the appropriate Chart Center FTP folder which are in maintenance for that monthly cycle. These files are typically in a ZIP format. The IENC History File Document (.xls file) included with each delivered chart will indicate that the charts were positively reviewed and whether they have changes for that month (Appendix D-1). The History.xls file also contains all the source changes applied by the Chart Producer from the LNM and any recent District supplied source (see Appendix D-2).

c. Using an S-57 ENC data viewer, "visually" inspect all S-57 feature occurrences within the electronic chart for blatant discrepancies against known source data (District supplied source, existing chart books, imagery, hydrographic surveys, etc.). This procedure (known as a "Sanity Check") is mandatory. Identified discrepancies should be reported on the IENC District QA Chart Documentation Sheet (Appendix E).

d. USACE Districts are responsible for the verification of whether delivered source data were properly implemented into intended charts. This is verified "visually" within the data as well as checking IENC History File Document located in the IENC Source Application tab (Appendix D-2). If new source was added, the transmittal number from its submission will be indicated for the feature in the Source Indication (SORIND) attribute of the feature.

e. When the Chart Producer makes changes to navigation aids (Daymarks, Lights and Lateral Beacons) it will also be reflected in the features themselves. By cross-referencing each line item in the IENC History File (Appendix D-2), District QA personnel are required to verify changes to the feature, its Object Name (OBJNAM), Source Date (SORDAT) a Source Indication (SORIND) will always reflect feature changes as tied to the original LNM which evoked the change.

f. Districts are responsible for the verification of whether current Local Notices to Mariners have been properly implemented into intended charts each cycle. This is achieved by checking for changes in the Chart Producer delivered History file and the verifying the feature change within the chart as well as dates of changes. The IENC Source Application tab (Appendix D-2) of the IENC History File Document (Appendix D-1) indicates that the chart producer has applied current information from sections I, II, III, VII and VIII of the LNMs. LNMs need to be checked for the weeks within the delivery cycle, typically the prior four weeks.

g. The information contained in Sections I and VII of the LNM is reflected in the M_NPUB IHO S-57 feature. The TXTDSC attribute field of the M_NPUB layer will contain a text file that can be opened and evaluated against LNM documents. This file contains LNM sections I and

VII messages only from the most recent week nearest delivery of the current chart and reflect any current concerns to mariners. Verify if Sections I and VII have this message reflected correctly for each M_NPUB text file. The week to verify can come from the Chart Producer's IENC Maintenance Status Report (Appendix C) as well as Appendix D-2 from the IENC History File. The text file may be manually inspected by opening it from the ENC_ROOT directory of Chart Producer delivered S-57 exchange set. An example file will have the naming convention of U3AR001NP1.txt for instance.

h. Finish completing the IENC District QA Chart Documentation Sheet (Appendix E) with its additional required information for the chart being evaluated. Repeat this step for each chart delivered. Submit this to the QA Manager to represent District signoff back into maintenance. One sheet is submitted for each chart evaluated. Sheets are not required for charts with no changes.

i. Submit all required sheets (one per delivery chart) via electronic notification to Chart Center by the COB of the 5th business day after initial notification of the monthly or periodic maintenance delivery.

4-10. QA Manager Requirements. It is the role of the QA Manager to disseminate digital data while also keeping accurate records of data received from the Chart Producer. The QA Manager ensures consistent chart accuracy and content while maintaining update frequency and availability to users. Performing QA on newly delivered IENC charts, adds another layer of chart scrutiny to discover errors within the data, and facilitates correction of those errors early in the process. Suitable software programs for performing QA are listed in section 4-8-c.

a. The QA Manager is required to perform independent QA checks of all delivered data products within each delivery cycle. This visual check will consist of evaluating each chart using software capable of viewing IENC cells to scan for features with blatant errors that may be present. This visual check is set to determine if all features are represented correctly, don't conflict other features and have relevant symbology portrayal. If errors are discovered they need to be logged and reported back to the originating District and the Chart Producer.Data must be loaded and all feature attributes validated against a software catalog that is tailored to the USACE Inland ENC Encoding Guide v. 2.2.0 (see Appendix A). These catalogs typically are supplied with Caris and SevenCs software and do well at indicating which mandatory and conditional attribute information is present or missing. If problem features are found, they need to be logged and reported back to the originating District for that chart in a timely manner.

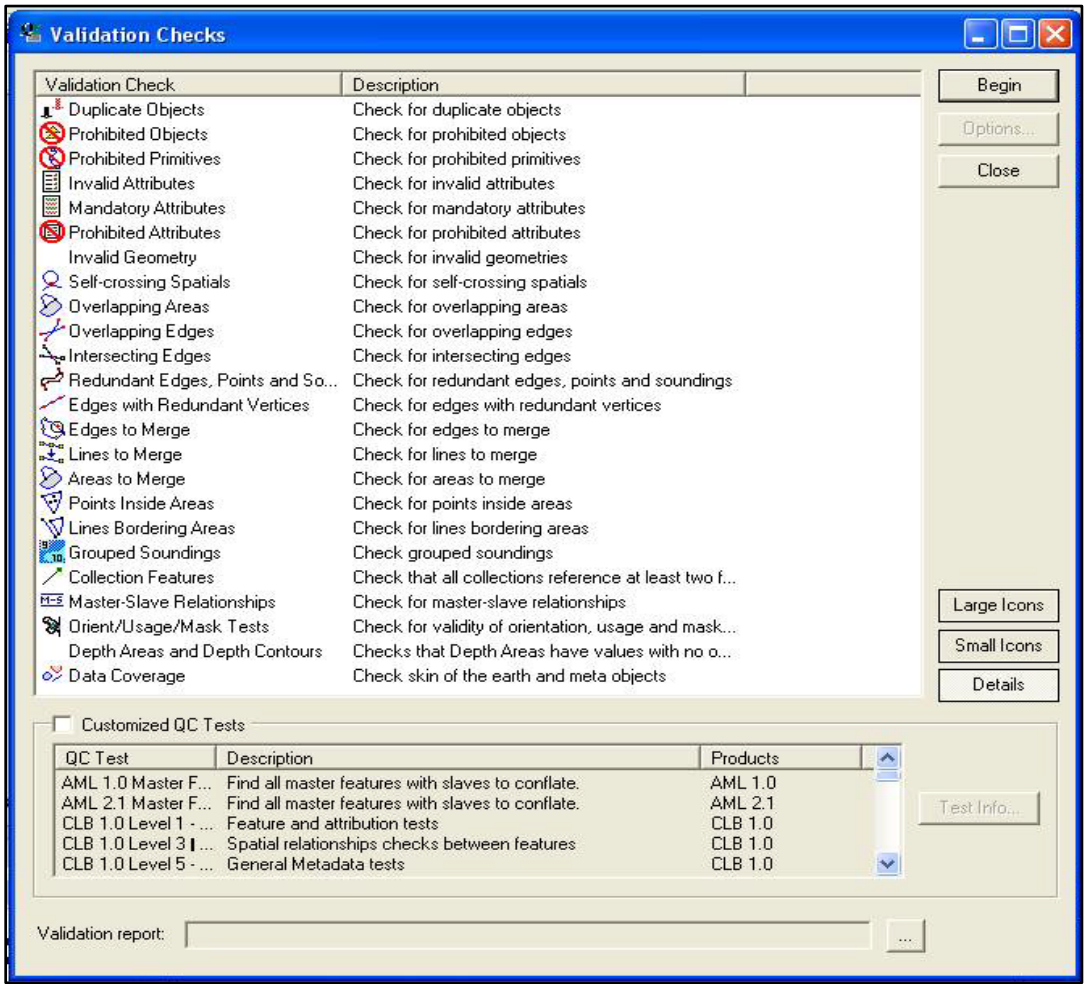

Figure 4-3. Typical Software Validation Checks. [Image courtesy of Caris S-57 Composer software].

b. Validation needs to be performed on all chart features within each chart of a monthly delivery cycle. These checks are usually written into the chart production software packages (Figure 4-3). These checks from IHO are known as S-58 checks. These software packages typically evaluate: data redundancy, spatial geometry, cartography checks, spatial orphans, proper depth encoding and feature encoding violations. As the needs for QA change, the QA manager will be able to design custom validations that look for more specific information if necessary.

c. Once the QA requirement has been fully satisfied, the QA manager will organize all comments and parse them out by District, and deliver them to the Districts for comment or direct feature improvement through the submission of new source. The QA manager should always follow-up all comments generated for individual USACE Districts to keep the chart improvement process running smoothly and make sure errors are being corrected in a timely manner.

4-11. IENC Chart Producer Requirements. Following acceptance of source data by the QA Manager, the data is provided to the Chart Producer. The Chart Producer has a 30-day cycle to apply the new source data to relevant IENCs, however some exceptions to this may occur. Group 1 objects (Section 4-4-a) that impact the topology of the SOE (Skin of the Earth layer) typically take more time for the Chart Producer to incorporate. If large volumes of new source data are submitted which require changes to SOE features, the 30-day implementation schedule may be delayed. If such a delay is anticipated, the Chart Producer shall notify the QA Manager and a new delivery date will be agreed upon. The QA manager will then convey the new delivery date to the affected USACE District."

a. The date that the QA Manager notifies the Chart Producer of the new source is considered the "Start" date for that source application. However, since all Chart Producer deliveries occur at the end of each month (or next business day), it is possible that the time between receipt of source and actual implementation can be more than 30 days. If source is received on or after the 15th of the month, the Chart Producer may not implement data within the current monthly delivery, but rather during the following month's delivery. The Chart Producer will work to implement source as quickly as possible, but depending on source content or amount of new source submitted, the timeframe could take longer than one cycle.

b. The primary recommendation is that the Chart Producer attempts to insert new source as soon as possible. If there is a delay, the Chart Producer needs to coordinate the delivery for a later date with the QA Manager and the USACE District that supplied the source. Figure 4-3 indicates the integration and chart delivery timeline. The diagram also indicates the timeline of delivery cycle dates (Chart Producer and QA Manager), USCG Local Notices to Mariners inclusion dates (Chart Producer), source submission deadlines as well as District QA deadlines. All new USACE District source updates applied to IENC's are to be compliant with the Inland ENC 2.2 Product Specifications.

c. A continuous weekly review of USCG LNMs is performed by the Chart Producer to determine critical Aids to Navigation corrections for IENCs throughout the monthly review process. This occurs every Wednesday (USCG Delivery Date) as per four week delivery cycle. All applicable information for IENC waterway stretches that are applied from Sections I, II, III, VII and VIII of LNMs. These sections are discussed below.

