OverDepth Dredging and Characterization

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Motivation

- In the past, USEPA has raised questions concerning dredging of material from outside channel dimensions regarding adequate characterization.
- Recognized a need for the USACE to have better communication with other agencies and public about channel terminology as well as the inherent imprecision of the dredging process.

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
WASHINGTON, D.C. 20314-1000

CECW-P/CECW-0 JAN 17 2006

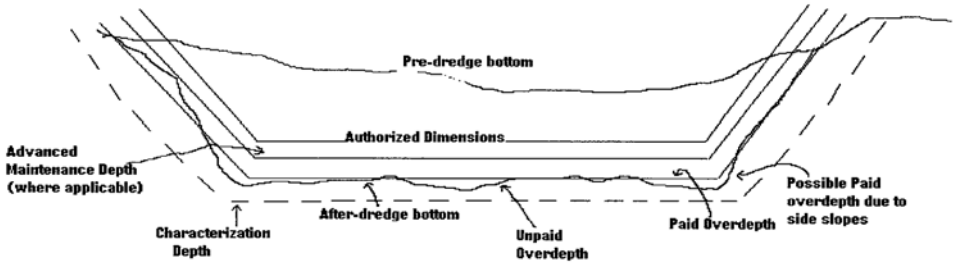
MEMORANDUM FOR COMMANDERS, MAJOR SUBORDINATE COMMANDS

SUBJECT: Assuring the Adequacy of Environmental Documentation for Construction and Maintenance Dredging of Federal Navigation Projects

1. Purpose. This memorandum provides guidance to assure that environmental compliance activities and environmental documentation associated with U.S. Army Corps of Engineers new Federal navigation project dredging or maintenance dredging adequately considers overdepth dredging. The guidance also has considerations relative to environmental documentation for permitting associated with non-Federal dredging. This guidance contains no new policy and is meant to supplement ER 1130-2-520 and to insure the future compatibility of the dredging description and quantities in environmental compliance documentation with the dredging as actually implemented.

2. Background. Congress specifically authorizes Federal navigation channels by specific depth and width. These authorized channel dimensions are generally based on maximizing net transportation savings considering the characteristics of the vessels using the channel and include consideration of safety, physical conditions, and vessel operating characteristics. In addition, the reliability of the channel is considered and may result in the incorporation of advance maintenance depths into the construction of the channel where such advance maintenance is justified to assure operational reliability and least overall cost. Finally, the construction techniques for the channel are considered. There is inherent imprecision in dredging processes which vary with the physical conditions (tides, currents, and waves); the dredged material characteristics (silt, clay, sand, gravel, rock, etc.); the channel design (depths being dredged, side slopes, etc.); and the type of dredging equipment (mechanical, hydraulic, hopper, etc.). Due to these variables and the resulting imprecision associated with the dredging activity, Corps engineering design, cost estimating and construction contracting documents recognize that dredging below the Congressionally authorized project dimensions will occur and is necessary to assure the required depth and width as well as cost effective operability. To balance project construction requirements against the need to limit dredging and disposal to the minimum required to achieve the designed dimensions, a paid or allowable overdepth (including side slopes) is incorporated into the project-dredging prism. Material removed from this allowable overdepth is paid under the terms of the dredging contract. Material removed beyond the limits of the allowable overdepth is not paid. These dredging zones are illustrated on the enclosed figure and defined and discussed in more detail below.

a. Authorized Dimensions. The authorized dimensions are the depth and width of the channel authorized by Congress to be constructed and maintained by the Corps. These authorized channel dimensions are generally based on maximizing net transportation savings considering the characteristics of the vessels using the channel and include consideration of safety, physical conditions, and vessel operating characteristics. For entrance channels from the ocean into harbors, the authorized dimensions often include an additional allowance of safety for wave action for that portion of the channel crossing the ocean bar. For example, a 45- foot entrance channel may have an authorized 47-foot depth over the ocean bar.



Paid Allowable Overdepth

Should reflect a process to balance consideration of:

- Cost,
- Minimizing environmental impacts,
- Dredge capability considering physical conditions, equipment, and material.

