Beneficial Uses of Dredged Material

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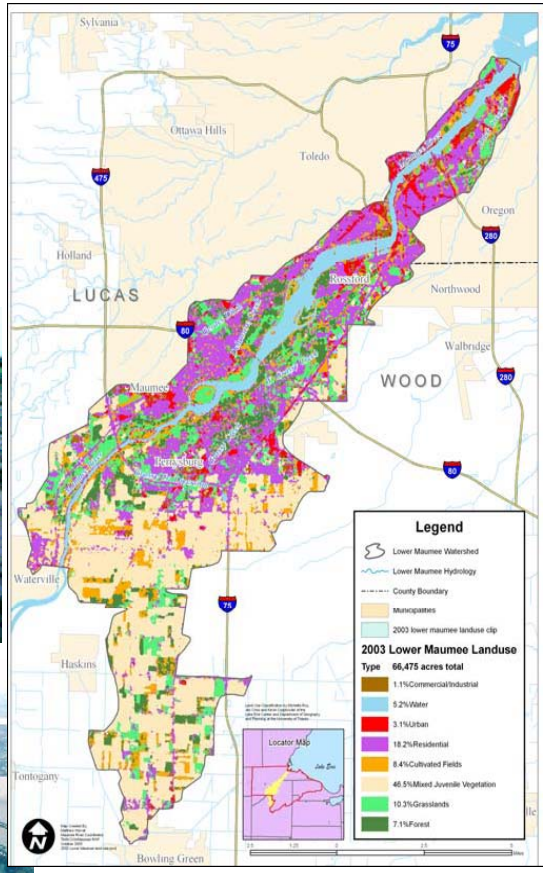
USACE Dredging and Regulatory Authority

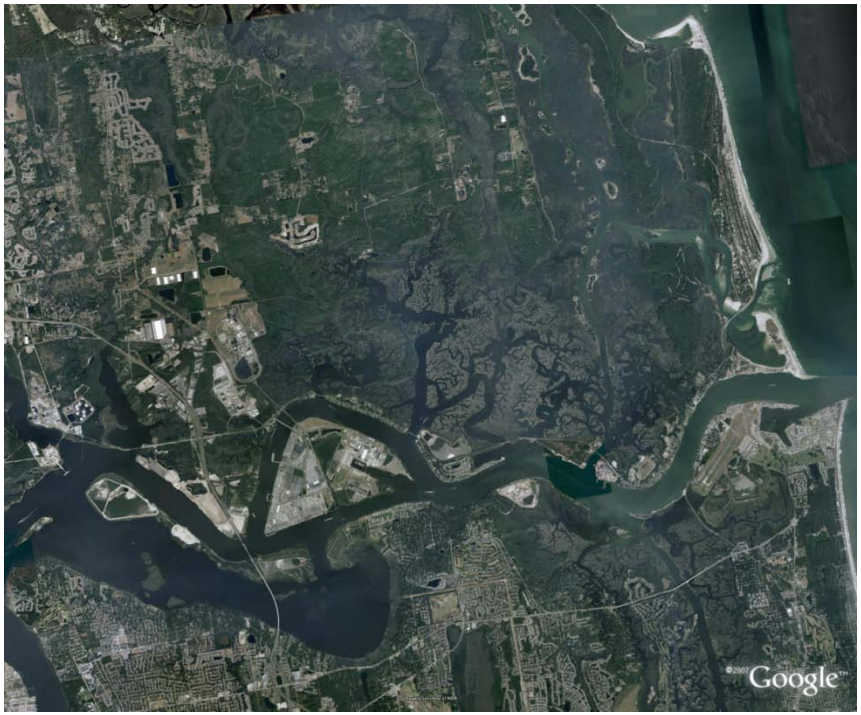
- **Navigation – discharge of fill into waters of the US and channel stability**
- **USACE is not responsible for:**
  - **Point-source discharges contaminants into water**
  - **Non-point discharge of contaminants from runoff**
  - **Watershed erosion of soil**
- **Unfortunate task**
  - **Managing watershed impacts at the dredging end**



Management of Dredged Material

- **Basic options**
  - **Aquatic placement**
    - **Deep water open**
    - **Nearshore open**
    - **Confined submersed**
    - **Confined islands**
  - **Upland placement**
    - **Direct land application**
    - **Confined development**
    - **Confined processed**
    - **Confined disposal**

Key to Sustainability



Beneficial Use

Beneficial Use

- **What is it?**

Regional Sediment Management

- **The use of sediment resources removed in dredging operations for shoreline habitat or structure, land development or as raw material in construction and soil material products returned to productive use.**

