# Overview of Dredging Equipment and Methodologies


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# The dredging process generally consists of the following stages:

- Excavation (loosening or dislodging) of the material from the bottom.
- Removal of the loosened material to the dredge vessel.
- Transportation of the material to the placement area.
- Placement of the material.

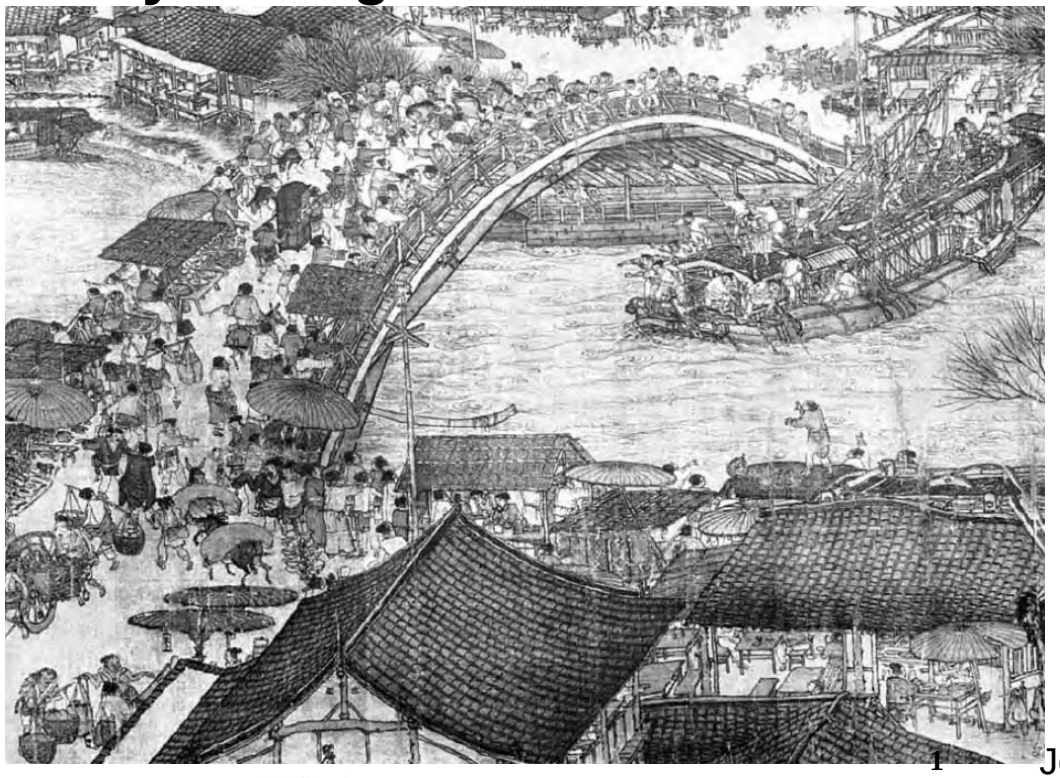
# Dredging Definitions

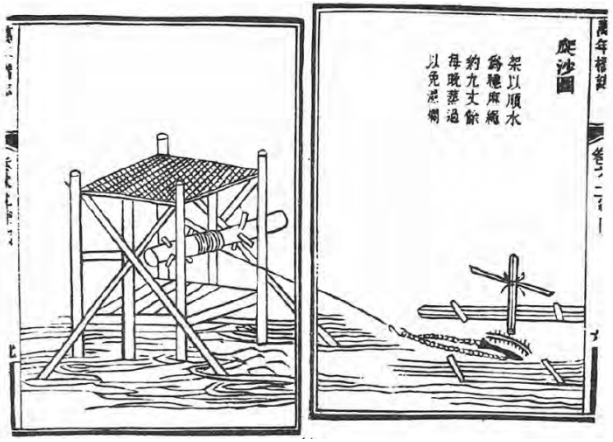
- **Sediment:** Unconsolidated material existing on the bottom of the waterway
- **Dredged Material:** Sediment which has been excavated by a dredge and has been or is being transported to a placement site
- **Dredged Spoil:** Term from past, considered a negative connotation, to be avoided in use
- **Disposal Site:** More politically correct term is placement site – where the dredged material is placed following dredging
- **Dredge Plant:** The dredge and all supporting equipment and attendant vessels
- **Dumping:** Term from past, still used, but not preferred for most effective communications
- **Environmental Dredging:** The removal of contaminated sediments from a waterbody for purposes of sediment remediation.

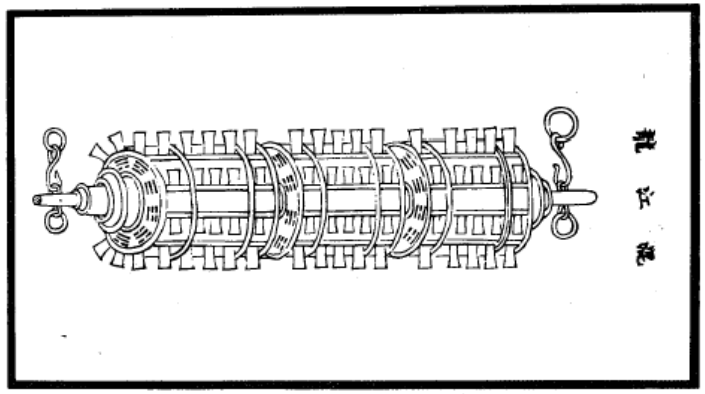
**http://el.erdc.usace.army.mil/elpubs/pdf/trel08-29.pdf**

# Early Development of Dredging

**Dredging began in rivers (Nile, Euphrates, Tigris, Yellow, & Indus, etc.) many 1000s of years ago.**

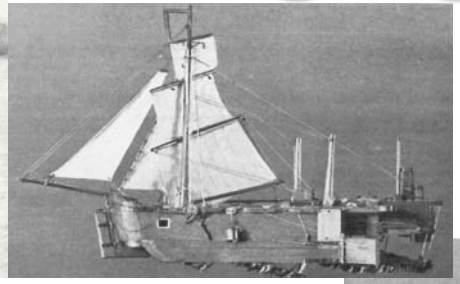




Source: Science and Civilisation in China
Joseph Needham, Wang ling, and Lu Gwei-Djen