Operations Technologies

Overdepth Dredging Research Task

Objectives:

- Provide a better understanding of overdepth dredging by different types of dredges in different types of site-specific conditions.

- Provide operations managers with tools to monitor overdepth dredging on their respective projects to facilitate regulatory compliance.

ERDC/TN EEDP-04-37
June 2007

Overdepth Dredging and Characterization Depth Recommendations

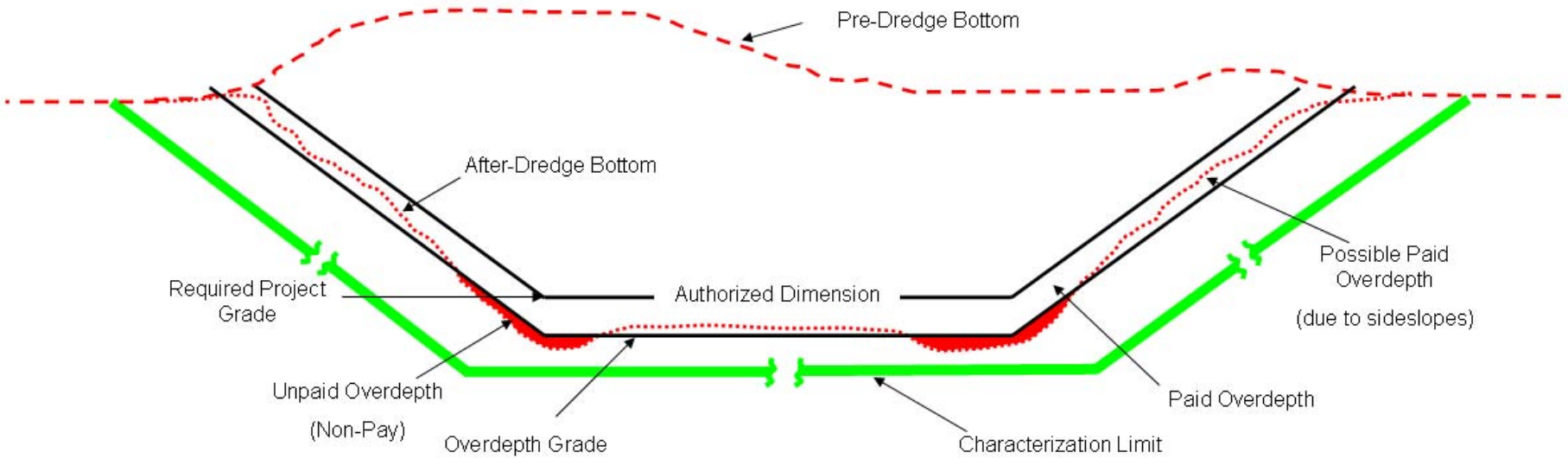
by John F. Tavolaro, Joseph R. Wilson, Timothy L. Welp, James E. Clausner, and Angela Y. Premo

PURPOSE: This technical note (TN) describes the excavation accuracy of various dredges under different project conditions, and provides guidance to U.S. Army Corps of Engineers (USACE) personnel in determining depths to adequately characterize and evaluate material to be dredged in the entire dredging prism, including paid allowable overdepth and non-pay dredging. The technical note also improves communication on these subjects with other agencies and the public. Proper selection of characterization depths, considering the dredge's excavating accuracy and respective project-specific conditions, is critical to ensure future compatibility of the dredging description and quantities in environmental compliance documentation with the dredging as actually implemented. This guidance is meant to supplement Engineer Regulation (ER) 1130-2-520 (USACE 1996) and the Memorandum for Commanders, Major Subordinate Commands, "Assuring the Adequacy of Environmental Documentation for Construction and Maintenance Dredging of Federal Navigation Projects" (USACE 2006). Much of the information from the USACE 17 Jan 2006 Memorandum is included in this technical note.

BACKGROUND: It is USACE policy that dredging will be accomplished in an efficient, cost-effective, and environmentally responsible manner to improve and maintain the Nation's waterways to make them suitable for navigation and other purposes consistent with Federal laws and regulations (USACE 1996).