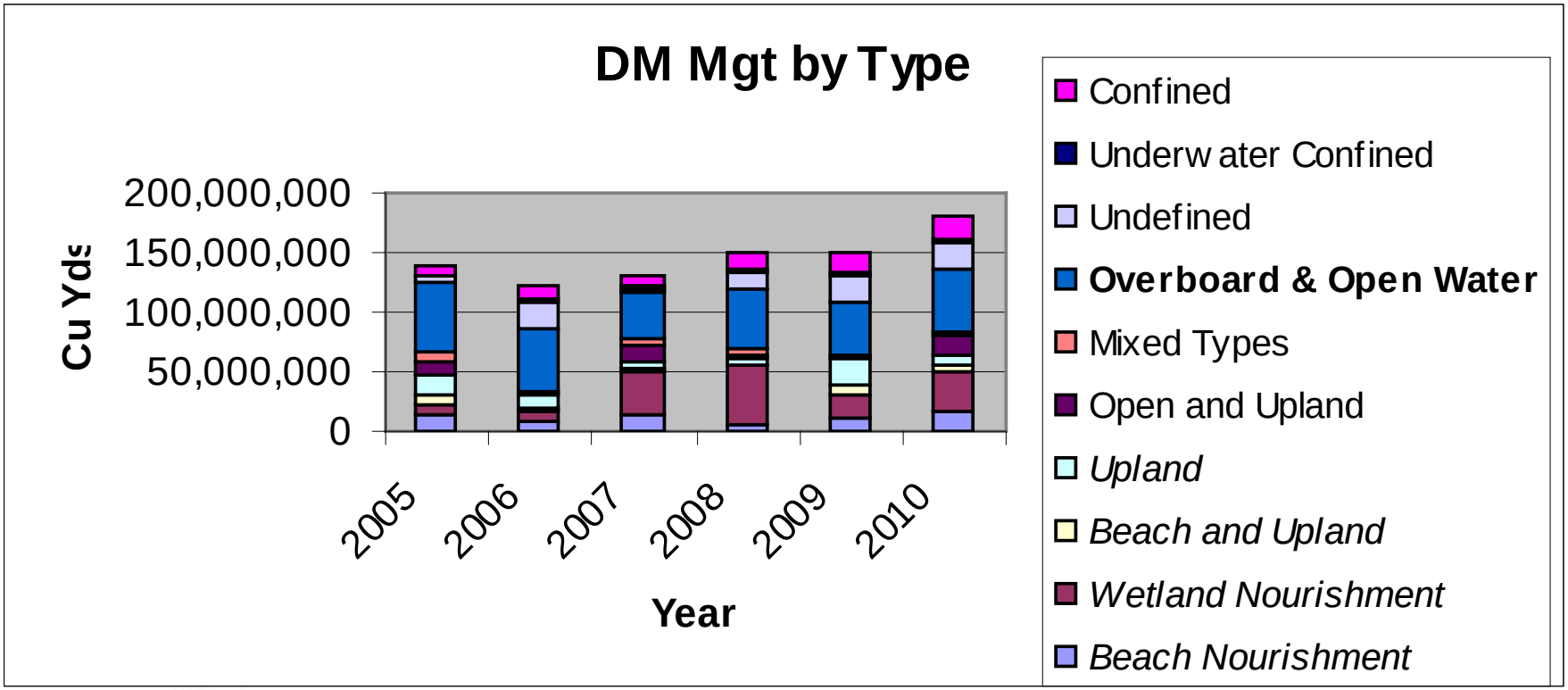
Keeping a productive resource in the watershed system

Two Paths for BU

- **Beneficial use is part of the dredging and placement process**
  - ***Regional Sediment Management***
    - ***Keeping sediment in the system***
- **Beneficial use is part of the CDF recovery process**
  - ***Mining CDFs to reclaim capacity***
  - ***Designed placement & processing***

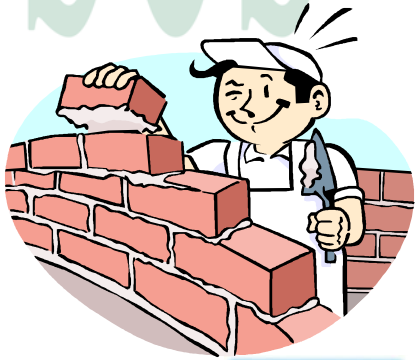
Where Does it Go?

- **Although greater than 90% of dredged material is deemed suitable for beneficial use, less than 40% can clearly be defined as such (IWR-NDC).**



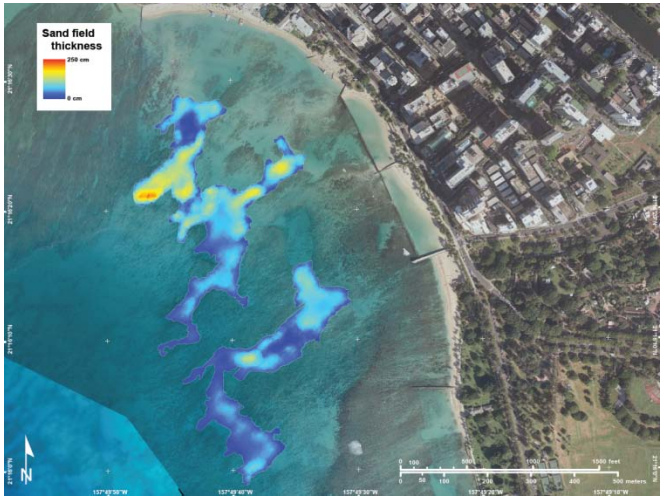
What Have We Done?

