Eastern Chapter WEDA

1972

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Present

Updates to the Southeast Regional Implementation Manual for Dredged Material Testing

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Ocean Dumping Program Coordinator
US Environmental Protection Agency, Region 4

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Dredged Material: Regulatory History

1972

1977

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Statute: MPRSA (Oct 23 1972)

⇩

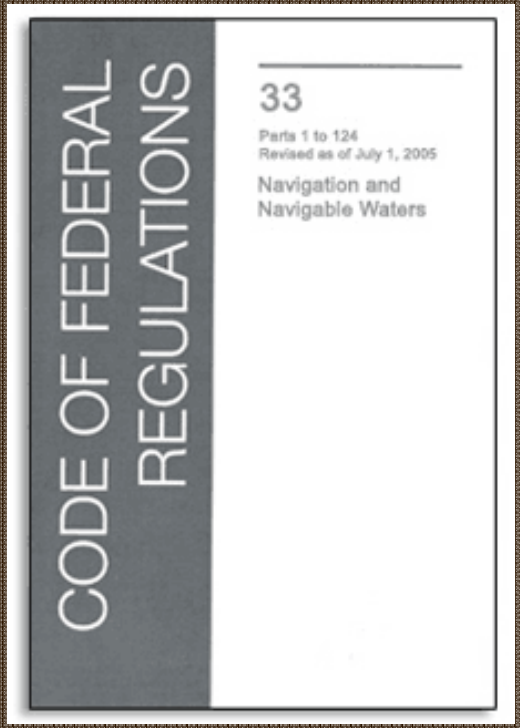
Regulation: CFR

⇩

National Guidance: Green Book

⇩

Regional Guidance: RIM



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Need: Why was revision of the RIM important?

1972

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- Old Guidance
- Difficult to Follow
- Improve Regional Consistency
- Court Decisions: Existing guidance was found to be inconsistent with the regulations

"The Green Book is merely a guidance document which cannot be given the effect of amending the regulations."

- Outdated Methods
- Improved Detection Limits
- Advances in Scientific Methodology

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2008 Manual

1972

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- Clarification on permit application and coordination requirements,
- Reference site selection,
- Identification of contaminants of concern,
- Additional guidance on sampling and sample handling,
- Advances in chemical testing,
- Updated reporting limits,
- Species and test conditions for biological testing,
- Additional bioaccumulation interpretation guidance,
- Guidance on data reporting and statistical analysis, and
- Detailed guidance on SAP and QAPP development.

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SERIM – Updates

1972

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- Updated links to online resources
- Updated lists of contacts
- Revised SAP/QAPP format
- Provides appropriate digestion procedures
- Bioassay test condition updates
- Corrected reference station locations
- Updated guidance on design and size of dredging/testing units
- Procedures for toxicity identification evaluations in the water column
  - Procedures for ammonia reductions in water column toxicity tests
  - Justification for ammonia application factor
- Updated procedures for calculating sums of organic constituents when non-detected values are present
- New guidance on water quality modeling including how to address material bulking and clumping during the dredging process
- Additional guidance on bioaccumulation interpretation

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Ammonia Reductions in Water Column Bioassays

1972

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- Water column bioassays are required as part of Tier III testing
- Results are used to calculate the limiting permissible concentration (LPC):
  - *That concentration of dredged material in the receiving water which, after allowance for initial mixing, will not exceed a toxicity threshold defined as 0.01 of a concentration shown to be acutely toxic to appropriate sensitive marine organisms (LC_{50}/EC_{50})*
- When there is ***reasonable scientific evidence on a specific waste*** material to justify the use of an application factor other than 0.01, such alternative application factor shall be used in calculating the LPC.
- SERIM Updates provides justification for alternative application factor (0.05) when toxicity is due solely to ammonia

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What does this mean?

$D_r = (100-(LC_{50} \times AF))/(LC_{50} \times AF)$

For an LC_{50} of 24.4%

$D_r = (100 – (24.4\% \times 0.01))/(24.4\% \times 0.01) = 409$

Substituting an AF of 0.05 for Ammonia

$D_r = (100 – (24.4\% \times 0.05))/(24.4\% \times 0.05) = 81$

3,600 cubic yards

or

13,000 cubic yards

When can I use the alternate application factor?

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- Toxicity due to ammonia cannot be determined simply by measuring ammonia in the elutriates
  - You must document this through the application of TIE procedures
- TIE procedures, and resulting LC_{50}s/EC_{50}s, can only be used to determine if all of the observed toxicity is due to NH_3
- Alternative AF (0.05) is applied to the original toxicity test results only, not to the NH_3 reduced test results.
- The potential effect of the ammonia-stripping process on the chemistry of the elutriates must also be assessed. If metals toxicity is removed with the ammonia toxicity during the ammonia-stripping process, the results of the water column bioassays could be positively biased.