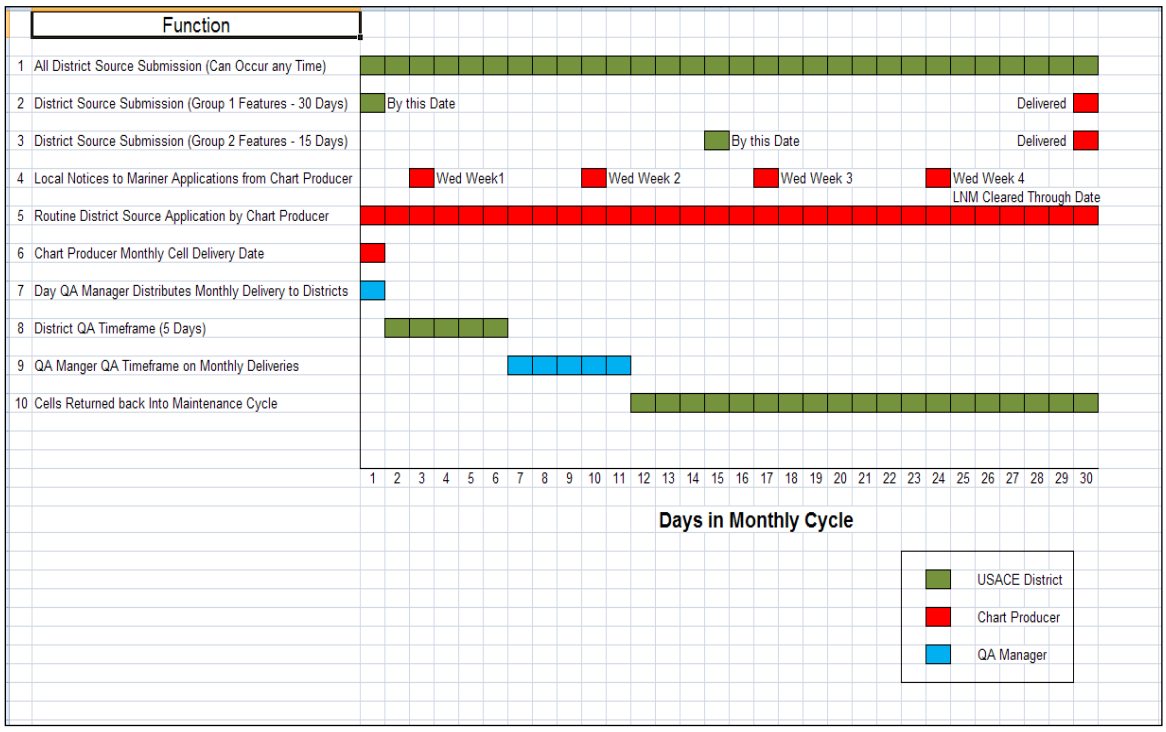

Figure 4-4. Source Delivery, Integration and Quality Assurance Timeline.

d. Section I – Special Notices - Contains information of special concern to the Mariner such as Department of Homeland Security (DHS) warnings, water level conditions, vessel information and Lock and Dam status updates, etc.

e. Section II – Discrepancies - Lists all reported and corrected discrepancies related to Aids to Navigation. A discrepancy is a change in the status of an aid to navigation that differs from what is published or charted.

f. Section III – Temporary Changes and Temporary Changes Corrected - Contains temporary changes and corrections to Aids to Navigation when charted aids are temporarily relocated for dredging, testing, evaluation or marking and obstruction.

g. Section VII – General - Contains information of general concern to the Mariners. Mariners are advised to use caution while transiting these areas.

h. Section VIII – Light List Corrections – USCG Light List volume corrections to a navigation aid. This section contains permanent changes to USCG maintained lights and daybeacons.

i. Local Notices to Mariner changes to charts are recorded by the Chart Producer within each monthly delivery cycle. Information from the LNM sections II, III, and VIII are typically

applied to navigation aids within the electronic charts. The general event, construction and condition statements from Section I and VII are reflected by the Chart Producer as textual statements within the M_NPUB layer of each applicable delivery chart. This is typically only from the most recent LNM edition closest to end of a chart delivery cycle to reflect the current navigation warnings prior to the delivery cycle cut-off. If an event doesn't continue into the timeframe the chart is delivered to the QA Manager, then the statement is removed as it is obsolete.

j. All feature and attribution data changes to navigation aids should be compliant with the Inland ENC Encoding Guide v. 2.2.0. A week before the end of each delivery cycle month, IENCs with changes from that month will have final QC performed prior to the delivery of the updates at the end of the month (or next business day). Immediately following the posting of the chart updates on the FTP site, an IENC Maintenance Status Report is issued indicating the IENCs with new editions or incremental updates (Appendix C). Records of all changes to USACE IENCs are also included in the IENC History File supplied with each chart in the monthly delivery. An explanation of the IENC History file, its contents and application are discussed in Section 4.9, USACE District Quality Assurance Requirements.

4-12. Chart History Maintenance.

a. Maintenance Process. The general process for regular monthly maintenance by the Chart Producer includes:

(1) Evaluating all USACE District provided source documents for possible application to geographically relevant IENC charts.

(2) Evaluating all source documents for significant changes or hazardous conditions and report any information that may warrant posting of a USACE Navigation Bulletin. If information is published it can be integrated into the USCG's LNMs from official record.

(3) Revising IENC charts, comparing the quality and timeliness (lineage and/or date) of the new source information with information already incorporated in the charts.

(4) Reporting all unresolved conflicts or discrepancies in the source data to the Districts for resolution.

(5) Maintaining chart history records of all IENC revisions and updates made by the Chart Producer (see IENC History File, Appendix D-1).

(6) Performing QA of the work to assure all IENC standards are met prior to the monthly delivery.

(7) Notifying the QA Manager and USACE Districts as to what IENC and reports are completed for monthly chart FTP download on a monthly basis. (Appendix C)

(8) The Chart Producer will apply sources within one month of receipt as described above unless source volume impacts the SOE which should allow more time. This must be arranged with the impacted District as well as the QA Manager.

(9) All monthly data updates and IENC Maintenance Status Report are sent at the end of each delivery month or the first business day thereafter to the QA Manager for dissemination to USACE Districts.

(10) USACE Districts and the QA Manager will accept or reject each delivery update within 10 business days of the monthly delivery cycle date. Thereafter, charts will go back into the monthly maintenance cycle with the Chart Producer.

b. Maintenance Delivery Status Report (Appendix C). This is an active document indicating the delivery cycle for IENCs within the USACE maintenance program. It is delivered with the digital chart data every time there is a monthly maintenance delivery from the Chart Producer. Cycles consist of new edition IENCs or updated edition IENCs; this document tracks the "Cleared Through Date", indicating the time stamp of all chart changes to that date, and the "Update Date", serves as the cycle date for delivery and posting of the chart to the user community. "Update Date" also indicates when source changes were applied to relevant charts during a delivery cycle. These are all key factors used to track the history of a chart and ensure the industry is using the most relevant information available; the report incorporates Local Notices to Mariner information from the USCG as well as District supplied source.

4-13. Data Publication. IENC data are disseminated to the public via a server at a central location. Currently this is performed by the US AGC. The data are in S-57 exchange format with base charts and supporting updates maintained in a database structure where client can download directly from an established FTP site. Users must be able to use web browsing clients to view a catalog of charts and related products for download. Caris ChartServer is the present software serving out these data. With changes in the future and the advent of in-house solutions, IENC chart selection and download of the data may take a different format. Any IENC data served to the public needs to contain certain critical information regarding chart naming and edition lineage. The requirements are:

a. Title – Typically the name of the IENC chart with to and from mileage extents.

b. Edition Number – This is the S-57 edition number of the chart. Update number for the chart can be listed as well.

c. Issue Date – When chart had source data applied that moved up the prior edition number because of Skin of the Earth (Group 1) changes to the base foundation data of the chart. When this occurs, the edition number of a chart will increase by 1 integer value.

d. Update Date – When changes to Group 2 features only occurred. Upon export of the chart the Edition number will not change, only the decimal extension (i.e., Edition 10.1-→Edition 10.2)

e. Cleared Through Date – This is the date of the last week the USCG LNM notice information was included prior to chart maintenance deliveries (i.e. 14/12 which represents the Fourteenth week of 2012).

f. Chart Name – This is the official name of the IENC chart that is posted. It must follow S-57 naming convention of Producer Code (U3), Production Scale (Harbor (5) or River (7)), River abbreviation (two letters) and chart beginning river mileage (3 digits) – i.e., U35AR126.

g. All chart data must be in standard IHO S-57 Exchange directory format when selected for download from the server. Files downloaded may be 'zipped' for file delivery as well.

4-14. USACE IENC Record Keeping Requirements. IENCs are published digital charts provided to the public. As such, they are official records and shall be properly managed and maintained in accordance with Army Records Information. Management System (ARIMS) requirements. As these charts have a linked and continuous data lineage all IENCs shall be considered permanent records. Chart history files, QC documents, and all source data shall also be maintained as permanent records by Chart Producer and QA Manager. All digital records shall be maintained in an electronic recordkeeping management system. The current USACE systems that are suitable for permanent ARIMS-compliant records are HP TRIM and ProjectWise.

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CHAPTER 5

Publication and Notification

5-1. Overview and Purpose. The purpose of this chapter is to define the authority, responsibility, information to publish, frequency and public notification for IENC publication. IENCs are intended primarily to serve navigation users on the inland waterways, and therefore must be made available to the general public, immediately following cell development, or update and final quality assurance. All IENCs cells shall be posted on the Internet, and shall remain available for public access until replaced with revised cells.

5-2. Authority and Responsibility. The Chart Center (see section 1-8) is the single authorized publication source for IENCs. It shall maintain the website or delegate such tasks. No other USACE server or website shall serve IENC files via internet or intranet. Other USACE webpages and internet applications may only reference or link to the official website to help disseminate IENCs or provide related information contained on the official website. Other media, such as CDs and DVDs may be used by USACE offices, as needed, to disseminate data but must reflect the cells and updates posted on the website at time of duplication. These media shall contain the advisory information stated in Section 5-3.