# Development of Dredging

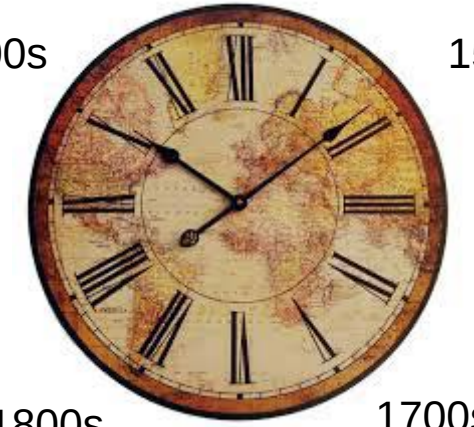


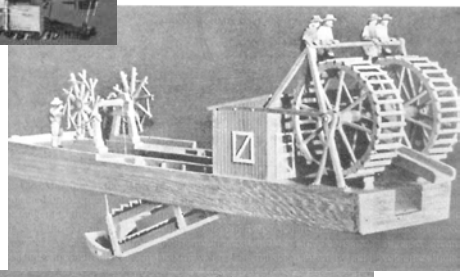
Sources:
Herbich, 2000
Ports and Dredging
Dr. Bob Randall

1400s

2000s

1500s





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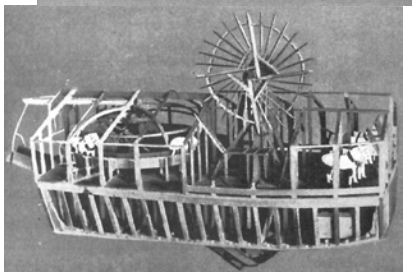


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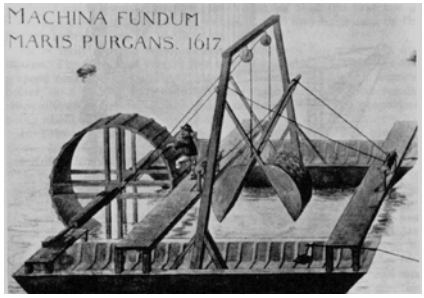
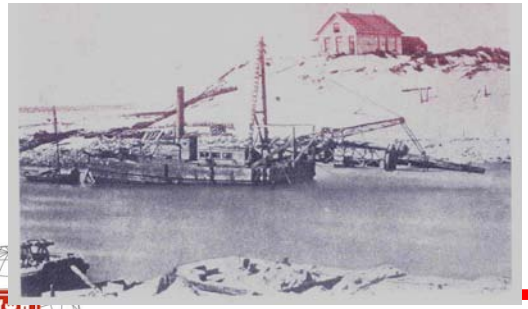



Technical Press Limited, London



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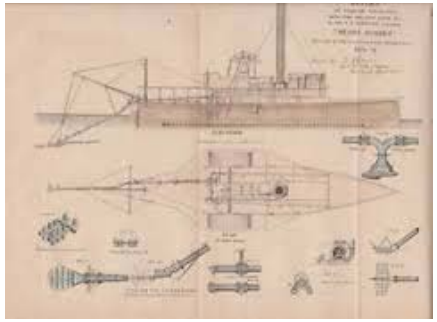
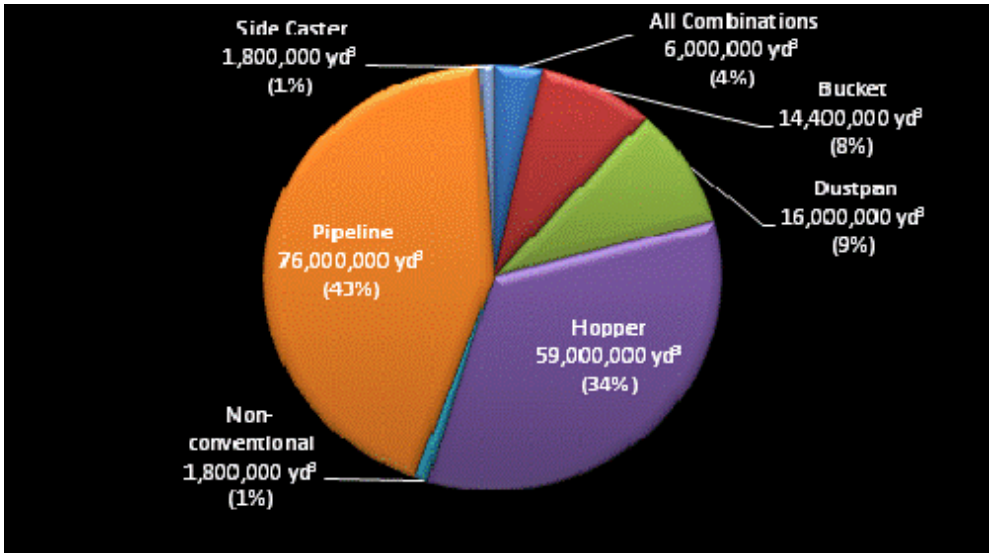


# Basic Dredge Types

- Mechanical
  - Clamshell (Bucket)
  - Backhoe
- Hydraulic
  - Pipeline (Cutterhead & Dustpan)
  - Hopper
  - Side-caster
- Other / Combinations