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Water Quality Modeling

1972

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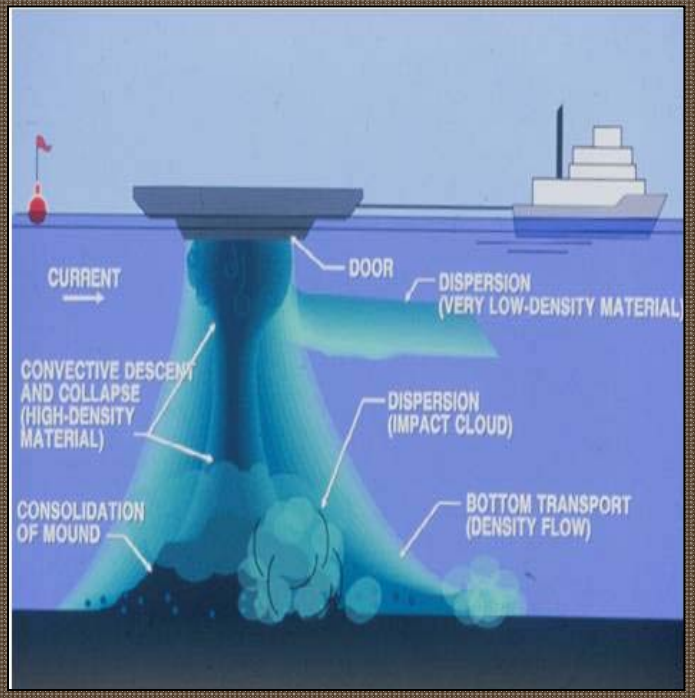
STFATE Modeling

- "Short-Term FATE of dredged material disposal in open water"
- Models discrete discharges from barges and hoppers
- Used to evaluate potential water-column effects (dilution).



Common Incorrect Assumptions

- Volume Fraction = Weight Fraction
- No water in the dredged material
- Water doesn't count
- In disposal vessel characteristics = *in situ* characteristics

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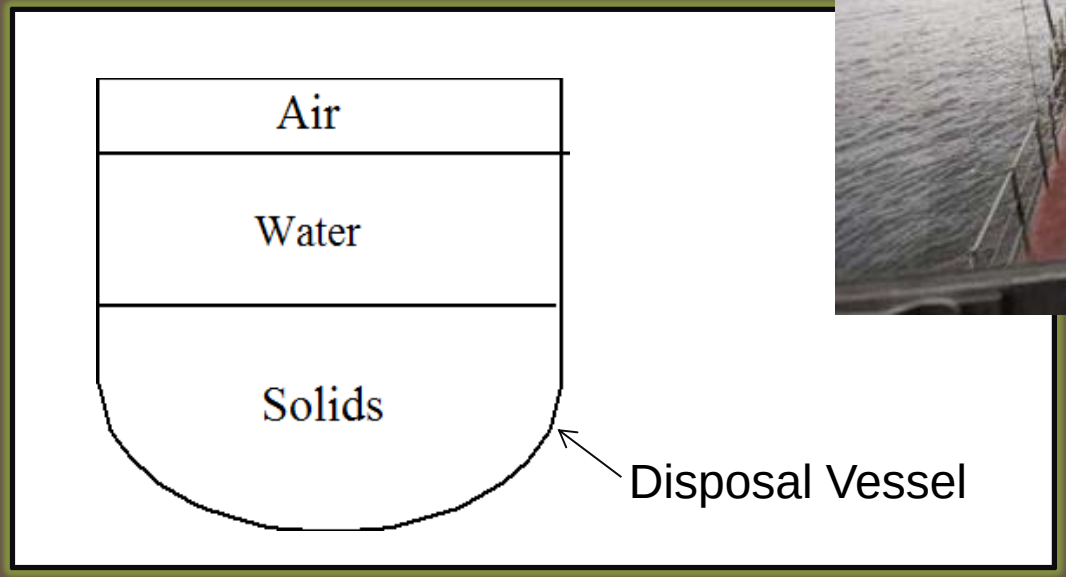
It's the Water

Dredged Material = Water and Solids

STFATE Volume= $V_{water}+V_{solids}$

Disposal Volume = $V_{water}+V_{solids}$



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Dredged Material Characteristics