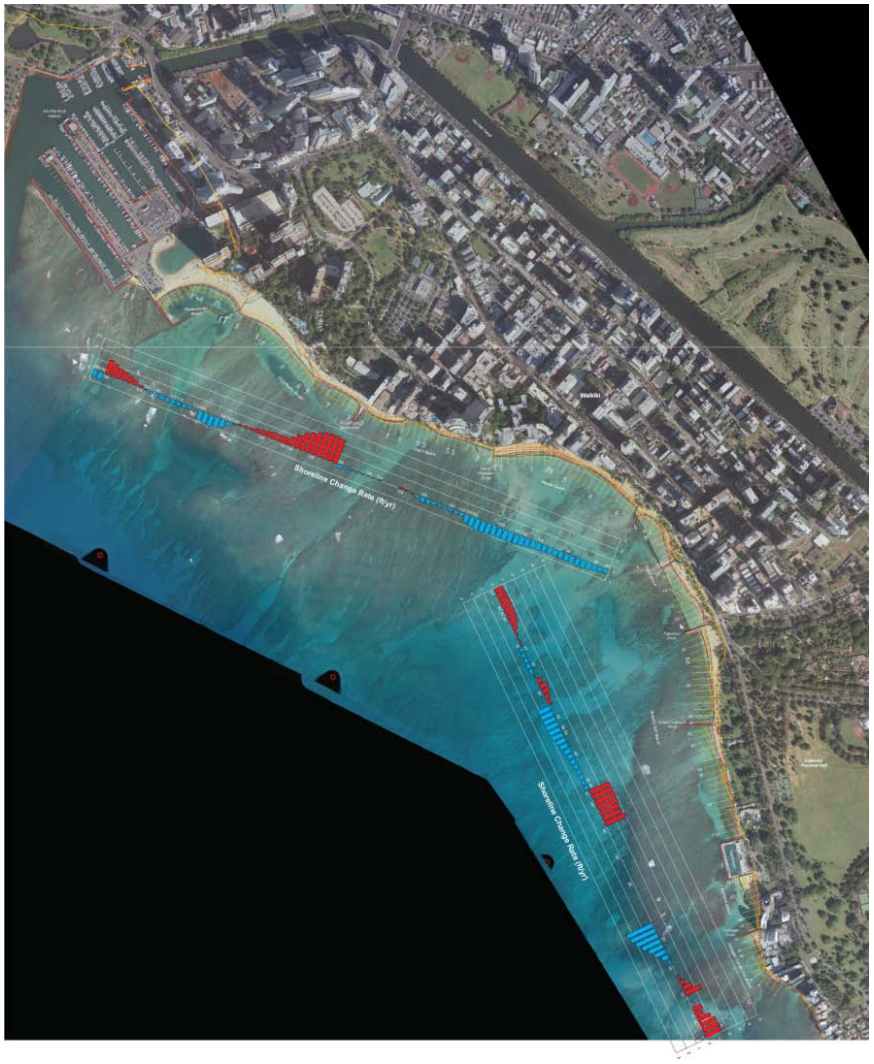
Beneficial Uses



Beach Nourishment

Beneficial Use and RSM





Construction Fill

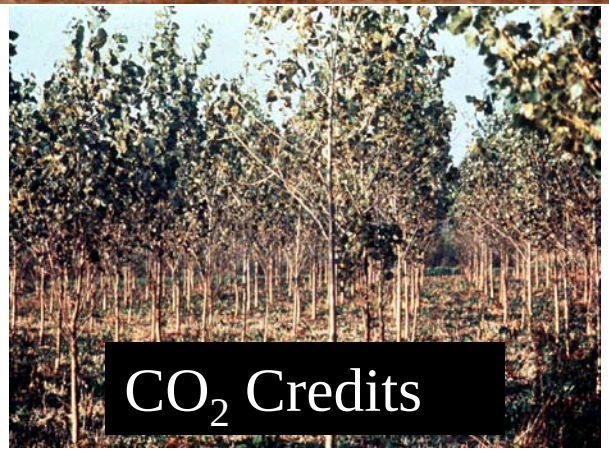
Removal of DM from CDFs

Keeping Harbors Open and People Working

PROJECT FUNDED BY THE

Harbor Maintenance Trust Fund

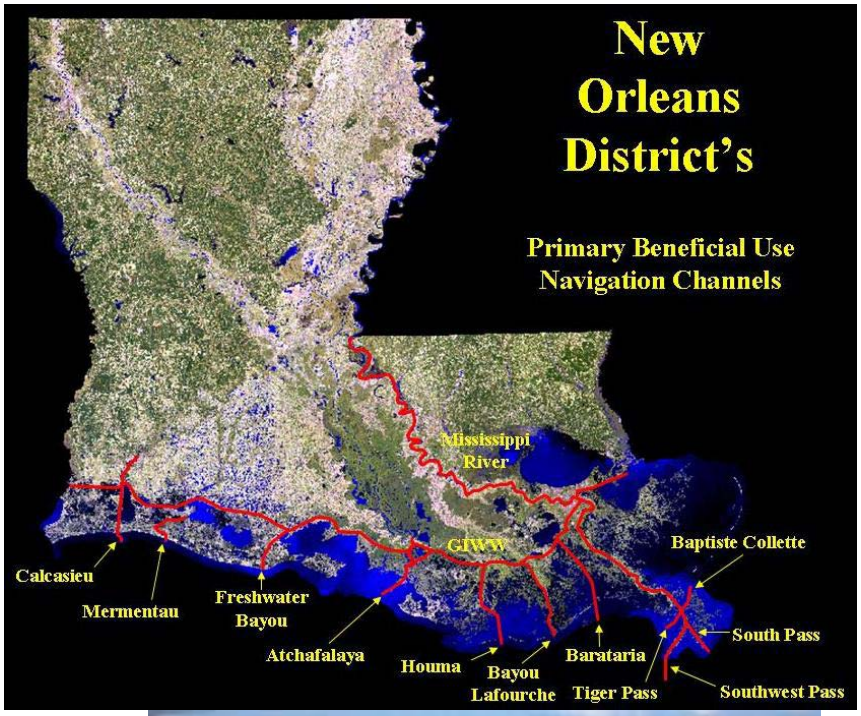
Agriculture/Forestry

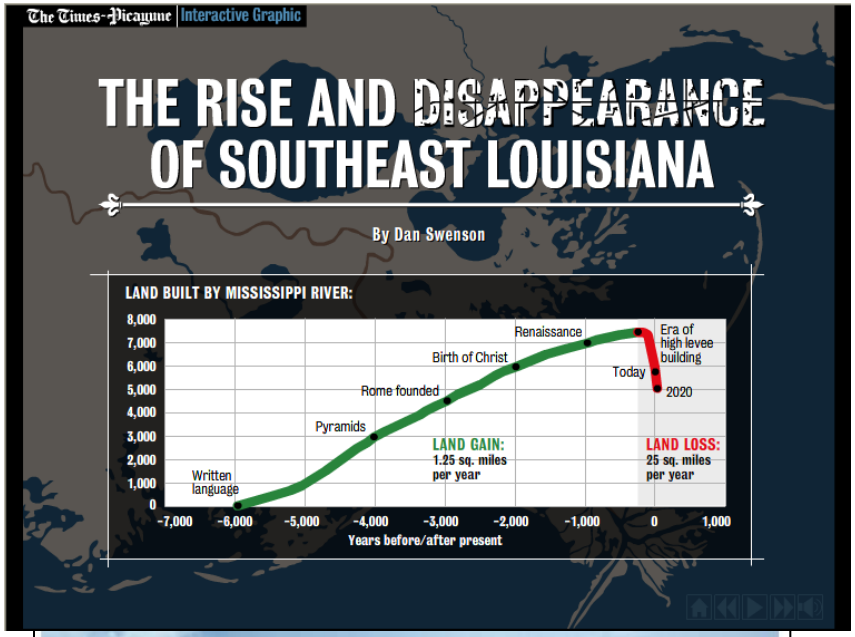


Recreation

Essential Habitats

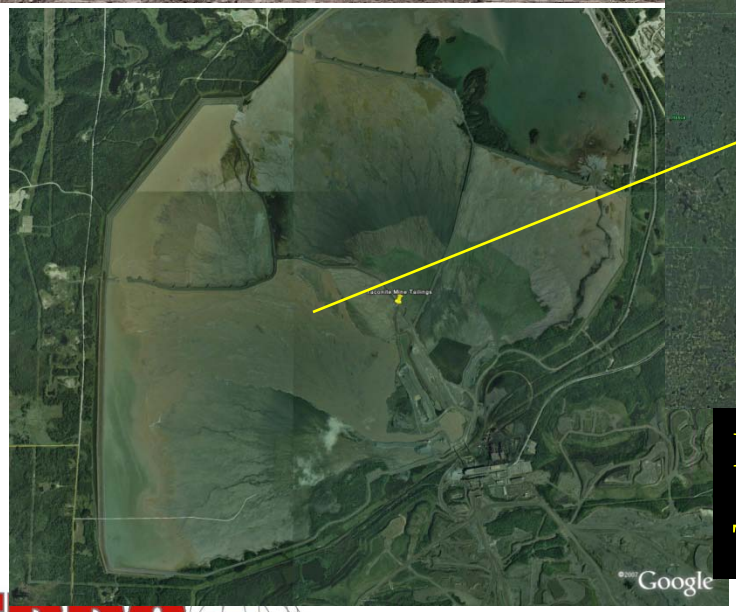
Coastal Wetland Restoration

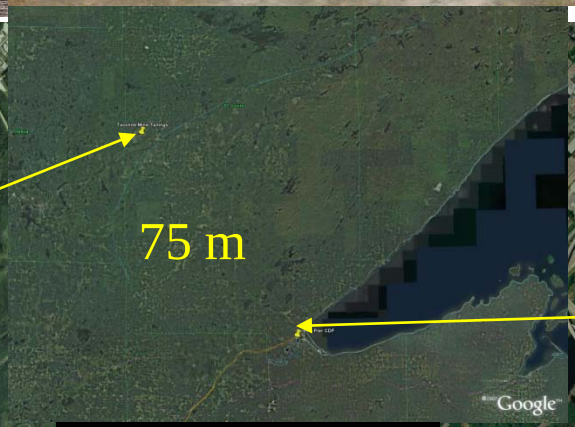




Island Habitat/Fisheries

Mineland Reclamation



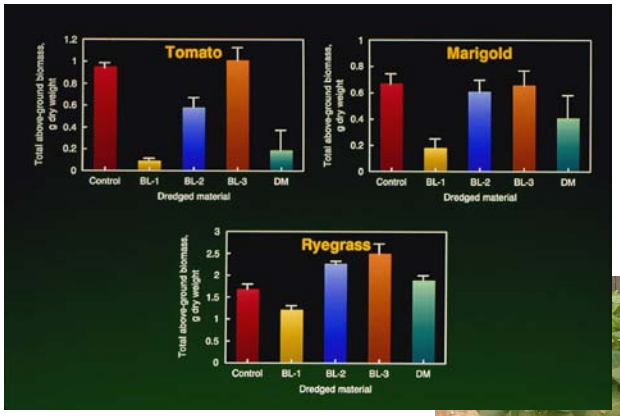


Erie Pier CDF

Taconite Mines

Dredged Material Recycling

Manufactured Soil



- Cellulose
  - Yard wastes, paper wastes
- Biosolids
  - Sewage sludge, animal wastes
- Industrial by-products
  - Red mud, fly ash

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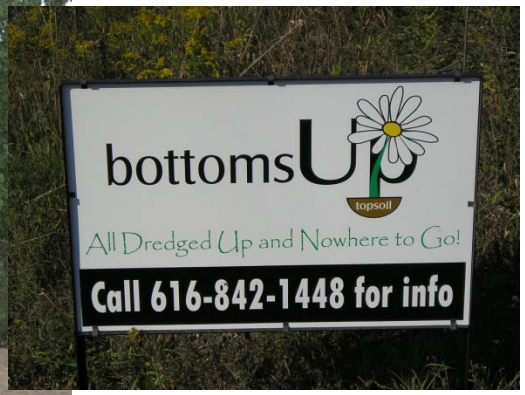
Commercialization



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Construction Materials

So, What is the Problem?

ISSUES

- Perceptions w/o scientific basis
- Lack of clear regulatory guidance