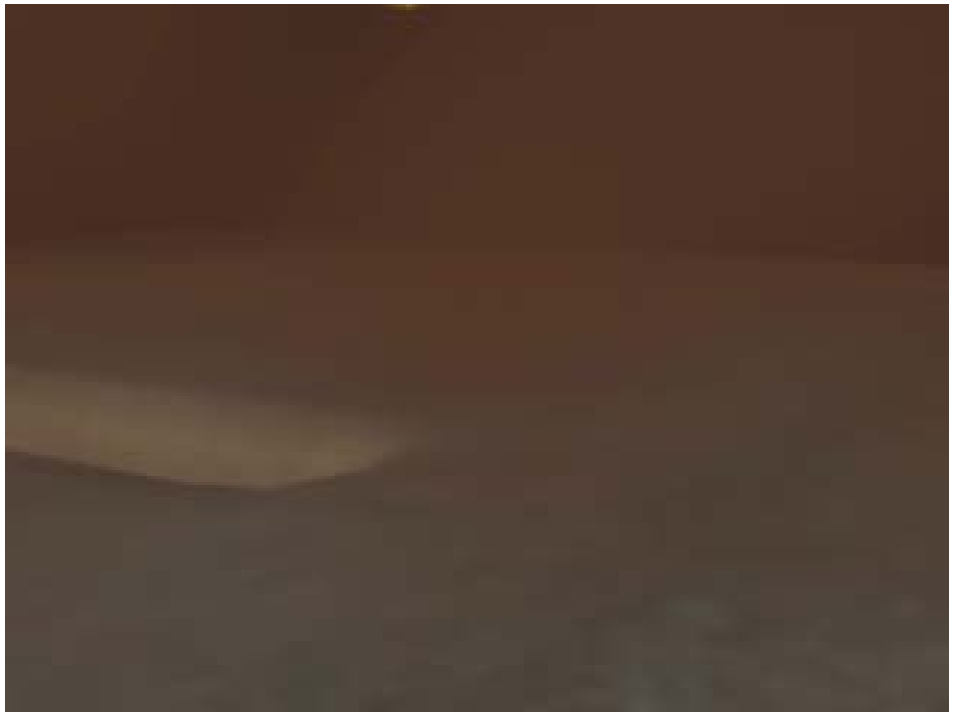


# Factors in Selection of Dredging Equipment

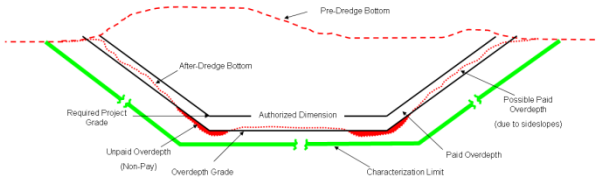
- Physical characteristics of sediments
- Quantities to be dredged
- Dredging depth
- Distance to disposal (placement) area
- Physical environment of and between areas
- Contamination level of sediments
- Method of disposal (placement)
- Production required
- Types of dredges available

# Clamshell (Bucket) Mechanical Dredge

# Bucket Dredge Excavation Process



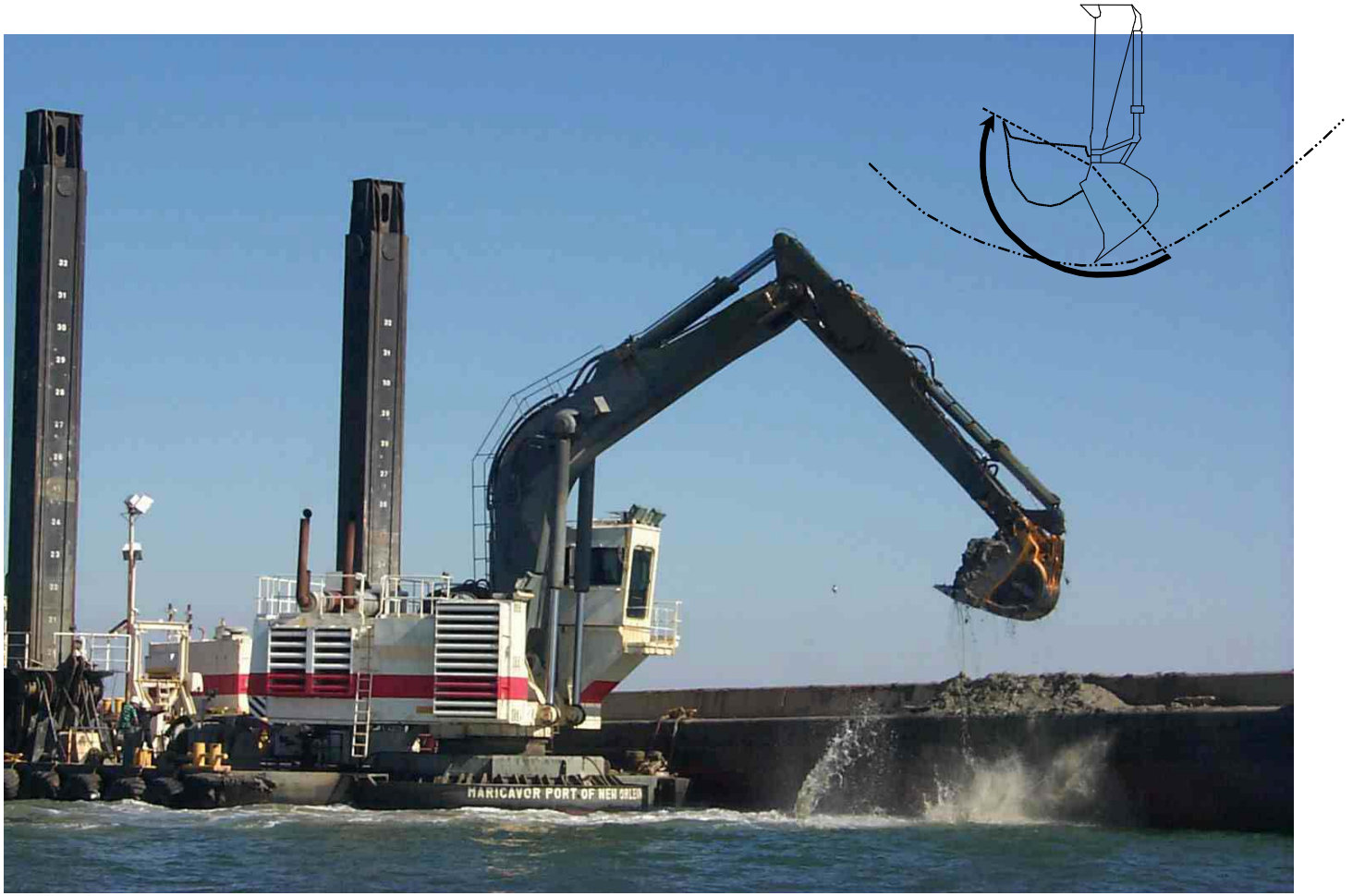
# Bucket Dredge Excavation Pattern





**Source: Great Lakes Dredge and Dock Co.**

# Backhoe (Bucket) Mechanical Dredge



# Barge Discharge

Split hull scow

Mechanical Off-loaders

Source: Great Lakes Dredge and Dock Co.