In a guidance memorandum dated 17 January 2006, Congress specifically authorizes Federal navigation channels with a specific depth and width (and length) (USACE 2006). The authorized depth and width (Figure 1) are generally based on maximizing net transportation savings considering the characteristics of vessels using the channel. In addition to authorized dimensions, channel reliability is considered and may result in the incorporation of advance maintenance depths into construction of the channel where such advance maintenance is justified to ensure channel reliability and least overall cost. There are inherent excavation inaccuracies in the dredging process. Excavation accuracy relates to closeness of the dredge's completed work to the design (project and/or overdepth) grade (Figure 1) as determined by an after-dredge hydrographic survey.

Dredge excavation accuracies vary as a function of type of dredging equipment used (mechanical or hydraulic) and interaction with site-specific physical conditions (tides, currents, waves), type and thickness of sediment or rock being dredged, and channel design (water depth, side slopes, etc.). Because of these variables and the resulting excavating inaccuracies associated with the dredging activity, USACE engineering design, cost estimating, and construction contracting documents recognize that dredging below the Congressionally authorized project dimensions


Pre-Dredge Bottom
After-Dredge Bottom
Required Project Grade
Authorized Dimension
Possible Paid Overdepth
(due to sideslopes)
Unpaid Overdepth
(Non-Pay)
Overdepth Grade
Paid Overdepth
Characterization Limit

Sediment Characterization

- Identification and evaluation of sediment characteristics to be dredged for predicting environmental impacts due to dredging and/or disposal activities.
- Can be physical, chemical, or biological sampling and/or testing, or any combination.
- Extent of sediment characterization necessary to ensure compliance with applicable environmental laws and regulations is site specific.
- Should be developed by the USACE after considering all site-specific variables.