5-3. Information to Publish. The official website for IENC dissemination is www.agc.army.mil/echarts. This site contains all IENCs that are available for unrestricted download by internet users. The exchange set for each cell, to include update messages (see Section 4-8), shall be posted, preferably in a compressed file using a common compression format. For each IENC cell exchange set, the following information is included:

a. Description. name of the waterway, milepost coverage, and geographic names or real-world prominent features at both ends of cell coverage. For example, “Lower Mississippi, 829 to 951, Huffman Landing to Cairo.”

b. Edition. The number of revision for the currently published cell

c. Issue Date. The day-month-year for posting of the cell on the website.

d. Update Date. The day-month-year for posting of the latest update for the corresponding cell. If no update exists, the Update Date shall be the same as the Issue Date. (see section 8-7, Current IENC Update Process)

e. Cleared Through. The day-month-year of the last check of the cell for correction or needed update. If no recent Issue Date or Update Date is posted, this data field provides assurance to users that the IENC information is still accurate and valid.

f. Cell Name. Official cell name, using the eight-character designation showing country producer code, scale or general purpose of the chart, waterway code, and river milepost at the beginning of the cell.

g. Advisory Note. There shall be an advisory note prominently displayed to any internet user before IENC data is downloaded (see Figure 5-1).

> These inland electronic navigational charts (IENCs) were developed from best- available data at the "cleared through" date. Users should be aware that some real-world features could change before updates or revisions can be posted; particularly depth contours, and fixed and floating aids to navigation. Visible and submerged obstructions could also occur before they can be surveyed and removed or included in IENC updates. Caution is urged in use of these IENCs or derived products for navigation planning or operation, or any decisions pertaining to or affecting safety of vessel operation. Users should frequently check www.agc.army.mil/echarts for updates or new revisions. These IENCs are not to be used as replacements for official government chart books, which are required in the U.S. Code of Federal Regulations.

Figure 5-1. IENC Advisory note

5-4. Frequency. The USACE suite of IENC cells maintains a monthly minimum update frequency. This monthly frequency is driven by LMN updates. New source data does drive updates; however, ingestion, update and QA of IENC updates are driven by the ability to process and produce these new charts. After new chart production, the new IENC information: new data set, update, reissue of a data set, or new edition of a data set, shall be posted on the official website within ten (10) business days after data completion. This frequency allows for a completed IENC within 10 days, but as many as 45 days for full QA review and publication. The Chart Center requires districts to schedule time and resources for data QA and QA report delivery to the Center, as specified in section 8-5.

5-5. Public Notification. As a new data set, reissue of a data set, or new edition of a data set is placed on the official website, a Navigation Bulletin should be sent to the Coast Guard for use in the Local Notice to Mariners Publication. Bulletins should be drafted and sent by the Lead District for each Division as data sets are published for the corresponding division. An example Navigation Bulletin is shown in Figure 5-2. Bulletins typically do not exceed one page and should include:

a. Statement of new data availability

b. Referral to official website for access.

c. List of cells available through identification of waterway and extent of coverage.

d. Note stating that previous editions are cancelled.

e. Name, phone number, and email address of IENC Program Lead .

Commander, Eighth Coast Guard District (oan)
Hale Boggs Federal Building, Room 1230
501 Magazine Street, New Orleans, LA 70130-3396)

DEPARTMENT OF THE ARMY
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160-0267

CEXXXX June 20xx

NAVIGATION BULLETIN NO. xx-xxx

SPECIAL NOTICE
NEW EDITIONS OF INLAND ELECTRONIC NAVIGATION CHARTS (IENC)

The U.S. Army Corps of Engineers Inland Electronic Navigational Charts (**USACE** IENCs) have been reissued as new editions or have new update files.

These reissued or updated charts are posted to the USACE IENC website. They are available for download at the U.S. Army Corps of Engineers, Army Geospatial Center web page, http://www.agc.army.mil/echarts.

The new cells are **available for**:

U37AR000	Arkansas River, Birmingham Bend (Mile 0) to Little Rock, AR (Mile 125)
U37AR000	Atchafalaya River: Red River, LA (Mile 0) to Morgan City, LA (Mile 118)
U37AR000	Black Warrior, Mile 311 to head, McPherson Landing to Head of Navigation
U37AR000	Green River, Spottsville, KY (Mile 1) to Rochester, KY (Mile 108)
U37AR000	Illinois River, Grafton (Mile 5) to Downstream of Junction with Cal-Sag to S.Pulaski Br/Up (Mile 319/322)
U37AR000	Red River: Atchafalaya River, LA (Mile 0) to Shreveport, LA (Mile 237)
U37AR000	Tombigbee/Black Warrior Waterway: Mobile Bay (Mile 0) to the head of navigation.
U37AR000	Lower Mississippi River: Wilkinson Pt. (Mile 236 AHP) to Cairo, IL (Mile 951 AHP)

All previous editions are canceled.
The USACE point of contact at is (*name of)* at (*phone number)* or (*email address).*
(*signature and title of branch or division chief with channel maintenance responsibility)*

Figure 5-2. Sample Navigation Bulletin

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Appendix A
References

A-1. Referenced Publications

Public Law 85-480
Title 33 – Navigation and Navigable Waters

Public Law 92-582
Brooks Architect-Engineer Act, 10 US Code 541-544

Code of Federal Regulations, Title 33, Subpart 72.01
Notices to Mariners

House of Representatives Report 107-112, Energy and Water Development Appropriations Bill 2002.
Funding was first authorized by Congress for USACE to produce and publish IENCs in the 2002 Civil Operation and Maintenance - Miscellaneous appropriation; “Inland Waterway Navigation Charts

ER 1110-2-1150
Engineering and Design for Civil Works Projects

EM 1110-1-1000
Photogrammetric Mapping

EM 1110-1-1003
NAVSTAR Global Positioning System Surveying

EM 1110-2-1009
Engineering and Design – Structural Deformation Surveying

EM 1110-1-1005
Engineering and Design – Control and Topographic Surveying

EM 1110-1-2909
Geospatial Data and Systems

EM 1110-2-1003
Hydrographic Surveying

EP 715-1-7
Architect-Engineer Contracting in USACE

EM 1110-2-6055
27 Feb 15

EP 1130-2-520
Navigation and Dredging Operations and Maintenance Guidance and Procedures

USACE PMBP
Project Management Business Process Manual, 2009

USACE Port Series Reports
http://www.ndc.iwr.usace.army.mil//ports/ports.asp

USACE Spatial Data Standards for Facilities, Infrastructure and Environment
http://www.sdsfie.org/

Inland ENC Encoding Guide -
http://ienc.openecdis.org/files/Inland_ENC_Encoding_Guide_2_2_0.pdf

IMO RESOLUTION A.817 (19)
Performance Standards For Electronic Chart Display And
Information Systems (ECDIS), International Maritime Organization, 1995 (Amended 1996, 1998)

IMO STCW 95
Model Course 1.27 for ECDIS Training, International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, International Maritime Organization, 1995 (Amended 2010)

ISO/IEC 8211
Transport Mechanism for Various Geographic Information Transfer Standards, International Organization for Standardization, 2000

IHO Publications

S-52, Main Document, Specifications for Chart Content and Display Aspects of ECDIS, International Hydrographic Organization, 5th edition, 1996 (amended 1999)

S-52, Appendix 1, Guidance on Updating the Electronic Navigational Chart, 3rd edition, 1996.

S-57, IHO Transfer Standard for Digital Hydrographic Data, Part 1 – General Introduction, International Hydrographic Organization, 2000

S-57, IHO Transfer Standard for Digital Hydrographic Data, Part 2 – Theoretical Data Model, International Hydrographic Organization, 2000

S-57, IHO Transfer Standard for Digital Hydrographic Data, Part 3 – Data Structure, International Hydrographic Organization, 2000

S-57, IHO Transfer Standard for Digital Hydrographic Data, Appendix A – Object Catalogue, International Hydrographic Organization, 2000

S-57, IHO Transfer Standard for Digital Hydrographic Data, Appendix B – Product Specifications, International Hydrographic Organization, 2000

S-58, IHO Recommended ENC Validation Checks, International Hydrographic Organization, 2014

A-2. URL Addresses

a. URL addresses for USACE commands frequently referenced in this manual.

IENC Download Site	http://www.agc.army.mil/echarts
Headquarters, US Army Corps of Engineers	http://www.usace.army.mil
HQ Publications: Engineer Manuals, Regulations Pamphlets & Circulars	http://publications.usace.army.mil/publications/

b. URL addresses for selected governmental agencies, standards organizations and IENC production tool suppliers referenced in this manual.

Inland ENC Harmonization Group	http://ienc.openecdis.org/?q=node/19
CARIS	http://www.caris.com
Code of Federal Regulations (CFR)	http://www.gpo.gov/nara/cfr/
dKart	http://www.hydroservice.no
ESRI	www.esri.com
Federal Geographic Data Committee (FGDC)	http://www.fgdc.gov
International Hydrographic Organization (IHO)	http://www.iho.shom.fr

International Maritime Organization (IMO)	http://www.imo.org
National Oceanic and Atmospheric Administration (NOAA)	http://www.noaa.gov
NOAA Coast Survey	http://www.nauticalcharts.noaa.gov/
Radio Technical Commission for Maritime Services (RTCM)	http://www.rtcm.org
SevenCs	http://www.sevencs.com
US Coast Guard Navigation Center (NAVCEN)	http://www.navcen.uscg.gov

Appendix B

IENC District Source Metadata & Check Sheet

IENC District Source Metadata & Check Sheet

US Army Corps of Engineers

USACE District Assessment of Current Data Source Submittals

28 April 2010

IENC Source Review Checklist:

This checklist is a form that should be completed prior to source delivery to the IENC program QA manager and IIC Technologies or the IENC Production Manager (LRD). Please submit this completed form with each new source submission. This form replaces the previously used metadata sheet, and can help identify potential problem areas common to differences between SDS 2.6 and IENC product specifications as well as any Skin of the Earth (SOE) changes that may have occurred. Discrepancies found in the data may result in a request for clarification or re-submission, resulting in the delay of data implementation.

District:

District POC:

POC Phone #:

Metadata:

Description of Data: (e.g. hydro or feature survey, pool elevation, etc.)

Delivery Date to Charting Center:

Intended Implementation Date (delivery cycle date):

Source Data Specifics

Each piece of submitted source information should have an independent line item.

