U.S. Coast Guard Navigation Center

Background Information for
IALA Task 2.2.3 Developing a Harmonized Waterways
Recommendation and Guideline

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U.S. Department of
Homeland Security
**United States
Coast Guard**

This slide deck is prepared for the purpose of describing the reason why Harmonized Waterways is a recommended concept to support the implementation of S-100 based product specifications.
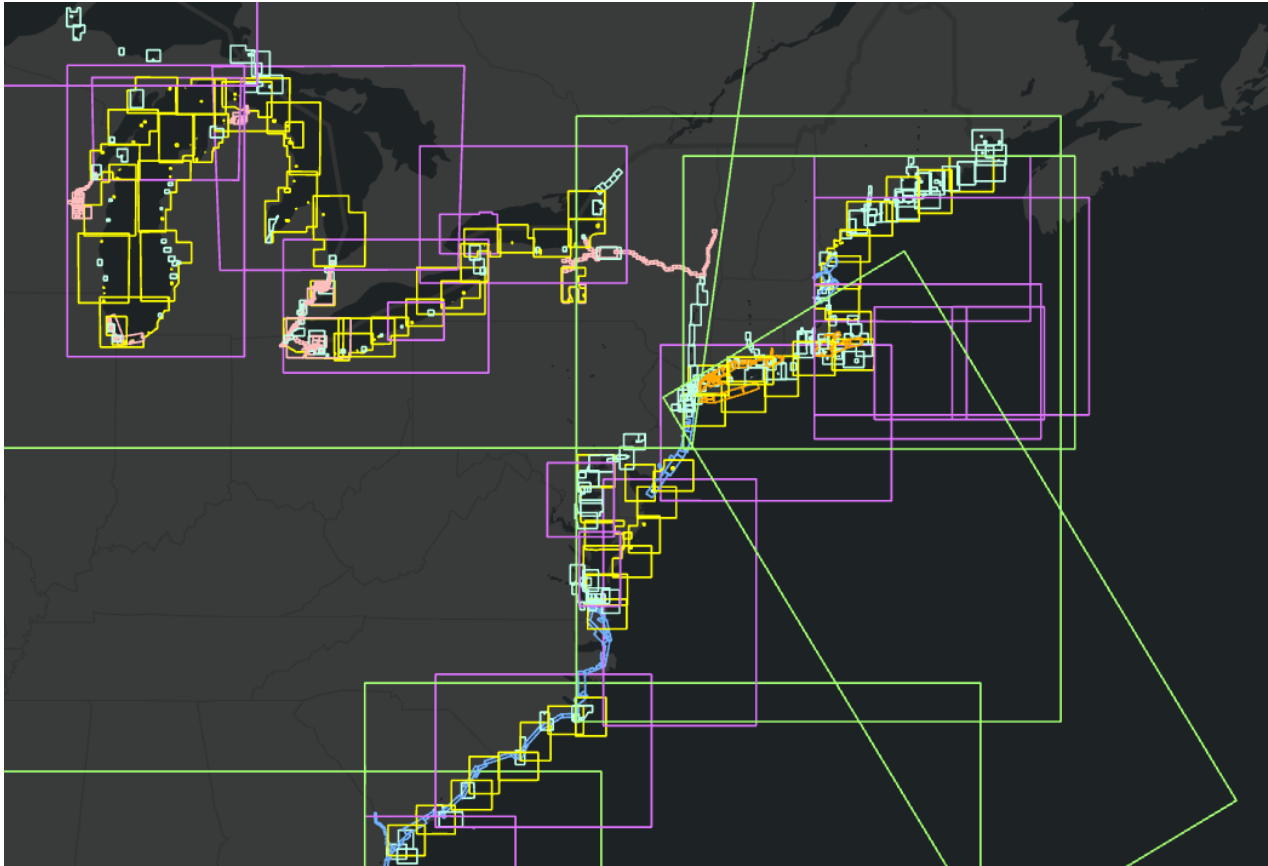
This slide deck provides the current state of harmonized waterways design considerations being contemplated by the United States Coast Guard to improve the maintenance and extensibility of the dataset for geospatial applications and domains beyond IHO's S-100 Universal Hydrographic Data Model.