Hydraulic Off-loaders

# Mechanical Dredges

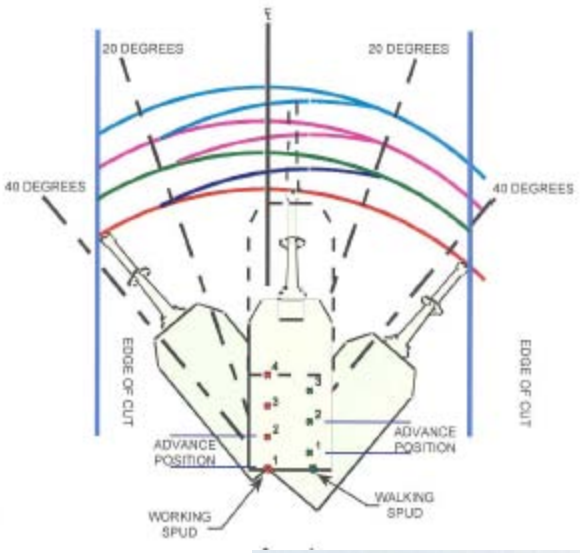
**Advantages**

- Rugged and capable of removing hard packed materials
- Can remove debris
- Can work tight areas
- Efficient for disposal at long haul distances

**Limitations**

- Difficult to retain fine loose material in conventional buckets
- Production low compared to pipeline dredges
- Resuspension can be an issue, especially in presence of debris

# Hydraulic Pipeline Cutterhead Dredge

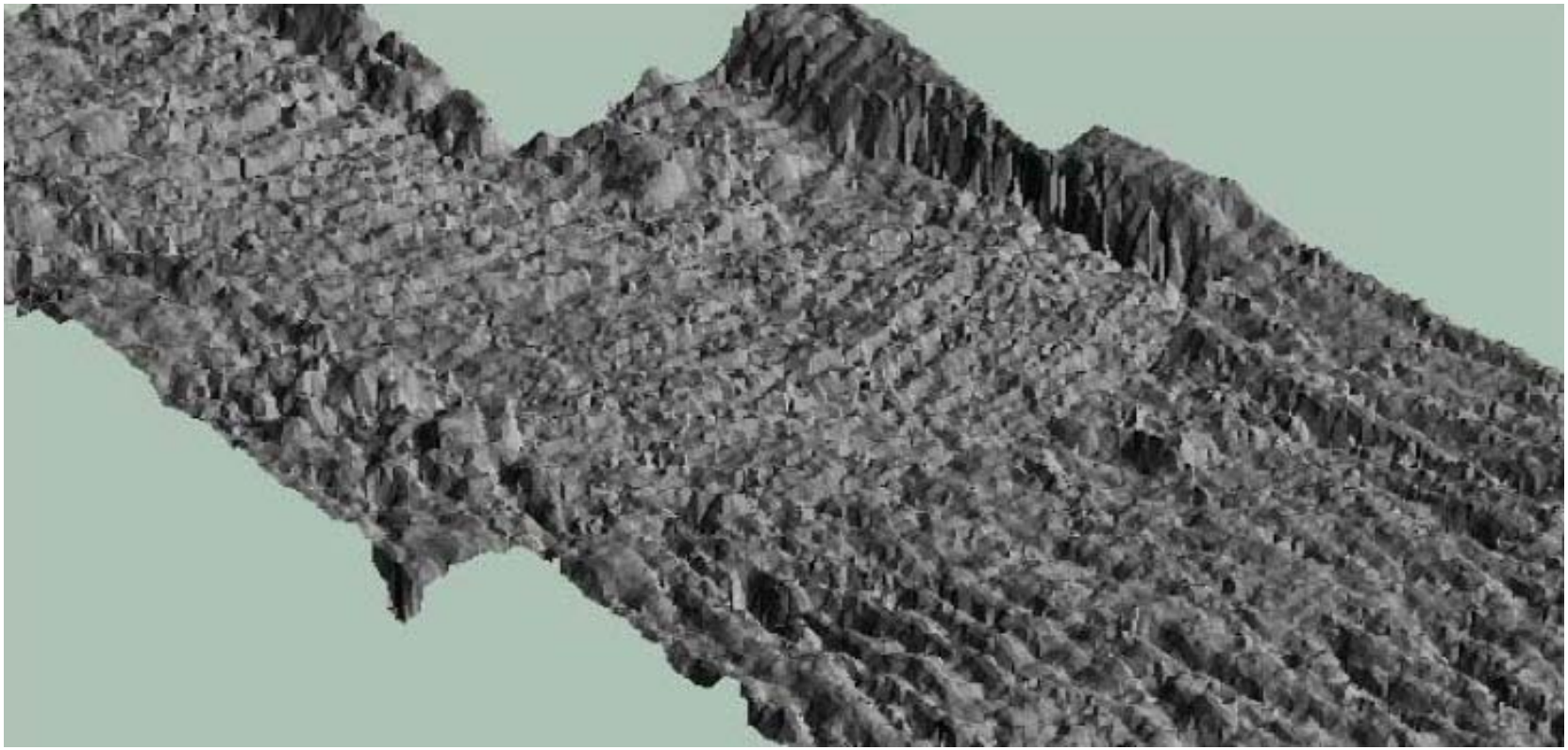


# Cutterhead Excavation Process

Source: Great Lakes Dredge and Dock Co.

# Cutterhead Dredge
## Goetz - St Paul District

# Cutterhead Dredge Excavation Pattern



Source: Great Lakes Dredge and Dock Co,

# Types of Discharge Pipeline



# Traditional Hydraulic Placement

# Booster Pumps


Source: Great Lakes Dredge and Dock Co.