(To add a new row, left click in a row, right mouse click and choose “insert” then choose “insert row below”)

File Name	File Format	Intended IENC(s)	Point, Line or Polygon	Data Projection	Source Date (SORDAT)

Feature & Attribute Specifics

Please indicate the following information for the source data files listed above:

(To add a new row, left click in a row, right mouse click and choose “insert” then choose “insert row below”)

File Name	S-57 Object Class	Feature Description	Additional Information (attribute specifics, vertical datum, etc.)

Source Replacement Specifics

Is any of the data a Total Source Replacement? (Newly submitted file is to supersede or replace existing layer in chart completely.)

☐ No

☐ Yes

If “Yes”, please list the file names:

Additional Remarks:

General:

IENC Encoding Guide, Edition 1.3.1:

☐ All mandatory features and attributes as defined in the Encoding Guide have been included in the source submittal.

Edge Matching:

If new source extends beyond the extents of an IENC cell, has adjacent District been provided with the source to ensure edges are matched?

☐ No – Please pass source data to adjacent District impacted by change

☐ Yes

To who was it provided and when? _____

☐ Not Applicable

Additional Remarks:

_____

Depths:

For all Depth Data submissions:

Should Data Quality (M_QUAL) be changed to reflect accuracy of data?

☐ Yes – Please choose Zone of Confidence (CATZOC) – most USACE IENCs should be 1 or 3.

☐ 1 – (A1) – Multibeam, full riverbed survey; all significant river bottom features and depths collected /measured, vertical accuracy <2 feet.

☐ 2 – (A2) – Full riverbed survey; all significant river bottom features and depths collected /measured, vertical accuracy > 2 feet.

☐ 3 – (B) – Full riverbed survey not achieved; hazardous (submerged) features may exist but are not expected (typically used for single-beam surveys).

☐ 4 – (C) – Full riverbed survey not achieved; depth anomalies expected, low accuracy survey

☐ 5 – (D) – Full riverbed survey not achieved; large depth anomalies expected, poor quality survey

☐ 6 – (U) – Data not assessed (USACE IENCs should no longer use this category)

☐ No – Please explain:

New Sounding Data:

1. Does sounding data overlap the coastline (COALNE) or shoreline features (SLCONS) that form the boundary between land and water?

   ☐ No – Proceed to question 2

   ☐ Yes – Answer question below

   If you answered "Yes" above, have you provided new coastline or shoreline feature data to avoid overlap or are sounding values which overlap coastline data provided as positive values to indicate land or drying height?

   ☐ No – Source will likely be rejected until new COALNE or SLCONS is provided

   ☐ Yes – Proceed to Question 2

   Additional Remarks:

2. Does the sailing line (RECTRC) stay within the project depth area that will be generated from the soundings?

   ☐ No – Answer question below

   ☐ Yes - Sounding data will likely be accepted.

   If you answered "No" above, have you provided a new sailing line (RECTRC)?

☐ No – Source will likely be rejected until new RECTRC is provided

☐ Yes – Sounding data will likely be accepted.

Additional Remarks:

New Depth Contour(s):

1. If 9’ or 0’depth contour (DEPCNT) provided, do contours overlap the coastline (COALNE) or shoreline features (SLCONS) that form the boundary between land and water?

   ☐ No – Proceed to question 2

   ☐ Yes – Answer question below

   If you answered “Yes” above, have you provided new coastline or shoreline feature data to avoid overlap?

   ☐ No – Source will likely be rejected until new COALNE or SLCONS is provided

   ☐ Yes – Proceed to Question 2

   Additional Remarks:

2. If new contours are only for a partial stretch of river (not for an entire pool or reach), do new contours match existing contour(s) at beginning and ending points?

   ☐ No – Source will likely be rejected until a continuous contour has been provided or edge matched.

   ☐ Yes - Proceed to Question 3

3. Does the sailing line (RECTRC) stay within the 9’ project depth area?

☐ No – Answer question below

☐ Yes - Proceed to Question 3

If you answered "No" above, have you provided a new sailing line (RECTRC)?

☐ No – Source will likely be rejected until new sailing line is provided

☐ Yes – New depth contour data will likely be accepted.

Additional Remarks:

Topography (Land / Shoreline):

1. Does coastline (COALNE) cross any depth contours (0' or 9')?

☐ No – Proceed to question 2

☐ Yes – Answer question below

If you answered "Yes" above, have you provided new depth contours or sounding data to avoid overlap?

☐ No – Source will likely be rejected until new depth information is provided

☐ Yes – Proceed to Question 2

Additional Remarks:

2. Does coastline (COALNE) maintain consistency with adjacent features, such as shoreline construction features (piers, wharfs, revetments, etc) or locks and dams?

☐ No – Answer question below

☐ Yes - Proceed to Question 3

If you answered "No" above, have you provided new source data for impacted features?

☐ No – Source will likely be rejected until new RECTRC is provided

☐ Yes – Coastline data will likely be accepted.

Additional Remarks:

3. Does coastline (COALNE) impact / overlap any secondary non-navigable features such as roads or railroads (are non-navigable features now submerged)?

☐ No – Coastline data will likely be accepted

☐ Yes - Answer question below

If you answered "Yes" above, have you provided a new feature dataset for the impacted features?

☐ No – Source will likely be rejected until new source or instructions for removal of the impacted features is provided

☐ Yes – Coastline data will likely be accepted

Additional Remarks:

Appendix C
Example IENC
Maintenance Status Report

IENC MAINTENANCE STATUS REPORT - PROJECT DETAILS

Project:	USACE Continual Maintenance	**Report No:**	USACE CM-XXXX-XX / Report 6
Base Year:	2012	**Date:**	April 2, 2011
Order No:	W91XXX-XX-XXXXXX	**Prepared by:**	
USACE Contact:		**E-Mail:**	
E-Mail:			

1. PROJECT SCHEDULE UPDATE

IENC Cell No.	Chart Name/(River Miles)	Team Maint. Date	Update Date: 3/2/2012 Corrected/Cleared through: LNM 9/2012 (February 29, 2012)	Update Date: 3/9/2011 Corrected/Cleared through: LNM 10/2012 (March 7, 2012)	Update Date: 3/16/2011 Corrected/Cleared through: LNM 11/2012 (March 14, 2012)	Update Date: 3/23/2011 Corrected/Cleared through: LNM 12/2012 (March 21, 2012)
U35AR001	Arkansas River (001 to 062)	9/30/2005	✓	✓	✓	✓
U35AR063	Arkansas River (063 to 125)	9/30/2005	✓	✓	✓	U35AR063.000 Ed. 33.0
U35AR126	Arkansas River (126 to 185)	9/15/2006	✓	✓	✓	✓
U35AR186	Arkansas River (186 to 245)	9/15/2006	✓	✓	✓	✓
U35AR246	Arkansas River (246 to 307)	9/15/2006	✓	✓	✓	✓
U35AR308	Arkansas River (308 to 375)	7/31/2006	✓	✓	✓	✓
U35AR376	Arkansas River (376 to 444)	1/10/2006	✓	✓	✓	U35AR376.000 Ed. 12.0
U35AT000	Atchafalaya River (000 to 045)	1/10/2006	✓	✓	✓	U35AT000.000 Ed. 17.0
U35AT046	Atchafalaya River (046 to 117)	1/10/2006	✓	✓	✓	U35AT046.000 Ed. 17.0
U35BW311	Black Warrior River (311 to Head)	1/10/2006	✓	✓	✓	✓
U35IL005	Illinois River (005 to 081)	1/10/2006	✓	✓	✓	U35IL005.000 Ed. 27.0
U35IL082	Illinois River (082 to 136)	1/10/2006	✓	✓	✓	✓
U35IL137	Illinois River (137 to 198)	1/10/2006	✓	✓	✓	U35IL137.000 Ed. 22.0
U35IL199	Illinois River (199 to 256)	1/10/2006	✓	✓	✓	✓
U35IL257	Illinois River (257 to 301)	1/10/2006	✓	✓	✓	✓
U35IL302	Illinois River (302 to 319/322)	1/10/2006	✓	✓	✓	✓

Example IENC
Maintenance Status Report
(continued)

U35KK002	Kaskaskia River (002 to 036)	9/1/2011	✓	✓	✓	✓
U35LM236	Lower Mississippi River (236 to 324)	1/10/2006	✓	✓	✓	✓
U35LM325	Lower Mississippi River (325 to 424)	1/10/2006	✓	✓	✓	U35LM325.000 Ed. 25.0
U35LM425	Lower Mississippi River (425 to 519)	1/10/2006	✓	✓	✓	✓
U35LM520	Lower Mississippi River (520 to 600)	1/10/2006	✓	✓	✓	✓
U35LM601	Lower Mississippi River (601 to 715)	1/10/2006	✓	✓	✓	U35LM601.000 Ed. 22.0
U35LM716	Lower Mississippi River (716 to 828)	1/10/2006	✓	✓	✓	U35LM716.000 Ed. 21.0
U35LM829	Lower Mississippi River (829 to 951)	1/10/2006	✓	✓	✓	✓
U35MO000	Missouri River (000 to 100)	10/1/2011	✓	✓	✓	✓
U35MO101	Missouri River (101 to 200)	10/1/2011	✓	✓	✓	U35MO101.000 Ed. 5.0
U35MO201	Missouri River (201 to 300)	10/1/2011	✓	✓	✓	✓
U35MO301	Missouri River (301 to 398)	10/1/2011	✓	✓	✓	U35MO301.000 Ed. 6.0
U35MO399	Missouri River (399 to 498)	10/1/2011	✓	✓	✓	✓
U35MO499	Missouri River (499 to 599)	10/1/2011	✓	✓	✓	✓
U35MO600	Missouri River (600 to 735)	10/1/2011	✓	✓	✓	✓
U35OU005	Ouachita River (005 to 088)	9/1/2011	✓	✓	✓	✓
U35OU089	Ouachita River (089 to 177)	9/1/2011	✓	✓	✓	✓
U35OU178	Ouachita River (178 to 255)	9/1/2011	✓	✓	✓	✓
U35OU256	Ouachita River (256 to 338)	9/1/2011	✓	✓	✓	✓
U35RR007	Red River (007 to 071)	12/31/2009	✓	✓	✓	✓
U35RR071	Red River (071 to 165)	12/31/2009	✓	✓	✓	✓
U35RR165	Red River (165 to 237)	12/31/2009	✓	✓	✓	✓
U35TB001	Tombigbee - Black Warrior River (001 to 087)	1/10/2006	✓	✓	✓	✓
U35TB088	Tombigbee - Black Warrior River (088 to 175)	1/10/2006	✓	✓	✓	✓
U35TB176	Tombigbee - Black Warrior River (176 to 311)	1/10/2006	✓	✓	✓	✓
U35TT218	Tennessee - Tombigbee Waterway (218 to 319)	1/10/2006	✓	✓	✓	✓
U35TT320	Tennessee - Tombigbee Waterway (320 to 384)	1/10/2006	✓	✓	✓	✓