The content presented is the current thinking based on experience and use of the first edition of the US Harmonized Waterways dataset which was delivered September 30, 2022.

Why Harmonize Waterways?

Reason 1 - Elimination of paper charts removed the reference system (chart number and chart extent) used to organize and provide Marine Safety Information (MSI) to mariners. S-100 compliant ECDIS users represent a subset of maritime that can access MSI without the necessity for a human comprehendible binning system for organizing and disseminating MSI

Why Harmonize Waterways?

Reason 2 – Authoritative boundaries to define the spatial extent of waterways typically do not exist.

Why Harmonize Waterways?

Reason 3 – A unique and persistent identification system is necessary to determine which waterway is being referenced. For example, there are 14 places called "Oyster Bay" in the lower 48 United States.

Other Value-added Benefits

1. Uniform agreement between Federal agencies regarding the unique identification and spatial definition of national waterways.
2. Uniform coordinate reference system (WGS1984)
3. Use of authoritative names established by the geographic name authority.
4. Provides spatial binning which enables traditional consumers of marine safety information to receive pertinent and spatially related marine safety information after paper charts are discontinued.
5. Provides well-known geographic feature filtering capability for navigational information presented online via data services.
6. Provides a method to identify a point of interest that is machine readable and discoverable in the digital environment.
7. Provides a tool for waterways managers/planners, industry leaders, and researchers to study and monitor our national waterways with implications for marine transportation system (MTS) supply chain, resilience, and safety.
8. Improved waterways management coordination. For example, harmonizing MSI such as the USCG's Local and Broadcast Notice to Mariners with USACE's Notice To Navigation Interests.

Structure of a Harmonized Waterways Dataset

➕ n^{th} National Requirement for Binning Sea Areas

National Requirement for Binning Sea Areas #4

National Requirement for Binning Sea Areas #3

National Requirement for Binning Sea Areas #2

National Requirement for Binning Sea Areas #1

Geographic "Total Water" Base Layer

Spatial Relationship via "Intersect" or "Within"

Structure of a Harmonized Waterways Dataset

Examples of National Requirement for Binning Sea Areas:
- Marine Safety/Coast Guard jurisdictional boundaries
- Natural resource extraction areas – wind energy, oil and gas, minerals and sand
- Vessel traffic management areas and routing measures
- Fisheries areas
- Weather forecast zones
- Military exercise areas
- Marine protected areas

Geographic "Total Water" base layer attributes:
- Polygon features
- MRN field required for all polygon features
- Includes all navigable waters
- Provides a contiguous topology of navigable waterways
- May be constructed from official shoreline, watershed boundary data, or constructed manually

Authoritative Name
Administrative Name
Maritime Resource Name
Spatial Definition

Authoritative Name Guidelines

Authoritative names are assigned by a National Authority. If a National Authority does not exist, the geographic name of places should be maintained in a national register.

Spatial extent of a named geographic place must exist. For example, the authoritative registry of geographic names in the United States is associated with a point feature, not a shape/area/polygon representing the extent of the named feature. A Geographic "Total Water" base layer requires named geographic places to be represented by a shape/area/polygon containing the extent of the named feature.

When an authoritative name exists, that name should be assigned to the administrative name field unless an exception is necessary.

Administrative Name Guidelines

Authoritative names may not exist or may represent a large or complex waterway that should be subdivided. In these cases, an administrative name may be assigned.

Examples where an administrative name may be used instead of an authoritative name:

- Some large waterways may be subdivided when an administrative name is well known and in common usage. For example, a subdivision of "San Francisco Bay" in to "Northern San Francisco Bay" and "Southern San Francisco Bay" may be used to describe two parts of the authoritatively named and spatially defined place "San Francisco Bay"

- Waterways that have not received an authoritative name but are well known and in common usage may be assigned an administrative name. Areas such as New York Bight or the Florida Big Bend are well known waterway areas to mariners, but these names are not authoritative names.