Source: GIW

# Spider Barge


# Cutterhead Dredges

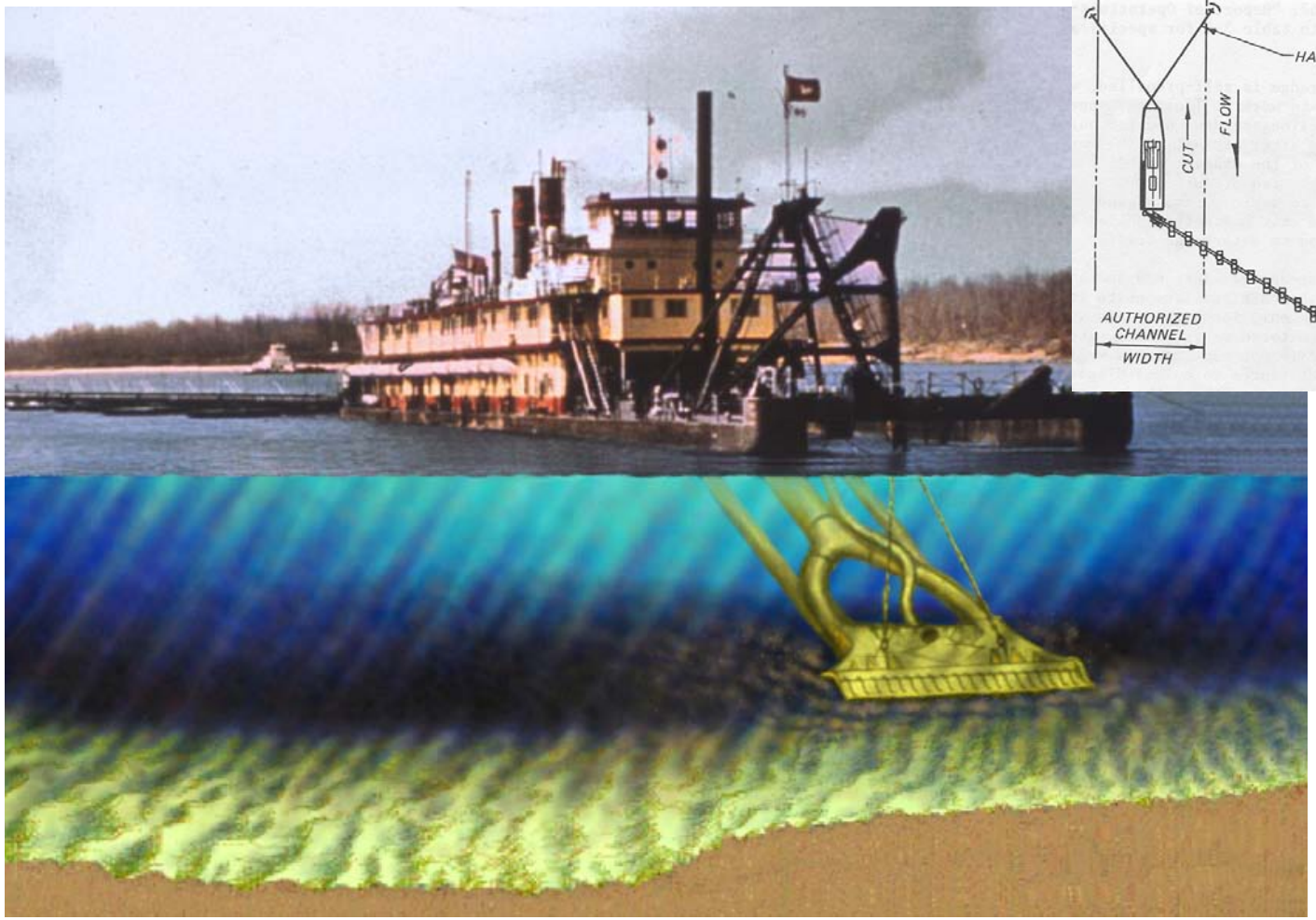
**Advantages**

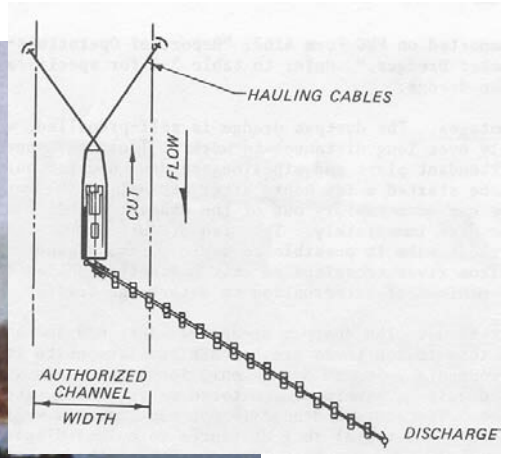
- Can excavate most materials
- Can pump directly to the placement site
- Almost continuous dredging
- Often least expensive if within pumping distance of placement area

**Limitations**

- Limited safe operational capability in waves
- Not self-propelled
- Add 3 -10 parts water to 1 part dredged material
- Interfere with Navigation (pipeline, anchor barges, etc.)
- Debris can reduce efficiency

# Dustpan Dredge





# Dustpan Excavation Process

# Dustpan Dredge
# Jadwin – Vicksburg District

# Dustpan Dredges

**Advantages**

- Are self-propelled, mob/bemob relatively quickly
- Can move out of channel to minimize traffic interference
- Pumps directly to the placement site
- Almost continuous dredging
- Design/methodology allows quicker channel opening