- Uncertainty dealing with contaminants
- Fear of product liability
- Funding cost-share

Criteria for Success

- **Human Benefits**
- **Ecological Benefits**
- **Compatible with RSM goals/CZM**
- **Technical feasibility**
- **Funding availability**
- **Environmental Impacts – of construction/project**
- **Legal Authority**
- **Public Support**
- ***Acceptable Level of Risk***

Determine Suitability Based on Quality

- **Sediment Quality**
  - Meets all physical and chemical properties when placed in aquatic environments to support littoral processes, structure and ecological development or restoration
- **Soil Quality**
  - Meets all physical and chemical properties when placed in upland environments to support terrestrial flora, fauna and recreational activities
- **Fill Quality**
  - Meets engineering and chemical properties to support construction fill or industrial development
- **Impaired**
  - Generally fails chemical requirements to provide safe beneficial use of the material without treatment

Physical Suitability

Table 2. Suitability of dredged material for various BUs.

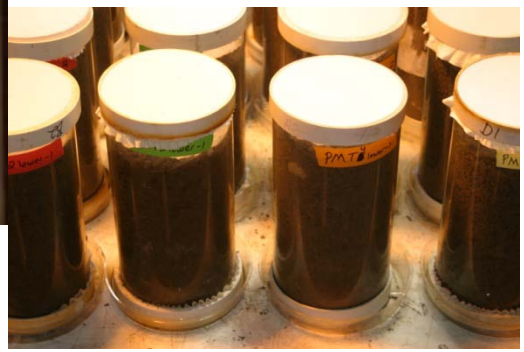