Maritime Resource Name Guidelines

$$mns_1 \quad mns_2 \quad mns_3 \quad mns_4 \quad mns_n$$
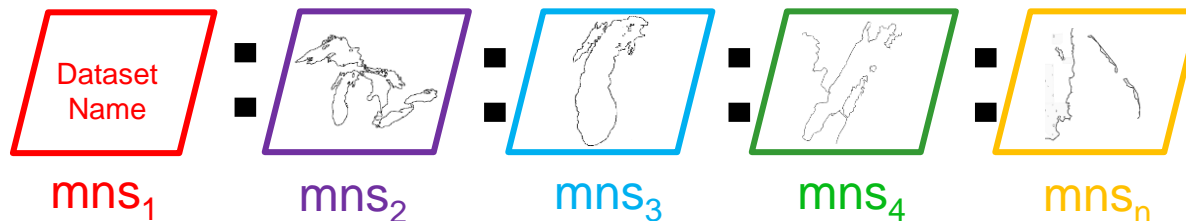
Maritime Resource Names (MRNs) should be constructed using the syntax described in IALA G1143.

Syntax
The arrangement of words and phrases to create well-formed sentences in a language.

Waterway MRN Syntax
　　urn:mrn:iala:wwy:<ISO 3166 Country Code>:<managed name spaces>

NOTE: The number and classification of <managed name spaces> are determined by national authority. A documented taxonomy* is recommended to establish criteria for the classification of each managed name space used in constructing an MRN.

*Taxonomy - the branch of science concerned with classification, especially of organisms and systematics. The practice and science of categorization or classification

Base Geography MRN Taxonomy

$$\text{baseGeography} : \text{mns}_1 \quad \text{mns}_2 \quad \text{mns}_3 \quad \text{mns}_4 \quad \text{mns}_n$$

urn:mrn:iala:wwy:us:baseGeography:greatLakes:lakeMichigan:greenBay:deadHorseBay

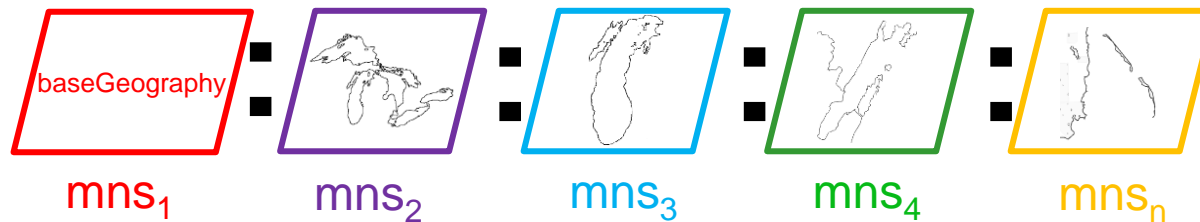**Taxonomy Principle 1: Use a name to reference the type/topic of a spatial dataset**
Taxonomy Principle 2: Provide general spatial guidance for mns levels

- mns_1: Description of the dataset, in the case of base geography "baseGeography" is applied. Other national datasets can be named such as "WindEnergyAreas" or "FederalChannels"
- mns_2: Well-known authoritative ocean area name
- mns_3: Well-known authoritative or administrative ocean subarea or inland sea name
- mns_4: Well-known authoritative or administrative name for a primary waterway. A general rule is to ensure primary waterway areas are $\gtrsim 300 \text{ km}^2$
- mns_n: Optional, only used when additional levels of detail are necessary.