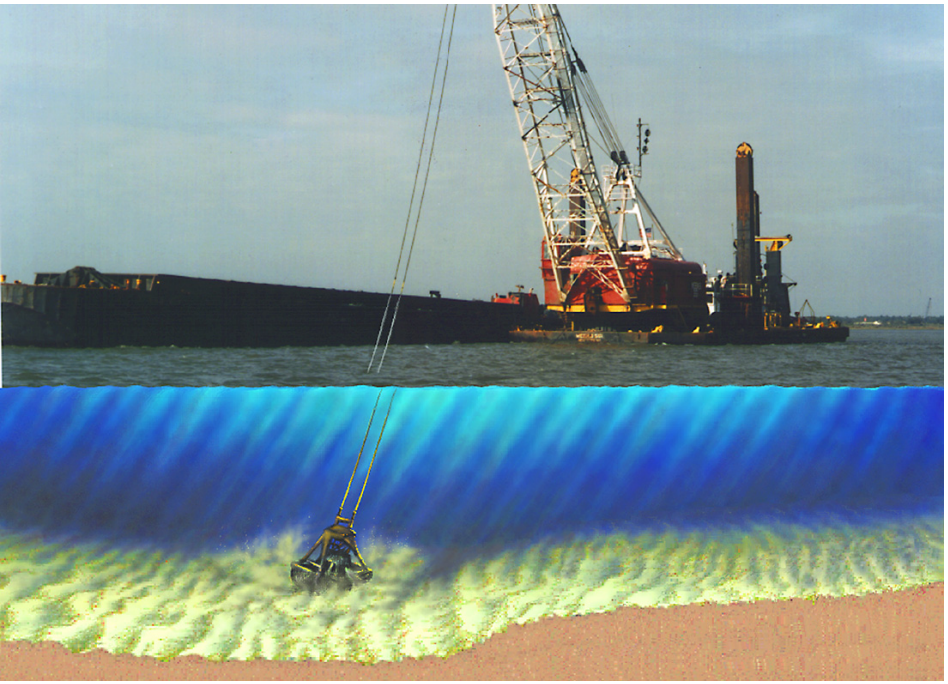
Excavation Accuracy

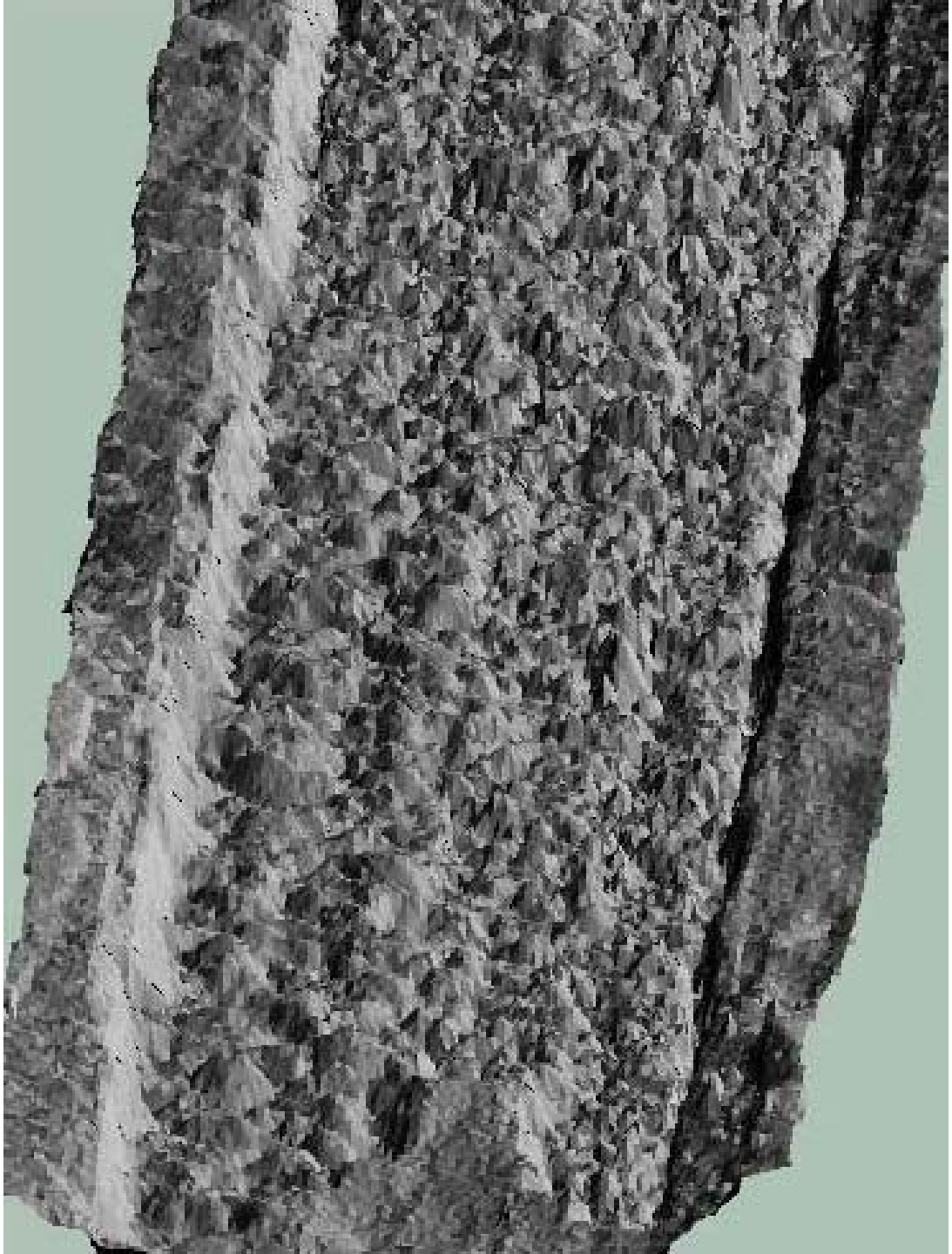
Relates to closeness of the dredge's completed work to the design (project and/or overdepth) grade as determined by an after-dredge hydrographic survey.

Major Factors that Influence Selection of Dredging Plant and it's Inherent Excavation Accuracy

- Physical characteristics of dredged material,
- Physical environment,
- Level of crew skill and effort,
- Quantities/physical layout.