	Dredged Material Sediment Type				
Beneficial Use Options	Rock	Gravel & Sand	Consolidated Clay	Silt/Soft Clay	Mixture
Engineered Uses					
Land creation	X	X	X	X	X
Land improvement	X	X	X	X	X
Berm creation	X	X	X		X
Shore protection	X	X	X		
Replacement fill	X	X			X
Beach nourishment		X			
Capping		X	X		X
Agricultural/Product Uses					
Construction materials	X	X	X	X	X
Aquaculture			X	X	X
Topsoil				X	X
Environmental Enhancements					
Wildlife habitats	X	X	X	X	X
Fisheries improvement	X	X	X	X	X
Wetland restoration			X	X	X
Source: http://el.erdc.usace.army.mil/dots/budm/types.html#mixture.					

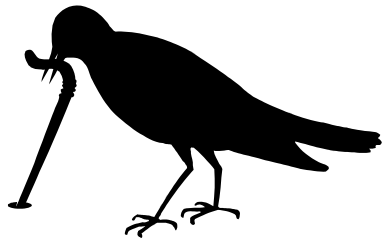
Physical Suitability

- **Issues**
  - **Considerations in habitat restoration, enhancement**
    - **Similar physical characteristics (particle size, geologic origin, salinity, etc)**
    - **Transport of invasive or detrimental biological components**
  - **Placement Stability/Transport**
    - **Engineering tests – sheer strength, compaction, etc**
    - **Tools to determine fate and transport of DM in aquatic systems**
    - **LTFATE – Long-term fate and stability of DM placement**
    - **Others**