Example IENC
Maintenance Status Report
(continued)

U35TT385	Tennessee - Tombigbee Waterway (385 to 450)	1/10/2006	✓	✓	✓	U35TT385.000 Ed. 20.0
U35UM000	Upper Mississippi River (000 to 078)	1/10/2006	✓	✓	✓	U35UM000.000 Ed. 38.0
U35UM079	Upper Mississippi River (079 to 154)	1/10/2006	✓	✓	✓	U35UM079.000 Ed. 38.0
U35UM155	Upper Mississippi River (155 to 217)	1/10/2006	✓	✓	✓	U35UM155.000 Ed. 47.0
U35UM218	Upper Mississippi River (218 to 300)	1/10/2006	✓	✓	✓	U35UM218.000 Ed. 41.0
U35UM301	Upper Mississippi River (301 to 358)	1/10/2006	✓	✓	✓	U35UM301.000 Ed. 25.0
U35UM359	Upper Mississippi River (359 to 431)	1/10/2006	✓	✓	✓	U35UM359.000 Ed. 20.0
U35UM432	Upper Mississippi River (432 to 480)	1/10/2006	✓	✓	✓	U35UM432.000 Ed. 19.0
U35UM481	Upper Mississippi River (481 to 525)	1/10/2006	✓	✓	✓	U35UM481.000 Ed. 20.0
U35UM526	Upper Mississippi River (526 to 552)	1/10/2006	✓	✓	✓	U35UM526.000 Ed. 16.0
U35UM553	Upper Mississippi River (553 to 577)	1/10/2006	✓	✓	✓	U35UM553.000 Ed. 16.0
U35UM578	Upper Mississippi River (578 to 614)	1/10/2006	✓	✓	✓	U35UM578.000 Ed. 20.0
U35UM615	Upper Mississippi River (615 to 659)	1/10/2006	✓	✓	✓	U35UM615.000 Ed. 19.0
U35UM660	Upper Mississippi River (660 to 722)	1/10/2006	✓	✓	✓	U35UM660.000 Ed. 21.0
U35UM723	Upper Mississippi River (723 to 784)	1/10/2006	✓	✓	✓	U35UM723.000 Ed. 20.0
U35UM785	Upper Mississippi River (785 to 818)	1/10/2006	✓	✓	✓	U35UM785.000 Ed. 18.0
U35UM819	Upper Mississippi River (819 to 866)	1/10/2006	✓	✓	✓	U35UM819.000 Ed. 24.0
U36MVDBY	Additional Layer		✓	✓	✓	✓
U36MVDPS	Additional Layer		✓	✓	✓	✓
U36MVDHS	Additional Layer		✓	✓	✓	✓

2. PROJECT SPECIFIC NOTES

March 2, 2012

1. All IENCs in maintenance have been corrected/cleared through LNM 9/2012 (February 29, 2012).

2. Only those IENCs in maintenance that have had a revision to the data this week have been posted to the FTP site. Each IENC is posted with all applicable files to date including the base .000 along with any incremental update files (.001, .002, etc), PICREP/TXTDSC & CATALOG.031. The main dir contains the dKart log and history file and the IENC data is contained in the ENC_ROOT dir.

March 9, 2012

1. All IENCs in maintenance have been corrected/cleared through LNM 10/2012 (March 7, 2012).

2. Only those IENCs in maintenance that have had a revision to the data this week have been posted to the FTP site. Each IENC is posted with all applicable files to date including the base .000 along with any incremental update files (.001, .002, etc), PICREP/TXTDSC & CATALOG.031. The main dir contains the dKart log and history file and the IENC data is contained in the ENC_ROOT dir.

March 16, 2012

1. All IENCs in maintenance have been corrected/cleared through LNM 11/2012 (March 14, 2012).

2. Only those IENCs in maintenance that have had a revision to the data this week have been posted to the FTP site. Each IENC is posted with all applicable files to date including the base .000 along with any incremental update files (.001, .002, etc), PICREP/TXTDSC & CATALOG.031. The main dir contains the dKart log and history file and the IENC data is contained in the ENC_ROOT dir.

March 23, 2012

1. All IENCs in maintenance have been corrected/cleared through LNM 12/2012 (March 21, 2012).

2. Only those IENCs in maintenance that have had a revision to the data this week have been posted to the FTP site. Each IENC is posted with all applicable files to date including the base .000 along with any incremental update files (.001, .002, etc), PICREP/TXTDSC & CATALOG.031. The main dir contains the dKart log and history file and the IENC data is contained in the ENC_ROOT dir.

3. New Orleans District: U35AT000 & U35AT046; submitted source to revise 12 foot contour, coastline, and lake areas.
4. Rock Island District: U35UM301, U35UM359, U35UM432, U35UM481, U35UM526, U35UM553 & U35UM578; submitted source to replace revetments and lights.
5. St. Louis District: U35UM079, U35UM155 & U35UM218; submitted source to revise mooring facilities, weirs, dolphins and shoreline construction dykes.
6. St. Paul District: U35UM615, U35UM660, U35UM723, U35UM785 & U35UM819; submitted source to revise bridges, pylon bridge piers, and obstruction stump fields.

3. GENERAL NOTES

Status reports will be submitted to USACE once a week accompanying the week's deliverables.

Section 1 – Project Schedule Update: This grid will show all IENC's in continual maintenance with IIC including the following:

- Team Maintenance Date; the date that IENC's were originally transferred to The Team for Maintenance.
- IENC's that have had updates applied will have the IENC cell name and edition inserted in the grid indicating the week of return.

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Appendix D-1
Example IENC History File

US Army Corps of Engineers
IENC History File

IENC Meta Data					
IENC Cell No.	**IENC Cell Name**	**River Name**	**District**	**From Mile**	**To Mile**
U35AR063	Plum Bayou, Murray Lock and Dam (No.7)	Arkansas River	CESWD	63	126

Product Release History					
New Edition (EN) / Update	**IENC File Name**	**Edition No.**	**Update No.**	**Update Application**	**Issue Date**
EN	U35AR063.000	1	-	9/30/2005	
EN	U35AR063.000	2	-	6/15/2006	
EN	U35AR063.000	3	-	8/15/2006	
EN	U35AR063.000	4	-	9/15/2006	
EN	U35AR063.000	5	-	11/15/2006	
EN	U35AR063.000	6	-	7/2/2007	
EN	U35AR063.000	7	-	8/31/2007	
ER	U35AR063.001	7	1	9/20/2007	
EN	U35AR063.000	8	-	10/26/2007	
EN	U35AR063.000	9	-	11/15/2007	
ER	U35AR063.001	9	1	1/23/2008	
EN	U35AR063.000	10	-	2/21/2008	
EN	U35AR063.000	11	-	3/27/2008	
EN	U35AR063.000	12	-	4/24/2008	
EN	U35AR063.000	13	-	5/23/2008	
EN	U35AR063.000	14	-	6/23/2008	
ER	U35AR063.001	14	1	7/17/2008	
EN	U35AR063.000	15	-	8/18/2008	
ER	U35AR063.001	15	1	9/19/2008	
ER	U35AR063.002	15	2	10/17/2008	
ER	U35AR063.003	15	3	11/21/2008	
ER	U35AR063.004	15	4	1/23/2009	
EN	U35AR063.000	16	-	2/20/2009	

Product Release History					
New Edition (EN) / Update	**IENC File Name**	**Edition No.**	**Update No.**	**Update Application**	**Issue Date**
ER	U35AR063.001	16	1	3/24/2009	
ER	U35AR063.002	16	2	5/26/2009	
EN	U35AR063.000	17	-	6/26/2009	
EN	U35AR063.000	18	-	7/24/2009	
EN	U35AR063.000	19	-	8/28/2009	
EN	U35AR063.000	20	-	9/24/2009	
ER	U35AR063.001	20	1	10/23/2009	
ER	U35AR063.002	20	2	12/17/2009	
ER	U35AR063.003	20	3	3/18/2010	
EN	U35AR063.000	21	-	4/23/2010	
EN	U35AR063.000	22	-	5/20/2010	
EN	U35AR063.000	23	-	6/22/2010	
EN	U35AR063.000	24	-	7/22/2010	
EN	U35AR063.000	25	-	8/26/2010	
EN	U35AR063.000	26	-	9/23/2010	
ER	U35AR063.001	26	1	10/21/2010	
EN	U35AR063.000	27	-	12/15/2010	
ER	U35AR063.001	27	1	1/20/2011	
EN	U35AR063.000	28	-	3/24/2011	
ER	U35AR063.001	28	1	4/6/2011	
ER	U35AR063.002	28	2	4/15/2011	
ER	U35AR063.003	28	3	4/28/2011	
ER	U35AR063.004	28	4	5/5/2011	
ER	U35AR063.005	28	5	5/12/2011	
ER	U35AR063.006	28	6	5/19/2011	
ER	U35AR063.007	28	7	5/26/2011	
EN	U35AR063.000	29	-	6/2/2011	
ER	U35AR063.001	29	1	6/16/2011	
ER	U35AR063.002	29	2	7/14/2011	
ER	U35AR063.003	29	3	7/28/2011	
ER	U35AR063.004	29	4	8/25/2011	
EN	U35AR063.000	30	-	10/27/2011	
EN	U35AR063.000	31	-	11/28/2011	
EN	U35AR063.000	32	-	2/23/2012	
EN	U35AR063.000	33	-	3/22/2012	

Appendix D-2

Example IENC Source Application

D-2-1. Description. This document is the tab from the monthly IENC History Report which describes all source application performed by the IENC Chart Producer during a regular monthly delivery cycle for each chart in the delivery. Every chart delivered will have this corresponding document tab to indicate all changes made for the person responsible for perform quality assurance. It is suggested that all chart producers deliver this document in the format of a Microsoft Excel spreadsheet. The document should include the following headings as described below.

a. Item Number. Consecutive numbering for each source application from the Chart Producer. Numbering is consistent with each physical year.

b. Source Type. Indication of what generated the new source changes. Example: USCG LNM or District Source.