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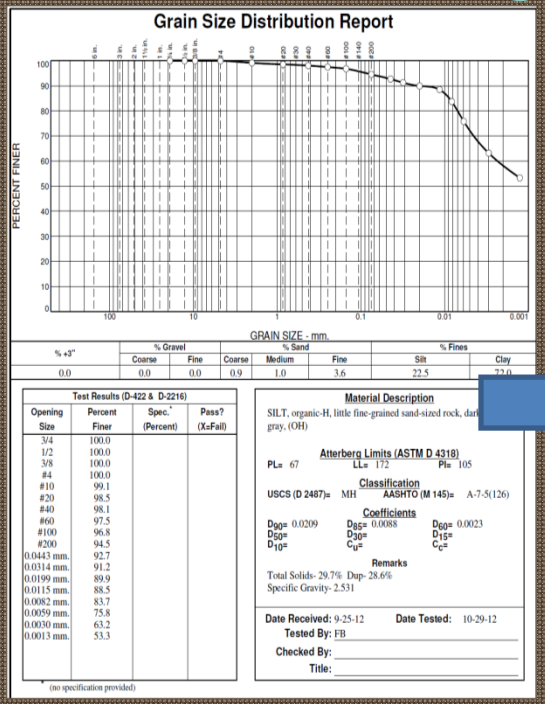

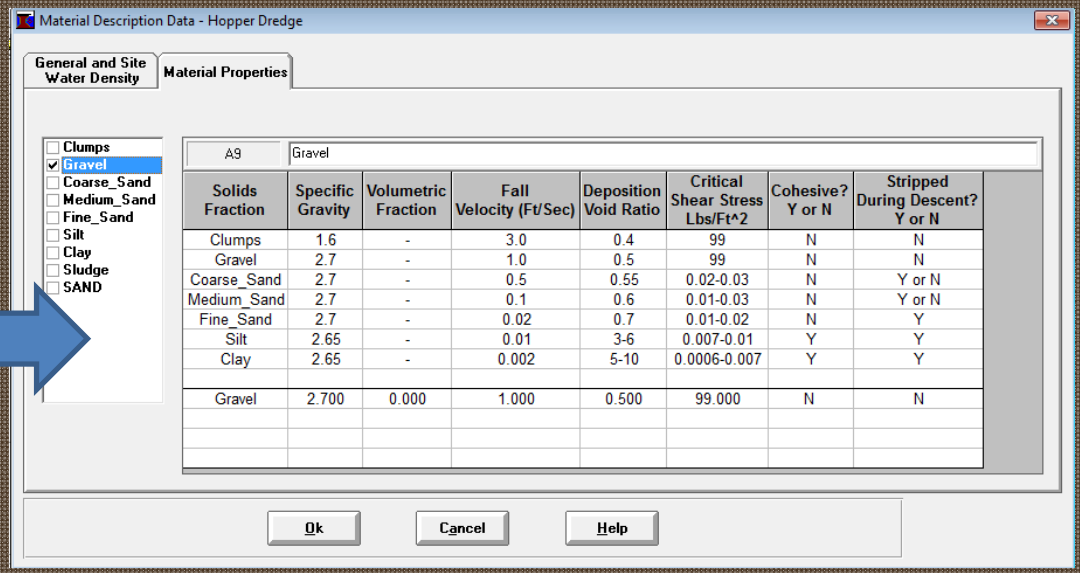

Solids Concentration (C_{sol}) can be expressed as a function of percent solids (n_s) and specific gravity (Gs) as,

$$C_{sol} = \frac{n_s}{Gs \times (100 - n_s) + n_s}$$

and volumetric fraction (vf) $= \frac{wf(\%)}{100\%} \times \frac{Gs}{Gsf} \times C_{sol}$

where Gsf is the specific gravity of the sediment fraction and wf(%) is the percent solids (or weight fraction) of the sediment fraction.

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Adjustments for Bulking

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- When material is dredged, additional voids are formed and the volume the material occupies in the disposal vessel is greater than the volume it occupied in the ground (*in situ*). This increase can be expressed as a percentage of the *in situ* volume or as a ratio of the two volumes and is generally known as the bulking factor.
- Any bulking during the dredging process needs to be accounted for when estimating the volumetric fractions of each sediment fraction.

$$B = \frac{Vt + Ve}{Vt} = 1 + \frac{Ve}{Vt}$$

Bulking Factors When Dredged Mechanically

Sediment Type	Bulking Factor (B)
Hard rock (blasted)	1.50-2.00
Medium rock (blasted)	1.40-1.80
Soft rock (blasted)	1.25-1.40
Gravel, hardpacked	1.35
Gravel, loose	1.10
Sand, hardpacked	1.25-1.35
Sand, medium soft to hard	1.15-1.25
Sand, soft	1.05-1.15
Silts, freshly deposited	1.00-1.10
Silts, consolidated	1.10-1.40
Clay, very hard	1.15-1.25
Clay, medium soft to hard	1.10-1.15
Clay, soft	1.00-1.10
Sand/gravel/clay mixtures	1.15-1.35

Clumping

1972

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- Clumping of dredged material can significantly reduce the amount of free water available and thereby reduce predicted adverse water column impacts.
- The amount of clumping that occurs is predicted using Atterberg limits (liquid and plastic limits), given as engineering water contents. The percent clumps clumps can be estimated as follows:

If ω % > 1.8 LL, percent clumps equal 0%.