See Joe Gailani

Chemical Suitability





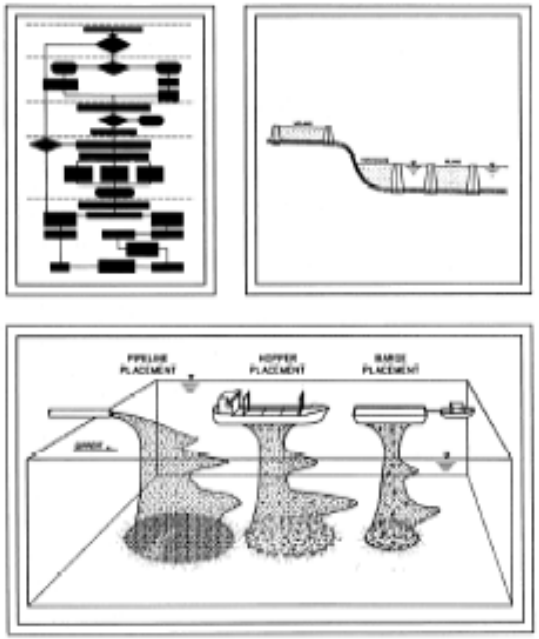
Federal/Regional Guidance

EPA

US Army Corps of Engineers

United States Environmental Protection Agency | Department of the Army U.S. Army Corps of Engineers | EPA842-B-92-008 Revised May 2004

Evaluating Environmental Effects of Dredged Material Management Alternatives—A Technical Framework



Great Lakes Commission
des Grands Lacs

Great Lakes Dredging Team

September, 2004
Second Edition

With references to:
Upland Beneficial Use of Dredged Material Testing and Evaluation
Annotated Bibliography

ERDC/EL TR-07-27

US Army Corps of Engineers®
Engineer Research and Development Center

Dredging Operations and Environmental Research Program

Summary of Available Guidance and Best Practices for Determining Suitability of Dredged Material for Beneficial Uses

Dennis L. Brandon and Richard A. Price — November 2007

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State Regulations

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

RULES AND REGULATIONS FOR DREDGING AND THE MANAGEMENT OF DREDGED MATERIAL

February 2003

Regulation # DEM-OWR-DR-02-03

Determine Suitability for Aquatic Use

- **Evaluation of Dredged Material Proposed for Ocean Disposal *(Ocean Testing Manual)* – *Evaluates suitability - BU***
  - **Sec. 103, Marine Protection, Research and Sanctuaries Act (1972)**
  - **Marine Water Quality Criteria**
  - **Biological Exposure/Effects**

- **Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual *(Inland Testing Manual)* – *Evaluates suitability - BU***
  - **Section 404 Clean Water Act (1977)**
  - **Fresh Water Quality Criteria**
  - **Biological Exposure/Effects**

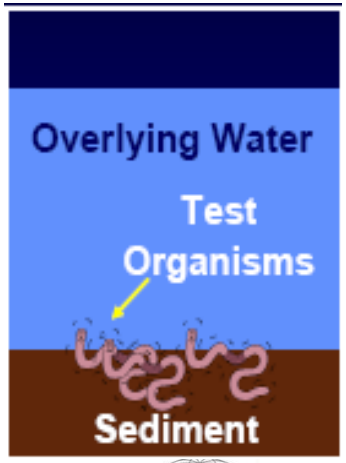
- **Other testing may be required to determine suitability to ensure compatible with habitat goals/performance**

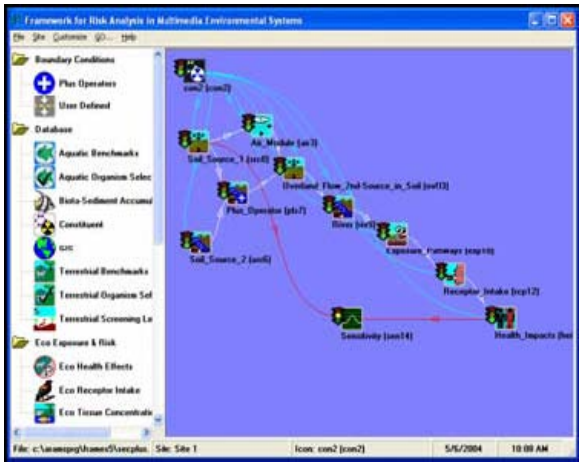
Determine Suitability for Terrestrial Use

- **Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing Manual *(Upland Testing Manual)* - *Evaluates management needs***
  - **National Environmental Policy Act and CWA**
  - **Bioavailability and Transport of Contaminants**
- **What if CWA does not apply?**
  - **Dredged material not regulated under MPRSA or CWA may be subject to Solid Waste Rules or other requirements**
- **Issues**
  - **Terrestrial use of dredged material complex**
  - **Risks may change depending on site selection**
    - **Wetland, upland**
  - **Risks affected by type of site use, potential receptors**
    - **Habitat, agronomic, recreational, industrial**
    - **State requirements vary**
    - **Criteria mostly based on human health risks or groundwater protection**

Tiered Testing Approach

- Tier I – Existing info, material determined inert
- Tier II – Compare DM chemistry to screening level
  - Pass: no further contaminant evaluation
  - Fail: Further evaluation
- Tier III - Physical and biological tests for bioavailability
  - Biological exposure for bioavailability or site specific use
- Tier IV - Risk assessment