c. Source Description. A brief description about where the source change originated. Example: Section 2: Discrepancies (USCG Local Notice to Mariners) or SWL Source (Example with USACE District source in the nomenclature).

d. Transmittal Identification. Every USACE District source submission is provided an individual transmittal ID. See Appendix F. Transmittal Identifications are in sequential order for each physical year.

e. Source Date. Date the new source change occurred. If the source is delivered by a USACE District, it is the date the source was received by the Chart Producer. If the change comes from a weekly USCG Local Notice to Mariners, list item as LNM week and year. Example: 5/29/12 (USACE District source or 18/14 (USCG LNM).

f. Location/River Mile. Approximate river mile the change occurred. If the change originates from the USCG and applies to the entire chart, list “Chart” in the field.

g. Descending Bank. Chart Producer lists whether the source change occurred on the Left Descending Bank (LDB) or Right Descending Bank (RDB). If the change is universal, or for the entire chart, list “Chart” in the field.

h. IENC Objects. List the corresponding IENC objects which resulted from the new source application. Example; LIGHTS/DAYMAR or M_NPUB Text File - U3AR063NP1.txt

i. Local Notice to Mariner Feature. List the particular Lights or Daymarks that had a change. Example: Light 21110 Peach Orchard Bend Light. If the change is textual from a LNM, list as: “Text”. If the change is from a USACE District source submission, the field will be left blank since the change is not a LNM change.

j. Addition or Revision. Indicate the actual feature changes made for this line item. Example: Removed “LT EXT” from OBJNAM or Removed Text entry MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM - TOW HAULAGE EQUIPMENT

k. IENC Object SORDAT. Reflects the date the changes were made for a line item by the Chart Producer. The format is year, month and day (YYYYMMDD). Example: 20140427.

l. IENC Object SORIND. Reflects the IENC source indication or where the source data changes came from. Example: US,U3,MS_LL,Edition_2006_LNM20/09 (For USCG LNM changes) or US,U3,SURVY,SWL_Field_Survey,IENC_09_032 (USACE District supplied source).

m. Date Completed. Listed in the format of YYYYMMDD, this value reflects when the Chart Producer completed the source change during a regular monthly delivery cycle.

Appendix D-3

Example IENC Compiler/Reviewer Information

IENC Compiler / Reviewer Information							
Source Application Item No.s	Completed By	Date Complete	Reviewed By	Review Complete; Ready for USACE Review	USACE Reviewer	Approved Date	Notes
1-4			IIC Technologies Inc.	9/30/2005			
5-5			IIC Technologies Inc.	2/15/2006			
6-6			IIC Technologies Inc.	3/15/2006			
7-7			IIC Technologies Inc.	4/17/2006			
8-8			IIC Technologies Inc.	5/15/2006			
9-12	IIC Technologies Inc. Production Team	6/8/2006	IIC Technologies Inc. QC Team	6/15/2006			
13-13			IIC Technologies Inc.	7/17/2006			
14-17	IIC Technologies Inc. Production Team	8/8/2006	IIC Technologies Inc. QC Team	8/15/2006			
18-22	IIC Technologies Inc. Production Team	9/8/2006	IIC Technologies Inc. QC Team	9/15/2006			
23-28	IIC Technologies Inc. Production Team	11/8/2006	IIC Technologies Inc. QC Team	11/15/2006			
29-29			IIC Technologies Inc.	5/31/2007			
30-32	IIC Technologies Inc. Production Team	6/25/2007	IIC Technologies Inc. QC Team	7/2/2007			
33-33			IIC Technologies Inc.	7/31/2007			
34-39	IIC Technologies Inc. Production Team	8/24/2007	IIC Technologies Inc. QC Team	8/31/2007			
40-60	IIC Technologies Inc. Production Team	9/20/2007	IIC Technologies Inc. QC Team	9/20/2007			
61-64	IIC Technologies Inc. Production Team	10/25/2007	IIC Technologies Inc. QC Team	10/25/2007			
65-77	IIC Technologies Inc. Production Team	11/15/2007	IIC Technologies Inc. QC Team	11/15/2007			
78-82	IIC Technologies Inc. Production Team	1/24/2008	IIC Technologies Inc. QC Team	1/24/2008			
83-86	IIC Technologies Inc. Production Team	2/21/2008	IIC Technologies Inc. QC Team	2/21/2008			
87-90	IIC Technologies Inc. Production Team	3/27/2008	IIC Technologies Inc. QC Team	3/27/2008			

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Appendix D-4

Example IENC Discrepancy Report

IENC Discrepancy Reports				
Discrepancy Report No.	Reference Source Application	Discrepancy Description	Date Reported	Date Resolved
1	3	[FE-001184] DRGARE ERROR LG0193: (T1766) illegal file name in 'txtdsc' <Dredged area>; *TXTDSC have had file names assigned as per IENC Encoding Guide V3.0 A.1-B.*	9/30/2005	
2	3	[FE-001313] BRIDGE ERROR LG0193: (T1766) illegal file name in 'picrep' <Bridge>; *PICREP images have had file names assigned as per IENC Encoding Guide V3.0 A.1-B.*	9/30/2005	
3	3	[FE-002920] DEPARE Warning LG0152: (T0044) value of 'drval2' not found in 'valdco' sequence <Depth area>; *DRVAL2 encoded as UNKNOWN*	9/30/2005	9/15/2006
4	3	Edge [01700] ERROR LG0089: (T1566) 'rivers' is bounded by unexpected object 'slcons'; Edge [01725] ERROR LG0089: (T1566) 'lakare' is bounded by unexpected object 'slcons'; *In locations where SLCONS lines are adjacent to or overlapping RIVERS/LAKARE areas, the SLCONS lines have been retained as per source data.*	9/30/2005	
5	9	Features updated to USACE IENC Chart 1 & Encoding Guide V3.0 have been assigned SORDAT=20060615.	6/15/2006	
6	17	[FE-001287] SISTAW Warning LG0192: (T1722) equipment without a structure <Signal station, warning>; [FE-001287] SISTAW Warning LG0188: (T1775) equipment without a structure in the water <Signal station, warning>; [FE-002071] SISTAW Warning LG0129: (T1722) objects hierarchy can be made out of "structure"<Shoreline construction> and "equipment" <Signal station, warning> -- 34°13'54.68"N : 91°53'28.17"W; *no master object created for SISTAW*	8/15/2006	
7	22	[FE-003070] DAYMAR Warning LG0142: (T1729) wrong 'daymar' on navigational mark <Daymark>; [FE-003103] LIGHTS Warning LG0199: (T1729) wrong 'lights' on navigational mark <Light>; *We have encoded DAYMAR and LIGHTS as per the IENC Encoding Guide V3.0 Q.1, P.1 and P.2*	9/15/2006	
8	39	[FE-000005] M_NPUB ERROR LG0193: illegal file name in 'txtdsc' <Nautical publication information>; *TXTDSC have had file names assigned as per "Incorperating Section VII of the LNtM Reports.pdf"*	8/31/2007	
9	39	[FE-002164] SISTAW ERROR LG0194: (T0552) attribute 'INFORM' does not contain description for 'catsiw'. <Signal station, warning> -- 34°45'29.19"N : 92°17'35.07"W; *SISTAW has been attributed as 'water level gauge' in CATSIW attribute, this information is not repeated in INFORM.*	8/31/2007	
10	N/A	RUNWAY area object not in encoding guide.	8/31/2007	
11	48	SLCONS line object with CATSLC = 10 (sea wall) is not in the encoding guide. Revise object, possibly to training wall.	8/31/2007	
12	49	SLCONS area objects with CATSLC = 12 (ramp) need to be point objects. These objects may be coded wrong and may be CATSLC = 6 (quay/wharf). Need new source to update.	8/31/2007	
13	50	Unknown SLCONS line object at 34-45-41N, 92-17-57W.	8/31/2007	
14	N/A	May want to remove SEAARE point object with OBJNAM = Arkansas River, since this is an Arkansas River chart.	9/20/2007	
15	64	Edge [02421] ERROR LG0147: (T1620) open border of 'dykcon', DYKCON area object in contact with water object which is prohibited.	10/25/2007	
16	64	open Indare, fixed and retested in dkart.	10/25/2007	
17	87	3 lights were left with the Dkart warning LIGHTS Warning LG0192: (T1722) equipment without a structure <Light> due to the fact that they are located on top of a overhead pipeline.	3/5/2008	
18	42	LOL and LNM states that there are 4 lights associated with LOL#2120 Little Rock Port Authority Lights. The IENC only has 3 lights. Please field verify the amount and proper location of these lights	4/22/2010	
19	N/A	Located at Mile 65.5 there are 4 MORFAC(A) objects on top of a SLCONS(A) object. Please field verify which is the proper object to have here	5/18/2010	

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Appendix E
IENC District QA Chart Documentation Sheet

Delivery Cycle Date: Date QA Started: Date QA

Completed: Chart Name: Edition and Update #: Date Produced:

River Name: River Section Covered: From mile: To mile:

USACE District: Chart Producer:

Deliverables:

- ☐ Chart Exchange Set (*.000 file(s), catalog file(s), Image file(s))
- ☐ Final Report
- ☐ Metadata File
- ☐ Error Report
- ☐ Final Chart Production Files
- ☐ Other files requested in Scope/Task Order:

S-57/IENC Compliance:

Performed by:

Results: Compliant? yes ☐ no ☐

Comments:

Visual Inspection:

Performed by:

Results and Comments:

Field Testing and Checking:

Performed by:

Results and Comments:

This QA was performed by:
(Name of District POC and Phone #)