**Limitations**

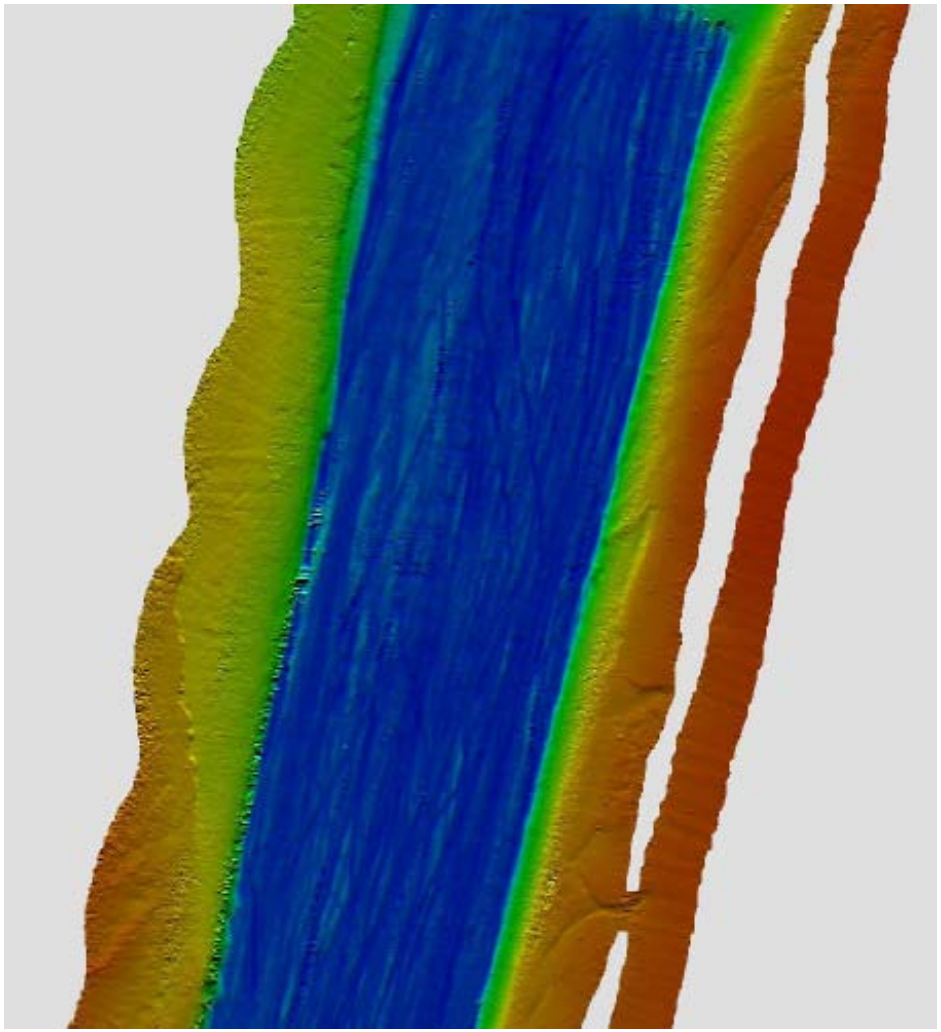
- Limited safe operational capability in waves
- Designed for unconsolidated sediment (sands/gravels)
- Relatively short pumping distance capacity
- Debris can reduce efficiency

# Hopper (Hydraulic) Dredge

# Draghead Excavation Process

# Hopper Dredge
# Essayons – Portland District

# Hopper Dredge Excavation Pattern



# Hopper Dredge Discharge

Split Hull

Pump-out

Bottom Dump Door

Rainbow Nozzle

Source:
Michael.D.MarineTraffic.com

# Hopper Dredges

**Advantages**

- Only dredge type for rough open water
- Can move quickly to job under its own power
- Minimizes traffic interference
- Improves navigation depth quickly
- Economical for medium haul distance

**Limitations**

- Cannot work in shallow depths
- Cannot dredge continuously
- Excavates with less precision
- Difficulty dredging hard banks
- Difficulty dredging consolidated materials

# Side-Caster Dredge

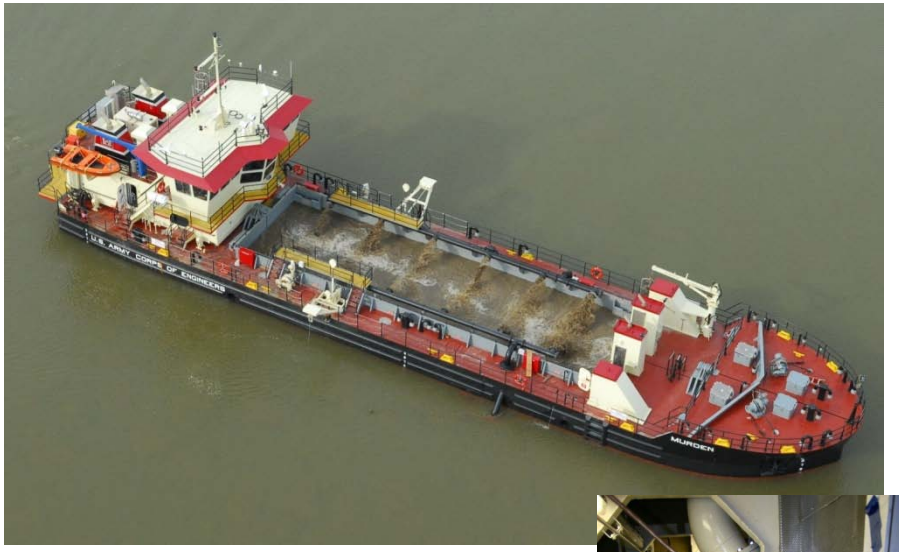
**Advantages.**

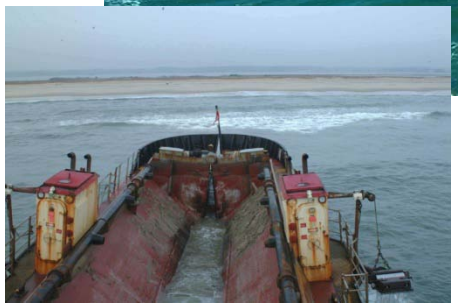
- Self-propelled, can rapidly move from one project location to another
- Can immediately go to work once at the site.
- Effective dredging tool removing bar channels in small coastal inlets

**Limitations.**

- Needs flotation depths before it can begin to work
- Cannot move the relatively large volumes of material
- Some of the material removed can return to the channel prism
- Only open-water placement capability.