State Regulatory Soil Surface Guidance

Table 8. Top 30 Elements for which Residential Surface Soil Guidance (mg/kg) is Provided

Rank	Frequency	CAS No.	Element	Element	Min	Max	LOV
1	69	7440-38-2	As	Arsenic	0.004	30	3.88
2	68	7440-43-9	Cd	Cadmium	0.5	550	3.04
3	65	7440-02-0	Ni	Nickel	10	40000	3.60
4	64	7440-41-7	Be	Beryllium	0.002	680	5.53
5	63	7440-22-4	Ag	Silver	0.189	2500	4.12
6	63	7440-39-3	Ba	Barium	100	63000	2.80
7	62	7439-92-1	Pb	Lead	2	500	2.40
8	62	7440-66-6	Zn	Zinc	20	170000	3.93
9	62	7782-49-2	Se	Selenium	1	2600	3.41
10	60	7440-36-0	Sb	Antimony	3	180	1.78
11	57	7440-50-8	Cu	Copper	25	20000	2.90
12	56	7440-62-2	V	Vanadium	7.4	1500	2.31
13	55	18540-29-9	Cr(VI)	Chromium (VI)	1.8	2500	3.14
-----	53	16065-83-1	Cr(III)	Chromium (III)	36	790000	4.34
14	52	7439-97-6	Hg	Mercury	0.00509	100000	7.29
15	52	7440-28-0	Tl	Thallium	0.516	35	1.83
16	49	7439-96-5	Mn	Manganese	9.5	30000	3.50
17	41	7440-48-4	Co	Cobalt	10	15000	3.18
18	37	7782-41-4 (1)	F- or F	Fluorine anion	7.36	15000	3.31
-----	34	7440-47-3 (2)	Cr (Total)	Total Chromium	10	59000	3.77
19	34	7429-90-5	Al	Aluminum	7600	150000	1.30
20	34	7440-42-8	B	Boron	1.6	51000	4.50
21	30	7439-98-7	Mo	Molybdenum	39	2600	1.82
22	29	7439-89-6	Fe	Iron	5.76	160000	4.44
23	29	7440-24-6	Sr	Strontium	4690	330000	1.85
24	29	7440-31-5	Sn	Tin	2000	93000	1.67
25	26	7723-14-0	P	Phosphorous	0.156	1000000	6.81
26	24	7439-93-2	Li	Lithium	136	5100	1.57
27	21	7440-61-1	U	Uranium	1.56	760	2.69
28	13	7782-50-5	Cl or Cl^-	Chlorine	12	20000	3.22
29	12	7440-32-6	Ti	Titanium	10000	38000000	3.58
30	8	7429-91-6	Dy	Dysprosium	782	16000	1.31

(1) or CAS No. 16984-48-8 (2) or Cr(total) based on an assumed Cr^{+6}:Cr^{+3} ratio of 1:6

- **Upland Beneficial Uses**
  - State regulatory authority under Title 40 for management of solid waste
  - Varies between states up to 7 orders of magnitude
- **Example from PADEP**
  - Boron limit under GP
    - 6.7 mg kg^{-1}
  - Boron Conc in DM
    - 13 mg kg^{-1}
  - Boron Range in PA Soils
    - 8.5 – 155 mg kg
    - Most > 50 mg kg^{-1}

Jennings, Aaron A. and Hanna, Amy (2010) "Database Analysis of State Surface Soil Regulatory Guidance Values," *International Journal of Soil, Sediment and Water*: Vol. 3: Iss. 2, Article 7.

Laboratory Toxicity and Bioaccumulation Tests

Refine estimates of potential risk to ecological receptors – material specific

- ✓ Chemical screening values can be under-predictive or over-predictive of actual toxicity to ecological receptors
- ✓ Soil quality screening values are problematic for evaluating dredged sediment
- ✓ Preference for direct measurements of toxicity and contaminant bioaccumulation
- ✓ Bioassay tests both whole sediment and elutriate samples







Ecological / Human Health Risk

Contaminant pathways

- **Soil**
  - **Direct contact, ingestion**
- **Water**
  - Water quality criteria (water column, effluent, surface runoff, leachate, groundwater)
- **Plant**
  - Wetland and upland toxicity and bioaccumulation
- **Animal**
  - Water column toxicity / Benthic bioaccumulation
  - Soil invertebrate toxicity and bioaccumulation
- **Air**
  - Volatile emissions
  - Dust