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Appendix F

Example Data Transmittal Log

Transmittal #	Data Source	District QA Document Source Change	Date	Req. District	Requestor	Submitted by / to:	IIC ETA (Delivery Date)	Special Notes
IENC-12-001	**IENC-12-001**	Created a caution area on the Illinois Waterway RM 293.1-293.3	12-Oct-11	Rock Island	John Doe	Dodson to IIC (E-mail notification)	11-Oct-11	Delivery Dec 11
IENC-12-002	**IENC-12-002**	Bankline, new revetment, dykes	1-Nov-11	St Louis	Jane Doe	Dodson to IIC (E-mail notification)	1-Dec-11	
IENC-12-003	**IENC-12-003**	MVR Lights - Buoy Lights and light movement	3-Nov-11	Rock Island	John Doe	Dodson to IIC (E-mail notification)	1-Dec-11	
IENC-12-004	**IENC-12-004**	New SLCONS feaure for Chevron	10-Nov-11	St Louis	Jane Doe	Dodson to IIC (E-mail notification)	1-Dec-11	
IENC-12-005	**IENC-12-005**	MVK - Arkansas River label - U35LM520	16-Nov-11	Vicksburg	Janet Doe	Dodson to IIC (E-mail notification)	1-Dec-11	
IENC-12-006	**IENC-12-006**	Cutline between MVS and NWK - Missouri and Mississippi.	16-Nov-11	St Louis	Jane Doe	Dodson to IIC (E-mail notification)	1-Dec-11	Contact District
IENC-12-007	**IENC-12-007**	New and Replacement Dikes- - UM079 and UM155	5-Dec-11	St Louis	Jane Doe	Dodson to IIC (E-mail notification)	1-Jan-12	

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GLOSSARY

Abbreviations

A-E	Architect-Engineer
AOR	Area Of Responsibility
AGC	Army Geospatial Center
CoP	Community of Practice
CHRIS	Committee on Hydrographic Requirements for Information Systems
CR	Continuing Resolution
COR	Contracting Officer's Representative
DFARS	Defense Federal Acquisition Regulation Supplement
ECDIS	Electronic Chart Display and Information System
ECS	Electronic Charting System
EG	Encoding Guide
EFARS	Engineer Federal Acquisition Regulation Supplement
ENC	Electronic Navigational Chart
ERDC	Engineer Research and Development Center
FAR:	Federal Acquisition Regulation
FFP:	Firm Fixed Price
FGDC:	Federal Geographic Data Committee
FOA:	Field Operating Activity
GIS	Geographic Information System
GPS	Global Positioning System
HQUSACE	Headquarters, U.S. Army Corps of Engineers
IDC:	Indefinite Delivery Contract
IENC	Inland Electronic Navigational Chart
IEHG	Inland ENC Harmonization Group
IGE:	Independent Government Estimate
IHO	International Hydrographic Organization
JPG	Joint Photographic Experts Group (standard image file format)
KO:	Contracting Officer
LMR:	Lower Mississippi River
LNM	Local Notice to Mariners
LWRP	Low Water Reference Planes
MSC	Major Subordinate Command
M_ACCY	Meta Accuracy (S-57 object)
M_COVR	Meta Coverage (s-57 object)
MLLW	Mean Lower Low Water
NAVD88	North American Vertical Datum 1988
NOAA	National Oceanic and Atmospheric Administration
PICREP	Pictorial Representation (S-57 and EG attribute)

PDT	Project Delivery Team
PM	Program Manager
PMBP	Program Management Business Process
QA	Quality Assurance
S-52	International display standard for Electronic Chart Display and Information Systems
S-57	Object-based hydrographic data exchange standard governed by the International Hydrographic Office
S-100	Hydrographic data exchange standard to replace S-57; to include register to accommodate inland waterways
SCAMIN:	Scale Minimum
SDS:	Spatial Data Standard
SOLAS:	Safety of Life at Sea
SOW	Scope of Work
SEMCE	Survey Engineering and Mapping Center of Expertise
UMR:	Upper Mississippi River
UPDN	Update Number
USACE:	US Army Corps of Engineers
USCG	US Coast Guard

GLOSSARY

Terms

Aerial Survey: A chart, map or plan made by surveying an area from above, usually from the airplane.

Architect-Engineer (A-E) Contract: The type of contract prescribed for procuring hydrographic surveys in accordance with FAR Part 36.

Area: The 2-dimensional geometric primitive of an object that specifies location.

Attribute label/code: A fixed length numeric label or a 2-byte unsigned integer code of an attribute as defined in Appendix A, IHO Object Catalogue.

Attribute: A characteristic of an object. It is implemented by a defined attribute label/code, acronym, definition and applicable values. In the data structure, the attribute is identified by its label/code. The acronym is only used as a quick reference in related documents and in ENC Product Specification. Attributes are either qualitative or quantitative.

Azimuth: The horizontal component of a direction (compass direction), measured around the horizon usually from the north toward the East, i.e. clockwise and is usually measured in degrees.

Cartographic object. Feature object which contains information about the cartographic representation (including text of real world entities).

Catalogue File: S-57 file listing the contents of an exchange set.

Cell: The basic unit for the distribution of ENC data covering a defined geographical area bounded by two meridians and two parallels, the content of which must not exceed 5 Mbytes, and which is intended for a particular navigational purpose.

Chain-node Topology: Data structure in which the geometry is described in terms of edges, isolated nodes and connected nodes. Edges and connected nodes are topologically linked. Nodes are explicitly coded in the data structure.

Channel (Inland River Navigation System): An inland waterway system typically used by shallow-draft (14 feet or less) commercial towing and recreational vessels. Includes open river navigation systems (Mississippi River below St. Louis, Missouri River, and Columbia River upstream from The Dalles Lock and Dam, The Dalles, Oregon) and canalized streams with locks and dams (e.g., Ohio River, Mississippi River above St. Louis, Arkansas River). Minimum width of inland waterway channels is dependent on the type and size of vessels, alignment, current velocities, traffic patterns and clearances, and many other factors.

Channel (Navigation): A project feature with authorized project limits/dimensions, which is designed, constructed, and maintained for use by commercial and/or recreational navigation traffic. Includes appropriate harbors, canals, turning basins, anchorage/mooring areas, and/or waterways.

Channel Depth: Depth of a navigation project as defined or refined below:

> Authorized depth (Authorized project depth): Depth of a waterway authorized in the enabling legislation for a river and harbor navigation project. Authorized depth is generally the actual dredging limit and not the draft limit of vessels to be accommodated. Channel depth based on draft of loaded design vessel, plus squat, sinkage in fresh water, effect of trim and wave action, safety and efficiency clearances.
>
> Design depth: Channel depth based on draft of loaded design vessel, plus squat, sinkage in fresh water, effect of trim and wave action, safety and efficiency clearances, advance maintenance, and dredging tolerances. Termed "required

depth" in dredging projects.

Allowable overdepth (dredging tolerance): Additional depth below the required depth specified in a dredging contract; a dredging pay item (typically 1 to 3 feet below the required depth) to account for inability to dredge at a uniform depth with a fluctuating water surface.

Controlling depth: Actual effective depth based on current hydrographic surveys (i.e., Channel Condition Surveys/Reports) of a navigation project. Due to shoaling and maintenance dredging schedules, controlling depths may be less than the authorized project depth.

Advance maintenance depth: Depth to which a channel is dredged deeper than the authorized depth to provide for the accumulation and storage of sediment.

Nominal project depth: The depth which must be maintained in order to ensure the safe passage of any vessel operating within the authorized project dimensions at mean low tide (typically mean lower low water).

Safety clearance: Designed clearance between bottom of vessel in motion and channel bottom; to avoid damage to ship's propellers from sunken timbers and debris, reduce displacement of bottom material, and avoid fouling pump and condensers by bottom material.

Efficiency clearance: Clearance in addition to that required for safety based on design vessel efficiency, resistance, etc.

Chart: A chart specifically designed to meet the requirements of marine navigation, showing depths of water, nature of bottom, elevations, configuration and characteristics of coast, dangers and aids to navigation. [HD] Note: The carriage of up-to-date charts (plus certain other nautical publications) by vessels at sea is a mandatory requirement of SOLAS regulation V 20. The term nautical chart may be applied also to a specially compiled data base (e.g., the ENC), from which such a map can be displayed.

Co-linear Lines: Coincident vectors (lines)

Compilation: In cartography, the selection, assembly, and graphic presentation of all relevant information required for the preparation of a new map/chart or a new edition thereof. . Such information may be derived from other maps/charts, aerial photographs, surveys, new data, and other sources.

Connected node: A node referred to as a beginning and/or end node by one or more edge. Connected nodes are defined only in the chain-node, planar graph and full topology data structures.

Controlling Depth: Actual minimum depth of a waterway at its shallowest point.

Data Buffer: Information extending 1000 meters from the bankline.

Data Model: A conceptual specification of the sets of components and the relationships among the components pertaining to the specific phenomena defined by the model reality. A data model is independent of specific systems or data structures. The S-57 data model defines real world entities as a combination of descriptive and spatial characteristics. These characteristics are defined in terms of feature objects and spatial objects and the relationship between them.

Data Types: Referring to spatial primitives of point, line and area.

Datum (geodetic): A set of parameters specifying the reference surface or the reference coordinate system used for geodetic control in the calculation of coordinates of points on the earth. Commonly datums are defined as horizontal and vertical datums separately. For a local geodetic datum the reference surface is defined by five parameters: the latitude and longitude of an initial point, the azimuth of a line from this point, and the parameters of the reference spheroid. Absolute datums specify the initial point of the reference ellipsoid to be (ideally) located at the earth's centre of mass. For modern reference systems using datum information given by satellites additional parameters are defined, e.g. gravity models.

Datum (vertical): Any level surface (e.g. sea mean sea level) taken as a surface of reference from which to reckon elevations.

Depth: The distance between a reference surface datum and grade below water.

Edge: A one-dimensional spatial object, located by two or more coordinate pairs (or two connected nodes) and optional interpolation parameters. If the parameters are missing, the interpolation is defaulted to straight line segments between the coordinate pairs. In the chain-node, planar graph and full topology data structures, an edge must reference a connected node at both ends and must not reference any other nodes.

Electronic Chart Display and Information System (ECDIS): A navigation information system which with adequate back-up arrangements can be accepted as complying with the up-to-date chart required by regulation V/20 of the 1974 SOLAS Convention, by displaying selected information from a System Electronic Navigational Chart (SENC) with positional information from navigation sensors to assist the mariner in route

planning and route monitoring, and if required display additional navigation-related information.

Electronic Chart Systems (ECS): Generic term for equipment which displays chart data but which is not intended to comply with the IMO Performance Standards for ECDIS, and is not intended to satisfy the SOLAS Chapter V requirement to carry a navigational chart.

Electronic Navigational Chart (ENC): The data base, standardized as to content, structure and format, issued for use with ECDIS on the authority of government authorized hydrographic offices. The ENC contains all the chart information necessary for safe navigation and may contain supplementary information in addition to that contained in the paper chart (eg sailing directions) which may be considered necessary for safe navigation.

Encapsulation: The identification of fields and records and the grouping of fields and records and the data syntax rules used.