NOTE: mns assigned using a classification method reduces the likelihood of duplication of an MRN when describing common or frequently used names such as "Oyster Bay" and improves dataset extensibility

4.1.1. MULTIPLE MRN IDENTIFIERS FOR A SINGLE ENTITY
It is possible to have more than one MRN assigned to a single resource, as outlined in RFC 8141: "a single resource MAY have more than one URN assigned to it, either in the same URN namespace (if the URN namespace permits it) or in different URN namespaces, and for either similar purposes or different purposes."
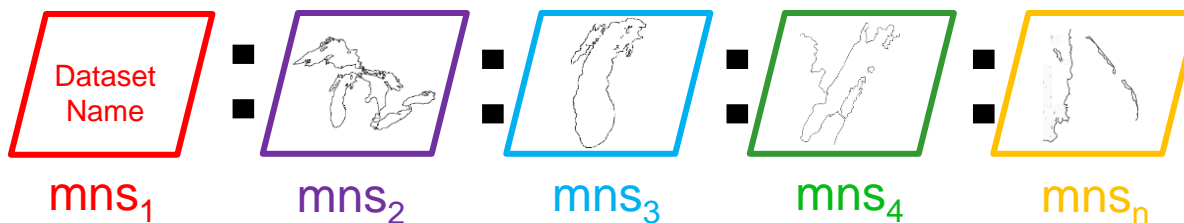
Base Geography MRN Taxonomy

$$mns_1 : mns_2 : mns_3 : mns_4 : mns_n$$

URN:MRN:IALA:WWY:US:datasetName:greatLakes:lakeMichigan:greenBay:deadHorseBay

Taxonomy Principle 3 – Parent-Child Relationship
Parent-child relationship defined through spatial relationship with successively larger scale/smaller area/more detailed layers.

Parent-child relationship should be limited to well known authoritative names describing ocean/river/inland sea feature names. For example:
- Dead Horse Bay is a child of Green Bay
- Green Bay is a child of Lake Michigan
- Lake Michigan is a child of the Great Lakes

Expanded to other examples:
- Illinois River is a child (tributary) of the parent waterway Mississippi River.
- San Francisco Bay is a child of the parent waterway Pacific Ocean.
- Gardiner's Bay is a child of Block Island Sound, Block Island Sound is a child of Atlantic Ocean.
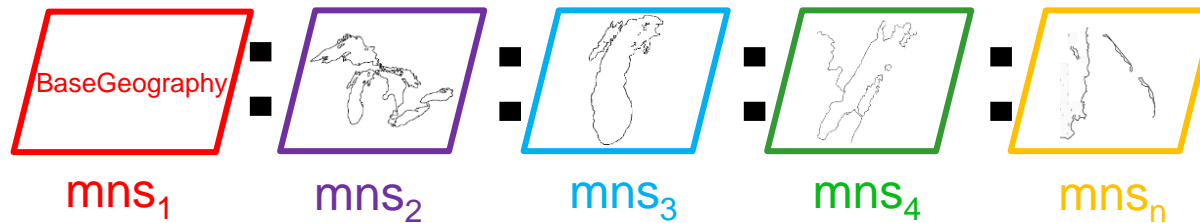
Base Geography MRN Taxonomy

BaseGeography

mns_1 : mns_2 : mns_3 : mns_4 : mns_n

Best Practices:

- When necessary, mns have spatial definitions assigned in a sequential largest area to smallest area order.

- Parent-child relationships between successive managed name space levels should be inclusive and not linear – i.e., maintaining a "ship's routing" or "proceeding from sea" relationship is implied via "within" relationships between successively higher (smaller area) mns polygons.

- Where spatial ordination is necessary, such as arrangement of features in a cardinal or "proceeding from sea" order, such ordination should be provided as a distinct attribute value in the attribute table and not incorporated in to an MRN. Sections of rivers described by "miles" are not considered ordination as such features are inherently linear and may be included in MRNs

- Use authoritative names for marine places to the greatest extent possible. Minimize use of administrative or terrestrial names.