# Special – Purpose Dredges
## Currituck & Murden – Wilmington District

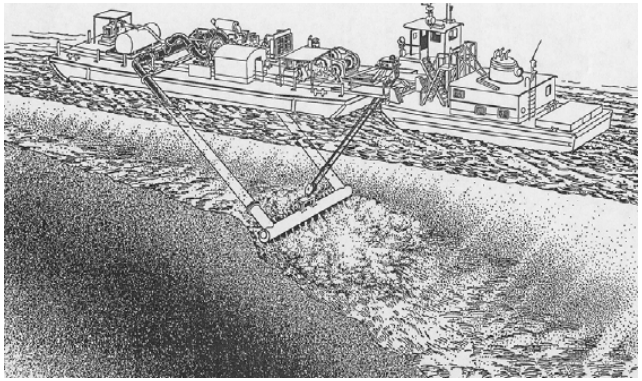
**Advantages**

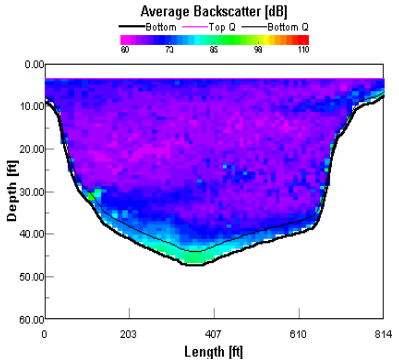
- Effective dredging tool for use in shallow-draft inlets
- Dredged material can be placed in the littoral zone

**Limitations**

- Production rates limited by relatively small hopper capacity
- Not effective on major navigation channels.

# Water Injection Dredge






**Advantages**

- In optimum conditions capable of very high production rates.
- Can rapidly mob/demob
- Reduced dredge plant = reduced workforce levels = reduced operating costs
- Minimizes traffic interference
- Injection head rides on sediment surface/safer operations around utilities

**Limitations**

- Can be used only where in-water placement of dredged material is allowed
- Can effectively operate only where favorable conditions exist
- Cannot be used in contaminated sediment where unacceptable environmental impacts occur

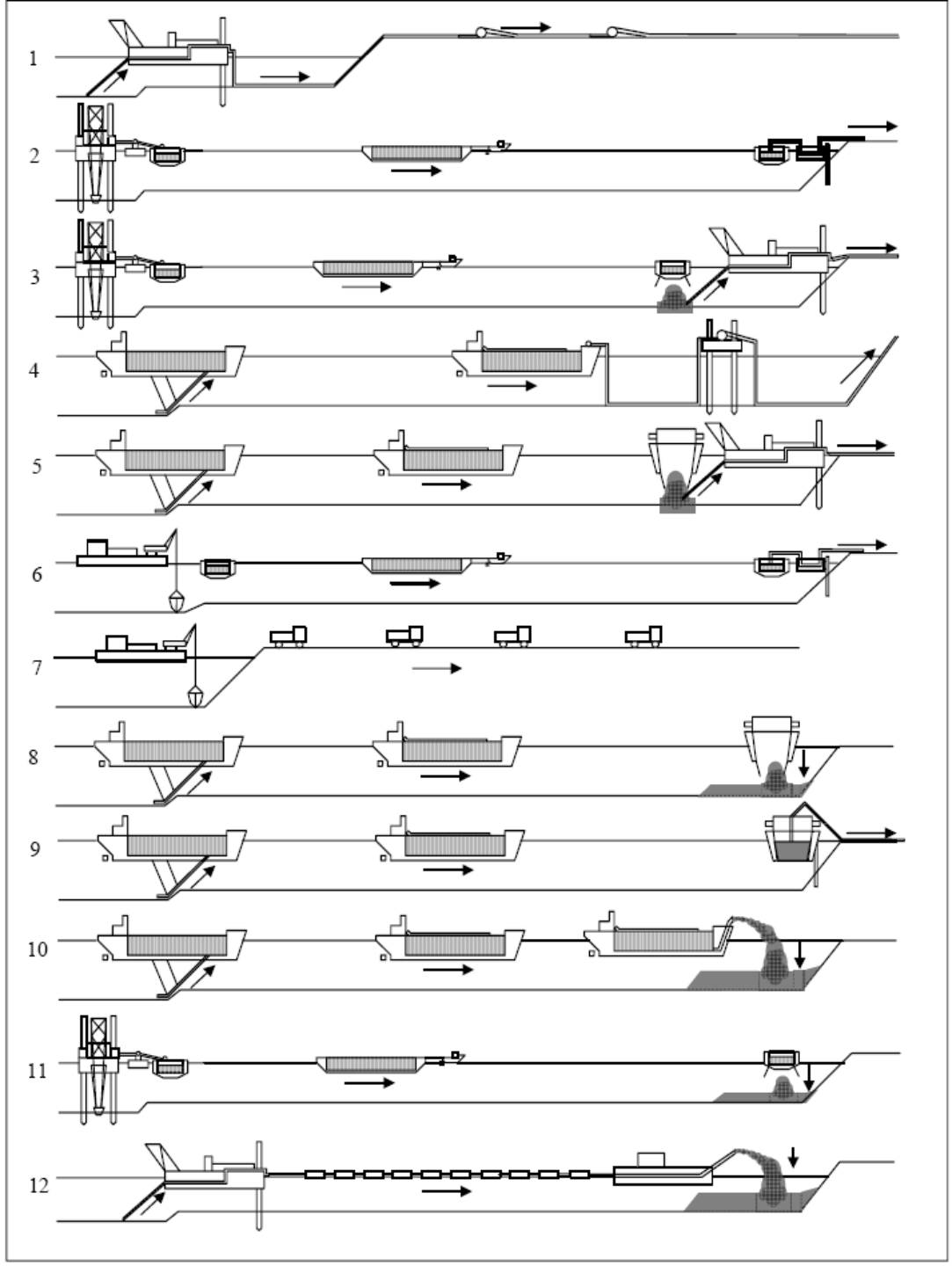
# Bed Levelers

Source: Weeks Marine, Inc.