If ω % < LL, percent clumps equal 100%; otherwise,

$$\%Clumps = 100\% \times \frac{\left(1.8 - \frac{\omega(\%)}{LL}\right)}{0.8}$$

where LL is the liquid limit (given as engineering water content) and ω(%) is the water content of the in situ dredged material.

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What does this mean?

Material	Solids Fraction	*In Situ* Volume Fraction	In Vessel Volume Fraction (B=1.11)	Clumping
Clumps	0	0	0	0.4768
Sand	0.055	0.0079	0.0071	0.0033
Silt	0.225	0.0322	0.0290	0.0136
Clay	0.720	0.1030	0.0927	0.0436
Water	0	0.8570	0.8713	0.4626
Dilution (9000cy)	∞	214	210	442
Max Disposal Volume (cy) (LPC=0.244)	∞	4100	4000	9000

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Bioaccumulation Assessment Tools

1972

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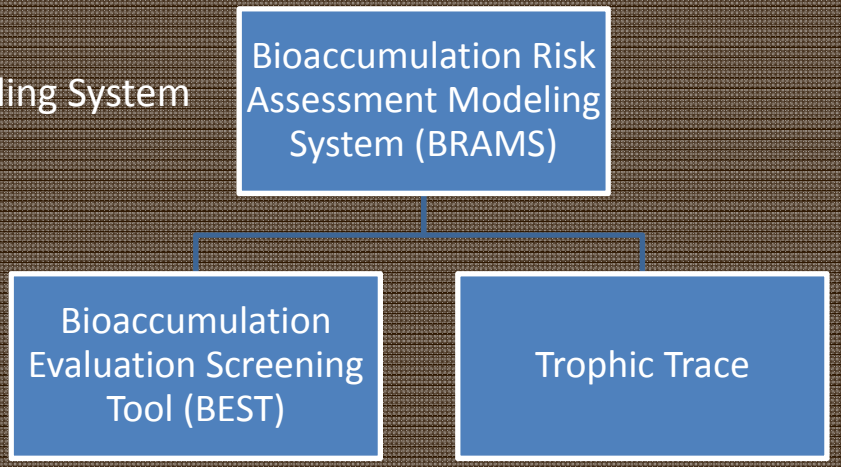
- Bioaccumulation Bioassays required as part of Tier III Testing
- Pre-2008
  - FDA Action Levels
  - Reference Levels
  - ERED Database
- 2008 Manual:
  - Ecological Effects Levels
  - Background Concentrations
- 2014:
  - Bioaccumulation Risk Assessment Modeling System (BRAMS)