- Stay within your nation's declared exclusive economic zone waters

Base Geography Spatial Definition
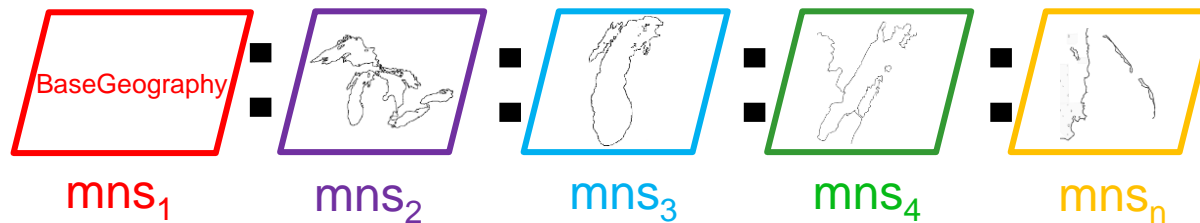

BaseGeography

mns_1 : mns_2 : mns_3 : mns_4 : mns_n

Best practices for the creation of the geographic "total water" base layer (Base Geography):

- Use existing authoritative sources to the greatest extent possible define waterway geometry.

- Where high resolution, nationwide waterway-land boundary data is not available, waterway areas may be constructed manually using simple polygons that may encompass portions of surrounding land areas.

- Taxonomy defines the managed name space geometry and the number of layers used to develop the geographic "total water" base layer – i.e., each mns is represented by a polygon feature class with each successive mns providing greater subdivision/refinement of the preceding layer in its own polygon feature class. A spatial union of these layers provides the geographic "total water" base layer.
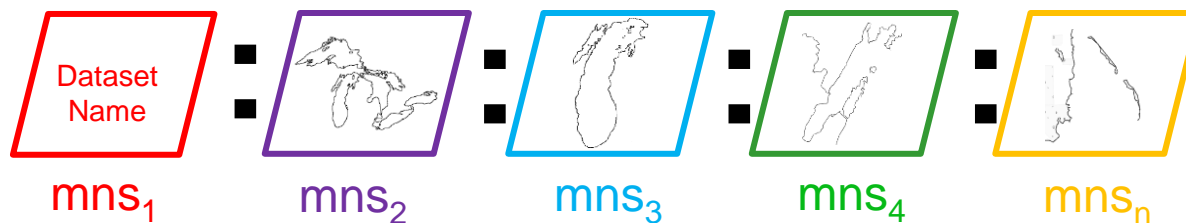
Maritime Resource Name Guidelines

$$mns_1 : mns_2 : mns_3 : mns_4 : mns_n$$

More best practices:

Spell Out Waterway Names in Camel Case

Camel Case = atlanticOcean, newYorkBight, hudsonRiver, erieCanal

Benefits: lower probability of duplicate MRNs, improved readability, precise language, follows S-100 convention.

Example: urn:mrn:iala:wwy:us:pacificOcean:pugetSound:elliotBay

Notes:
G1143 5.1.3 – The entire MRN is case insensitive
G1143 5.2 – Inserting 'iala' or 'int' as <governing-organization> will create namespaces where IALA can define unique type identifiers that must contain a minimum of 3 lower case alphanumeric characters)
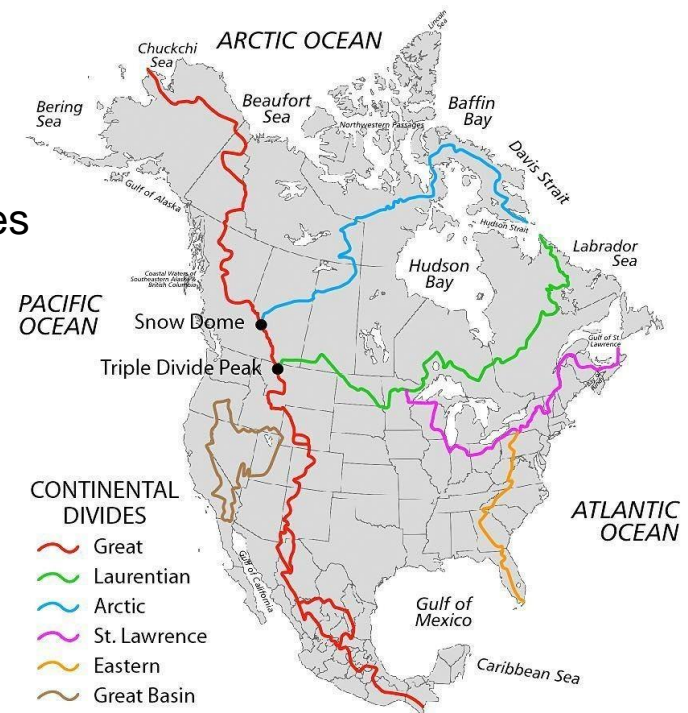
Spatial Definition – US Example