Consider contaminant degradation/sequestering

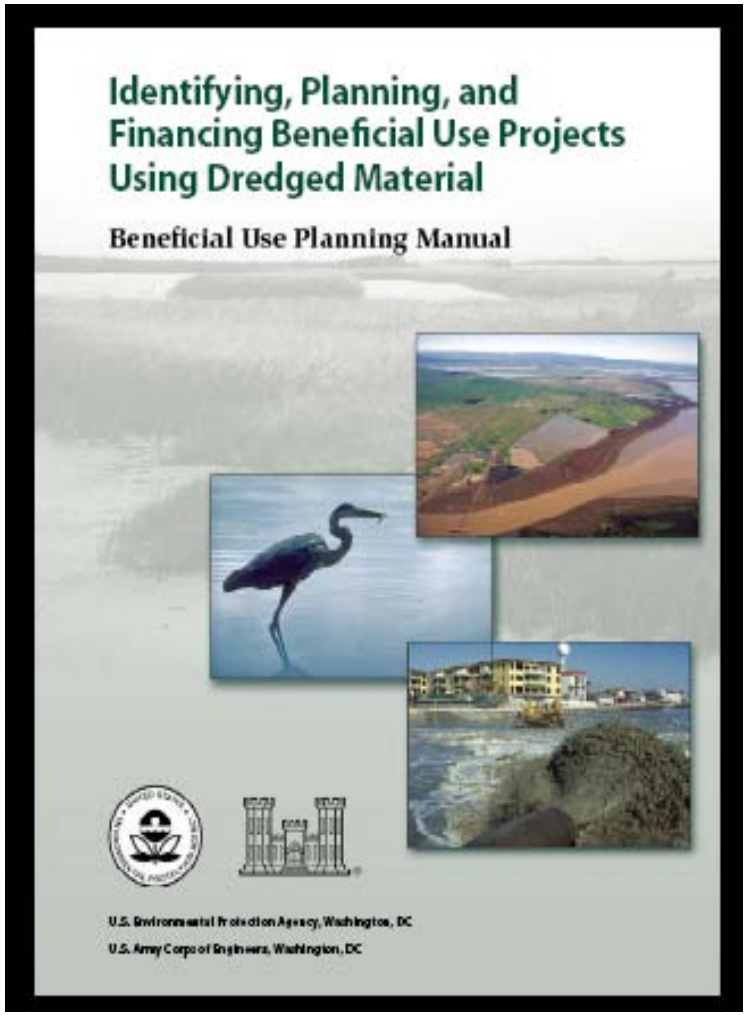
Bioavailability of Contaminants to Exposed Receptors

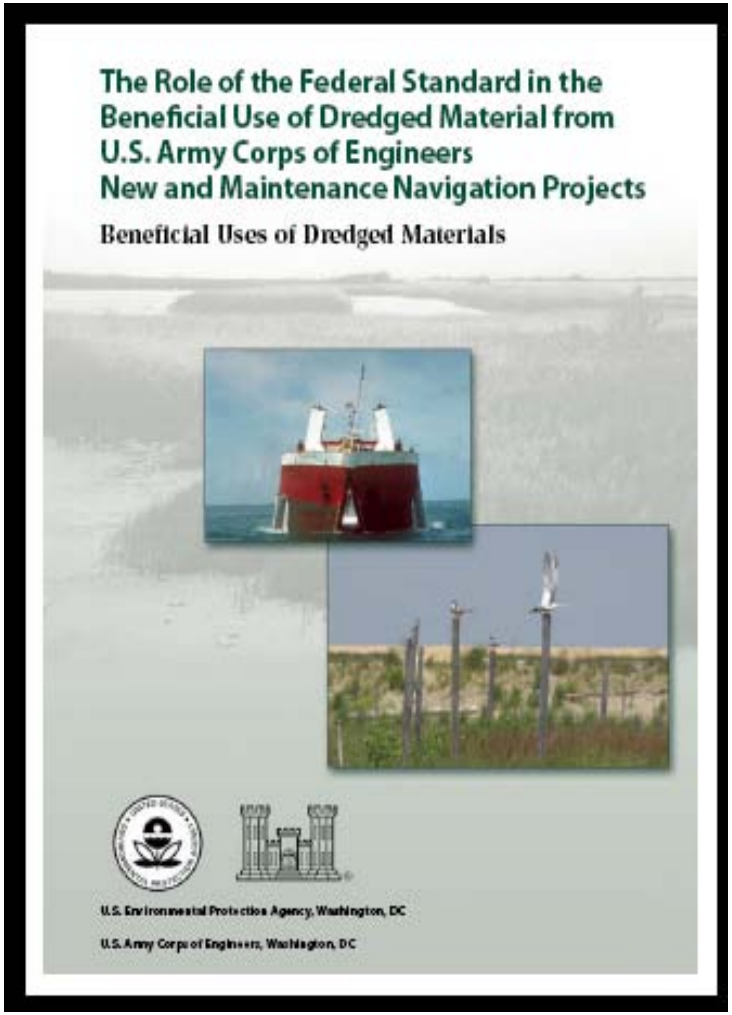
Receptor = Vole

Exposed Plant = Yellow Nutsedge

Soil - Plant - Mammal

Guidance on Planning/Funding/Authorities





Summary

- Dredged material from maintenance dredging of navigation generally reflects watershed quality
- Environmental restoration/enhancement offers greatest widespread use in volume
- All beneficial use options must be evaluated for sustainability
- State criteria for BU suitability increasingly restrictive
- Potential risk associated with low to moderate contaminant levels best addressed by biological exposure testing – site/use specific
- *Dredged material is a resource – don't waste it!*

Web Resources

- **Dredging Operations Technical Support**
  http://el.erdc.usace.army.mil/dots/dots.html

- **Beneficial Uses of Dredged Material**
  http://el.erdc.usace.army.mil/dots/budm/budm.cfm

- **Dredging Operations and Environmental Research Program**
  http://el.erdc.usace.army.mil/dots/doer/doer.html