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What is BRAMS

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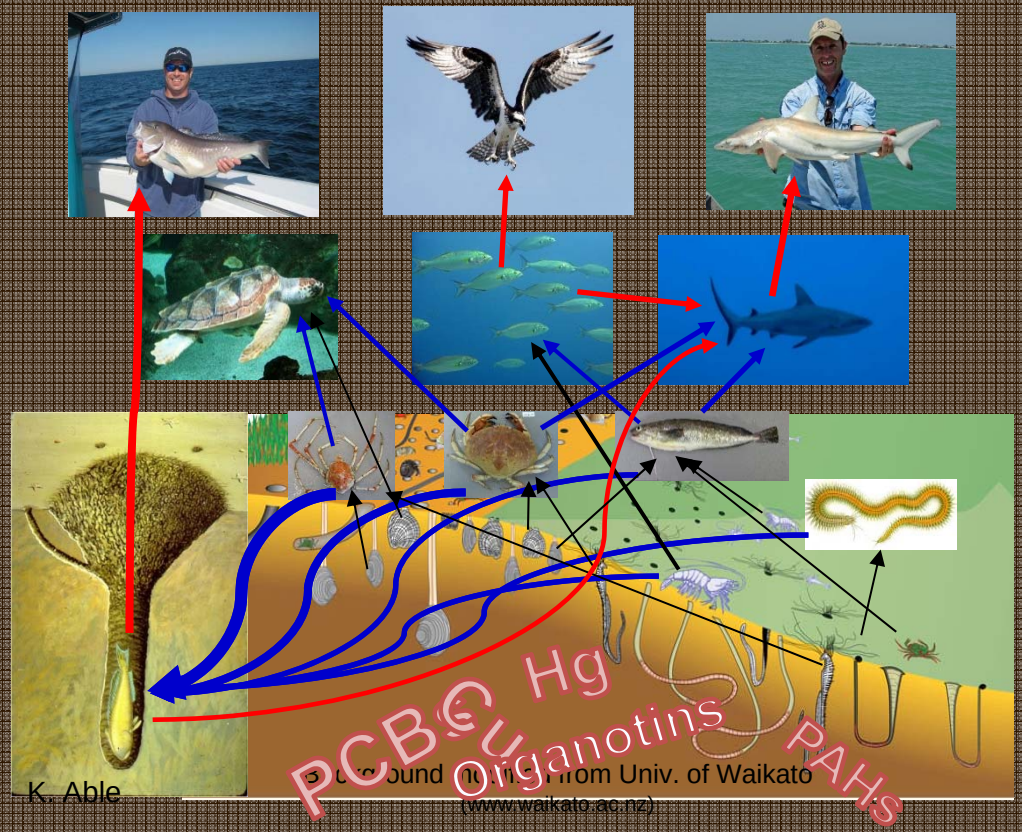
- Provides human health and ecologically-protective estimates of potential risk
- Follows EPA and USACE risk assessment guidance
- Risk calculated based on the characteristics of the site including:
  - Environment
  - Species
  - Chemicals and concentrations
  - Food Chain Dynamics
- Outputs:
  - Total carcinogenic and non-carcinogenic risks to humans
  - Toxicity quotients for ecological receptors



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BRAMS Guidance- Regional Inputs

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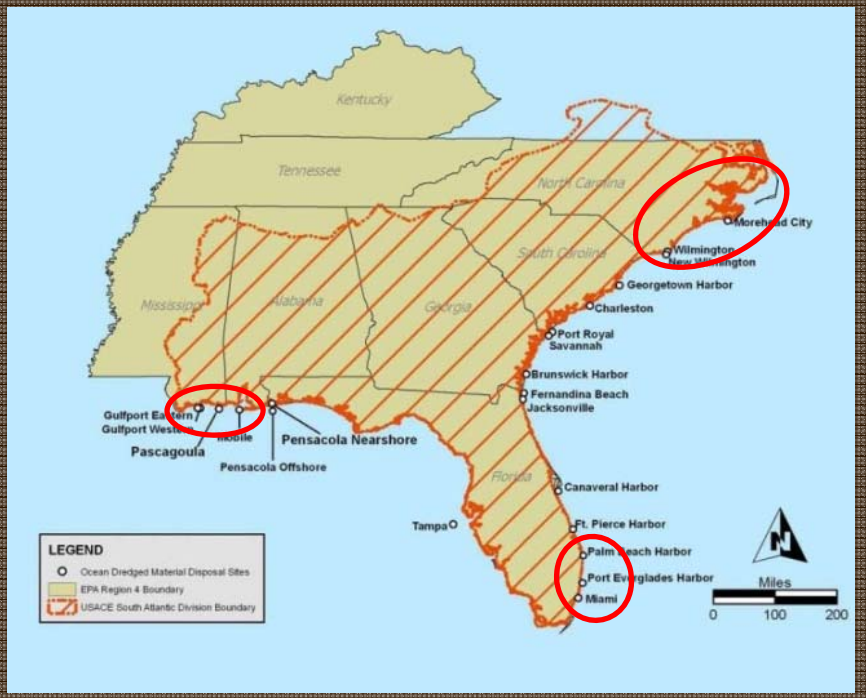
- Seafood Consumption Rates
- Sediment Based Trophic Community
  - Infauna
  - Crabs/Shrimp
  - Forage Fish
  - Preditors
- Water Column Based Trophic Community
  - Zooplankton
  - Planktivores
  - Piscivores
- Receptors
  - Marine reptiles
  - Birds
  - Marine mammals
  - Humans
- Environmental Inputs
  - Total organic carbon in sediments
  - Dissolved organic carbon in water
  - Particulate organic carbon in water
  - Water temperature near seafloor



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What's Next?

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1991

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Present

- December 2014: proposed updates reviewed and approved by USACE
- Early 2015: Updates incorporated and published

http://www.epa.gov/region4/water/oceans/index.html

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1972

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- ANAMAR Environmental Consulting
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