Exchange set: The set of files representing a complete, single purpose (i.e. product specific) data transfer. The ENC Product Specification defines an exchange set which contains one Catalogue file and at least one data set file.

Face: A face is a two-dimensional spatial object. A face is a continuous area defined by a loop of one or more edges which bound it. A face may contain interior holes, defined by closing loops of edges. These interior boundaries must be within the outer boundary. No boundary may cross itself or touch itself other than at the beginning/end node.

Feature Codes: Naming of CADD/GIS vectors to facilitate identification, symbolization and conversion.

Feature object: An object which contains the non-locational information about real world entities. Feature objects are defined in Appendix A, IHO Object Catalogue. See also geo, meta, collection and cartographic objects.

Feature: Representation of a real world phenomenon.

Fix: The instant at which the position of a vessel is observed.

Flat Pool Level: Vertical reference datum used above Melvin Price Locks and Dam on the Upper Mississippi River.

Fluxgate Compass: A simple electromagnetic device that employs two or more small coils of wire around a core of non-linear magnetic material, to directly sense the direction

of the horizontal component of the earth's magnetic field.

Generalization: The omission of less important detail when compiling a chart. Its purpose is to avoid overloading charts where space is limited.

Geometric primitive: One of the three basic geometric units of representation: point, line and area.

Global Positioning System (GPS): A space-based, radio-positioning, navigation and time-transfer system operated by the United States Government. GPS to which differential corrections have been applied is known as Differential GPS (DGPS).

Gyro Compass: A compass which finds North by using an (electrically powered) fast spinning wheel and friction forces in order to exploit the rotation of the Earth.

Hydrographic Survey: A survey conducted with the purpose of mapping the seabed for navigation, engineering, or resource management purposes. On the Western Rivers it is used to establish project depth.

IENC Cell: See Cell

IENC Encoding Guide: USACE Chart No.1 & Encoding Guide that defines how real world objects are presented using the S-57 data model.

IHO Transfer Standard for Digital Hydrographic Data: Originally published as SP57 (later version was changed to S-57) Version 1 and then Version 2. The latest release of the standard, S-57 Edition 3, consists of a Theoretical Data Model, Data Structure, Object Catalogue, ENC Product Specification, Use of the Object Catalogue for ENC and an Object Catalogue Data Dictionary Product Specification.

Indefinite Delivery Contract (IDC): Form of A-E service contract for procuring recurring services, such as hydrographic surveys.

Independent Government Estimate (IGE): The government's estimate used as the basis for comparing and negotiating contracted services.

International Hydrographic Organization (IHO): Coordinates the activities of national hydrographic offices; promotes standards and provides advice to developing countries in the fields of hydrographic surveying and production of nautical charts and publications.

International Maritime Organization (IMO): The specialized agency of the United Nations responsible for measures to improve the safety of international shipping and to prevent marine pollution from ships [IMO].

Isolated node: An isolated zero-dimensional spatial object that represents the geometric location of a point feature. An isolated node is never used as a beginning or end node.

Kinematic Positioning: A position determined while a vessel is in motion (used synonymously with dynamic positioning).

Laser Range Finder: A device which uses a laser beam in order to determine the distance to a reflective object.

Levee: A flood control structure along a waterway, often protected with revetments.

Light List: See List of Lights

Line: The one-dimensional geometric primitive of an object that specifies location.

List of Lights: A publication tabulating navigational lights, with their locations, candle powers, characteristics, etc. to assist in their identification, and details of any accompanying fog signal. A list of lights may contain other information useful to a navigator. Also called light list. Note: This publication is issued under the authority of a marine administration

Local Notices to Mariners: Corrections to navigation aids and special marine notices published by the U.S. Coast Guard.

Low Water Pool: Hydraulically based lower surface reference plane in a controlled/regulated body of water.

Low Water Reference Plane: A hydraulic reference plane based on a particular stage-duration profile (e.g., 1974 Low Water Reference Plane on the Lower Mississippi River).

Mean Lower Low Water (MLLW): Tidal datum defined by the mean of the lower low water heights, observed over a specific 19-year period.

Meta object: A feature object which contains information about other objects. [TS] Note: For example compilation scale or vertical datum.

National Geodetic Vertical Datum of 1929 (NGVD 29): A fixed reference adopted as a standard geodetic datum for heights, based on an adjustment holding 26 primary tide stations in North America fixed. The latest general adjustment is the NGVD 29. Portions of the upper Mississippi River are referenced to the previous (1912) general adjustment. A new readjustment is currently in progress, and will be termed the North American Vertical Datum of 1988 (NAVD 88) when completed. The NGVD is not the same as mean sea level (MSL).

Navigation Aid (NAVAID): An object used for vessel navigation purposes (e.g., buoys, lights, daymarks, beacons, ranges, etc.).

Navigation Channel: A project feature with authorized project limits/dimensions, which is designed, constructed, and maintained for use by commercial and/or recreational navigation traffic. A navigation channel includes harbors, canals, turning basins, anchorage/mooring areas, and/or waterways.

Navigational purpose: The specific purpose for which a chart cell has been compiled. There are six such purposes, namely berthing, harbour, approach, coastal, general and overview.

NGS Control: Survey control maintained by the National Geodetic Survey.

Node: A zero-dimensional spatial object, located by a coordinate pair. A node is either isolated or connected.

Nominal Project Depth: The depth which must be maintained in order to ensure safe passage at mean low tide.

Notice to Mariners (NtM): A periodical notice issued by maritime administrations, or other competent authorities, regarding changes in aids to navigation, dangers to navigation, important new soundings, and, in general, all such information as affects nautical charts, sailing directions, light lists and other nautical publications.

Object Catalogue: The Object Catalogue is the feature schema for S-57. Its primary function is to provide a description of real world entities. It contains a list of feature object classes (each relating to a real world entity), attributes and allowable attribute values.

Object class: A generic description of objects which have the same characteristics.
Note: Examples of object classes in S-57 are "buoy, cardinal" and "caution area.

Object description: The definition of which object class a specific object belongs to.

Object identifier: The identification of a S-57 feature object. The object identifier is the concatenation of the "Producing Agency", "Feature Identification Number" and "Feature Identification Subdivision" subfields. Within the context of this Standard the object identifier is referred to as the "Long Name".
Note: This provides a unique world-wide identifier for any object as specified in Para 3.1 of the ENC Product Specification.

Object: An identifiable set of information. An object may have attributes and may be

related to other objects. Also see spatial object and feature object.

Point: The 0-dimensional geometric primitive of an object that specifies location.

Polygon: A non-self-intersecting, closed chain defining the boundary of an area.

Pool Elevation: The surface elevation of a controlled body of water.

Presentation Model: Defines, via a set of presentation rules the way in which real-world information must be displayed for a specified application.

Producer Code: The IHO issues a two character code to agency that produces ENCS and IENCs. This code ensures differentiation of products between producing countries and organizations. USACE's code is U3.

Product Construction Record: A USACE District document recording all production and maintenance performed on an IENC cell.

Quality Assurance (QA): Construction procedure by which quality control procedures are monitored. Also, procedures for assessing quality of observed hydrographic depth data.

Quality Control (QC): All actions taken to ensure that standards and procedures are adhered to and that delivered products or services meet performance requirements.

Relationship: A logical link between two elements from the data model which may be spatial (e.g. topological relationship) and/or non-spatial. In general a relationship is implemented in the data structure as a pointer.
Note: The relationships permitted in ENC data are described in the ENC Product Specification.

S-57 Attributes/Values: Describe the characteristics (e.g. color, construction, clearance) of an S-57 object.

S-57 Object: The S-57 data model assumes that all real-world features can be classified into a finite number of types such as light, docks, bridges etc. These types are called objects.

S-57 Updating: The mechanism defined by S-57 to incrementally update IENC cells through the delivery of an exchange set.

Sailing Line: Recommended navigation channel in an inland waterway system. Recommended sailing lines may vary seasonally.

Shallow Draft: Refers to those waterways maintained at a depth of nine to fourteen feet, depending upon the waterway project authorization language.

SOLAS: International Convention for the Safety of Life at Sea developed by IMO. The contracting governments undertake to promulgate all laws, decrees, orders and regulations and to take all other steps which may be necessary to give the present Convention full and complete effect, so as to ensure that, from the point of view of safety of life, a ship is fit for the service for which it is intended.

Sounding: A subsurface depth measured by an acoustic device or echo sounder. This term is generalized to include any depth regardless of how it was measured (lead line, sounding pole, etc.).

Spatial object: An object which contains locational information about real world entities. Note: for example, in S-57 the location of a buoy or the boundary of a caution area.

Spatial record: A spatial record is the implemented term used in the S-57 data structure for a spatial object (i.e. a spatial object as defined in the data model is encoded as a spatial record in the data structure). There are three types of spatial records: vector, raster and matrix.

System Electronic Navigational Chart (SENC): A data base resulting from the transformation of the ENC by ECDIS for appropriate use, updates to the ENC by appropriate means and other data added by the mariner. It is this data base that is actually accessed by ECDIS for the display generation and other navigational functions, and is equivalent to an up-to-date paper chart. The SENC may also contain information from other sources.

Task Order: Separate work item under an Indefinite Delivery Contract for surveying services. Previously termed Delivery Order or Work Order.

Topographic Survey: A survey that measures the elevation of points on a particular piece of land, and presents them as contours on a plot.

Topology: The set of properties of geometric forms (such as connectivity, neighborhood) which is defined with the data model remaining invariant when subject to a continuous transformation. Note: The level of topology chosen for the ENC allows for color fill, activation of area warnings, e.g. depth area warnings, cautionary areas. The different levels of topology are described in the S57 Data Model.

Total Station: An optical instrument used in modern surveying. It is a combination of an electronic theodolite (transit), an electronic distance measuring device (EDM) and software running on an external computer.

Vector: Direct connection between two points, either given as two sets of coordinates (points), or by direction and distance from one given set of coordinates, or a point in a vector space defined by one set of coordinates relative to the origin of a coordinate system.

World Geodetic System 1984 (WGS 84): A rotational ellipsoid having the following dimensions: semi-major axis, 6,378,137 m; semi-minor axis (derived), 6,356,752 m; flattening (derived), 1/298.257224. This ellipsoid reference model/datum is the surface from which GPS coordinates are computed. The WGS 84 and the GRS 80 use the same earth center, which makes the NAD 83 adjustment coordinates compatible for practical engineering applications using differential GPS measurements to obtain geodetic positions relative to the reference station.