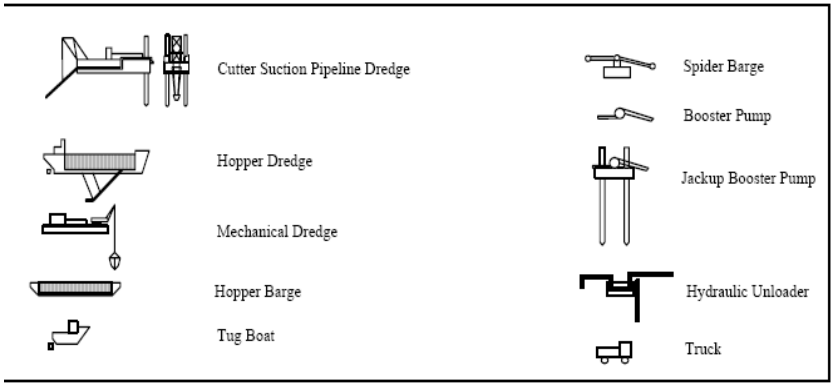
Source: Bean Dredging Company

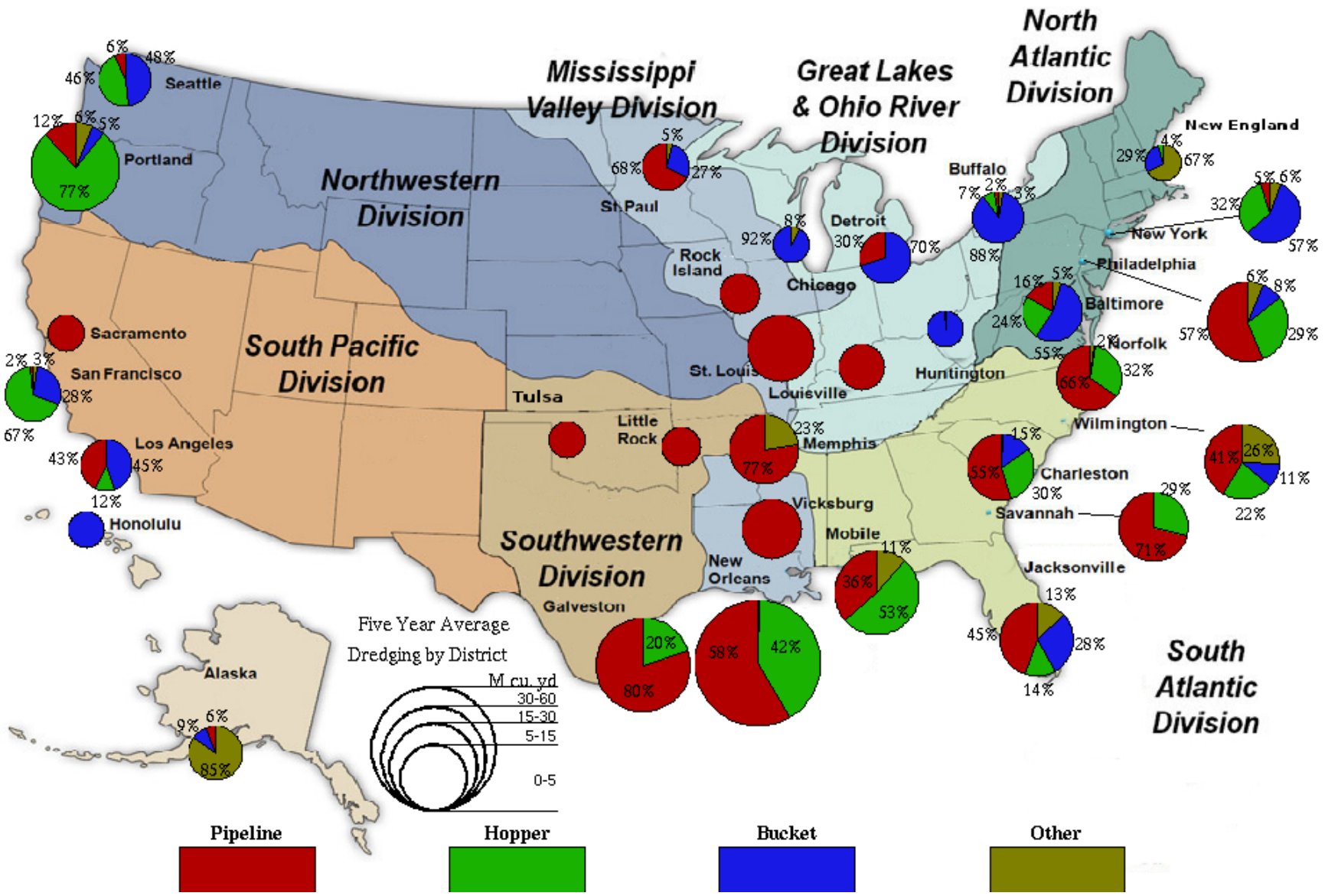
Source: Great Lakes Dredge and Dock Company

# Beach Nourishment Scenarios Using Different Dredging Equipment Combos




**Source: Dr. Bob Randall, CDS**




North Atlantic Division
Mississippi Valley Division
Great Lakes & Ohio River Division
Northwestern Division
South Pacific Division
Southwestern Division
South Atlantic Division
Seattle
Portland
Sacramento
San Francisco
Los Angeles
Honolulu
Alaska
St Paul
Rock Island
Chicago
Detroit
Buffalo
New England
New York
Philadelphia
Baltimore
Norfolk
Wilmington
Huntington
Louisville
St. Louis
Tulsa
Little Rock
Memphis
Vicksburg
Mobile
New Orleans
Galveston
Charleston
Savannah
Jacksonville
Five Year Average Dredging by District
M cu. yd
30-60
15-30
5-15
0-5
Pipeline
Hopper
Bucket
Other

# REALLY APPROXIMATE Daily Dredging Costs

- Function
  - Volume of material
  - Type of material
  - Type of dredge
  - Distance to disposal site
  - Type of disposal/placement site
- Typical Corps Jobs (10s to 100sK to M cy)

Big hopper dredges can cost **REALLY APPROXIMATELY** $90K-$120K/day

Big cutterheads can cost **REALLY APPROXIMATELY** $45K-$65K/day

Big mechanical dredges can cost **REALLY APPROXIMATELY** $30K-$35K /day

# The End

# Questions?