Managed Name Space 2 – mns$_2$

- Reserved for TOP LEVEL waterways. Domain values – atlanticOcean, pacificOcean, greatLakes, gulfOfMexico, River systems, e.g., westernRivers, columbiaRiver

- Geometry includes river basins/watershed boundaries on land. Delineation in South Florida requires interpolation.

Spatial Definition – US Example

Managed Name Space 3 – mns$_3$
- Reserved for bays, sounds, and tributary rivers within a river system. Sample domain values – Pensacola Bay, Block Island Sound, Gulf of Maine, Ohio River, Mississippi River, Puget Sound
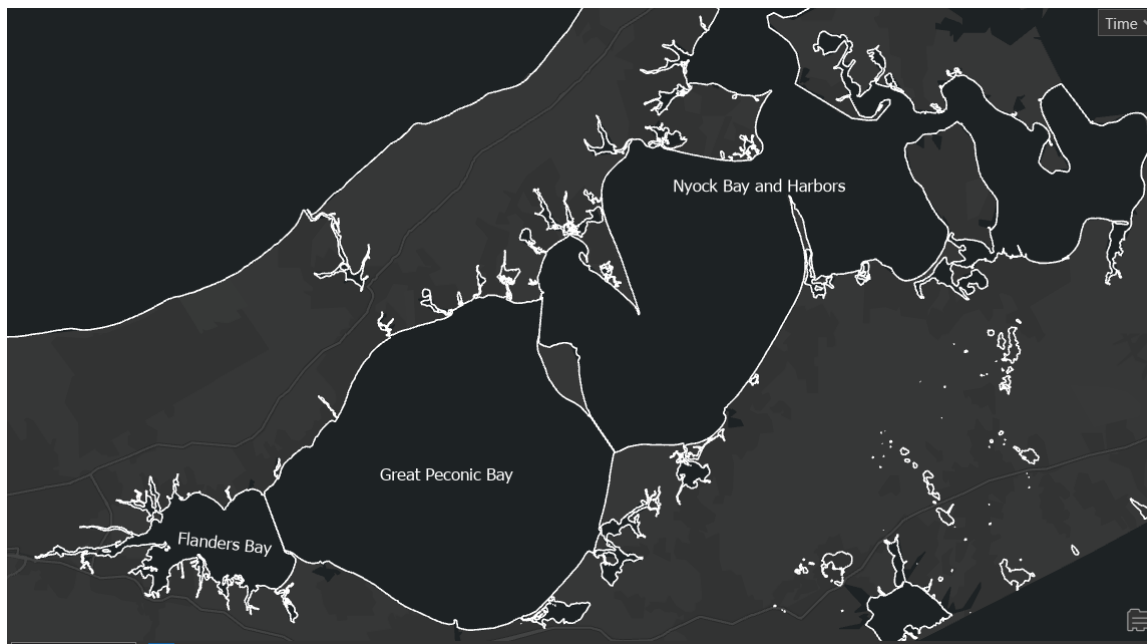
Spatial Definition – US Example

Managed Name Space 4 – mns$_4$

- Reserved for waterbodies located within an mns$_3$ waterbody or part of an mns$_3$ catchment area. I.e., Commencement Bay in Puget Sound, Great Egg Harbor in Barnegat Bay, Manatee River in Tampa Bay.

- Areal coverage approximately ≥ 300 square kilometers

- Does not include isolated lakes or reservoirs unless determined by law to be navigable waters.

Spatial Definition – US Example

Managed Name Space 5 – mns$_5$ (Optional)

- Authoritative marine place name point layer
- Provides reference to specific, well known small-scale features within a geographic waterway.