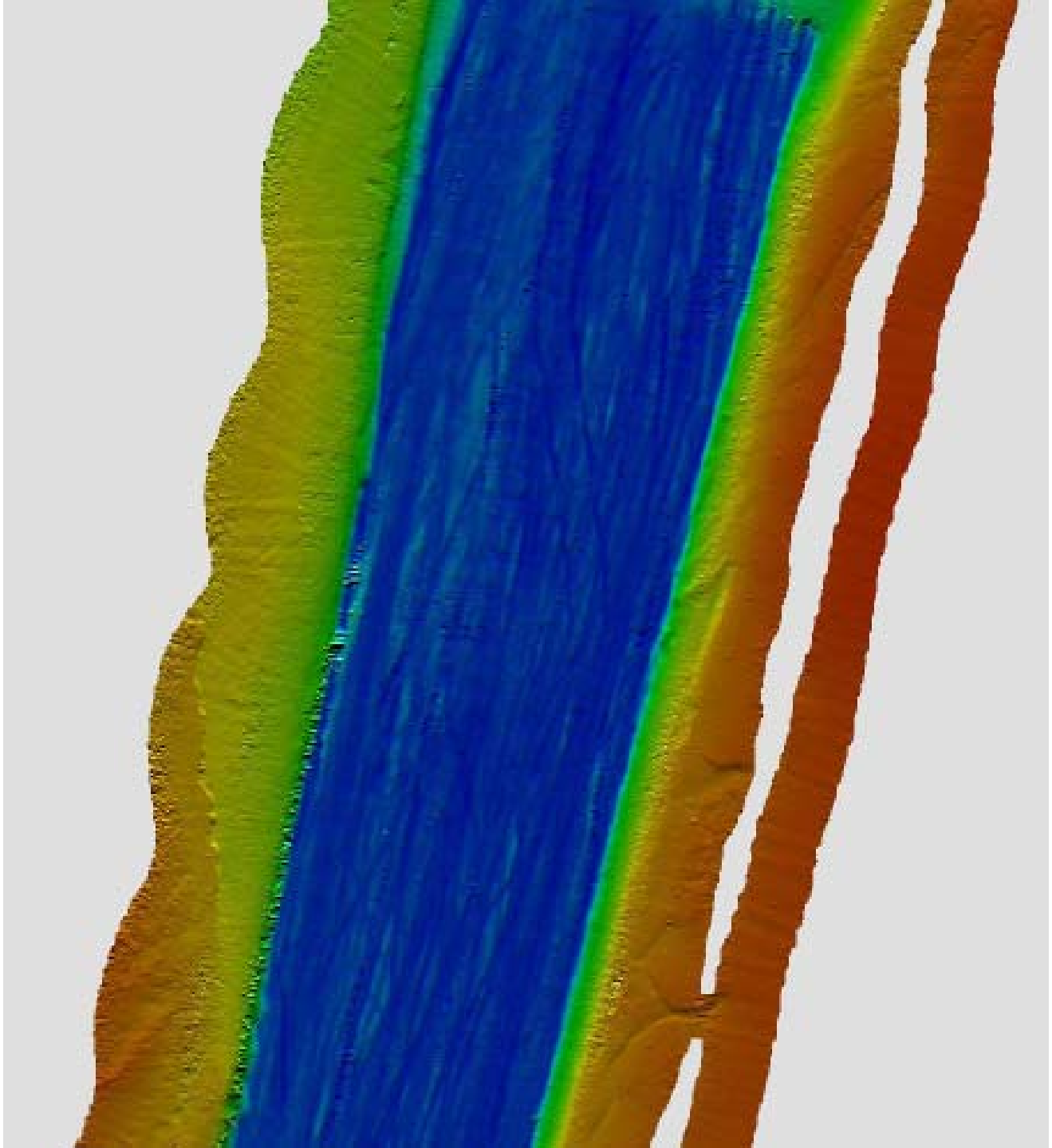
Mechanical Dredges



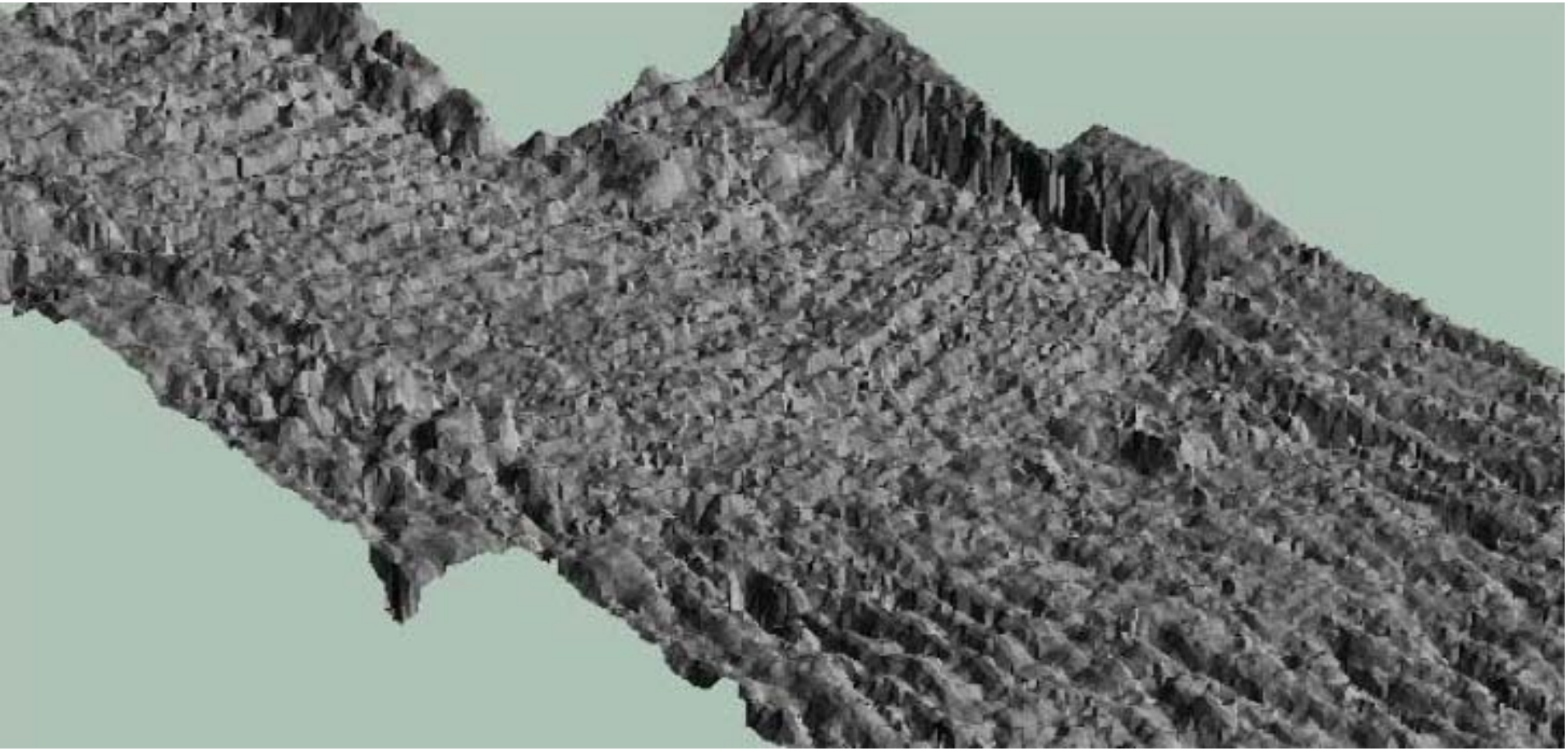


Courtesy of Great Lakes Dredge and Dock

Hopper Dredge



Cutterhead Dredge



Courtesy of Great Lakes Dredge and Dock

Additional Error Components

Hydrographic surveying accuracy is a critical component.

- In sheltered waters typical hydrographic survey accuracies of +/- 0.5 ft are achievable
- As waves increase, so can the motion of the survey vessel
- Water surface's relationship to the dredge datum must be measured (tide gage or RTK)

The dredge often relies on the same methodology for determining the depth of the excavation head.

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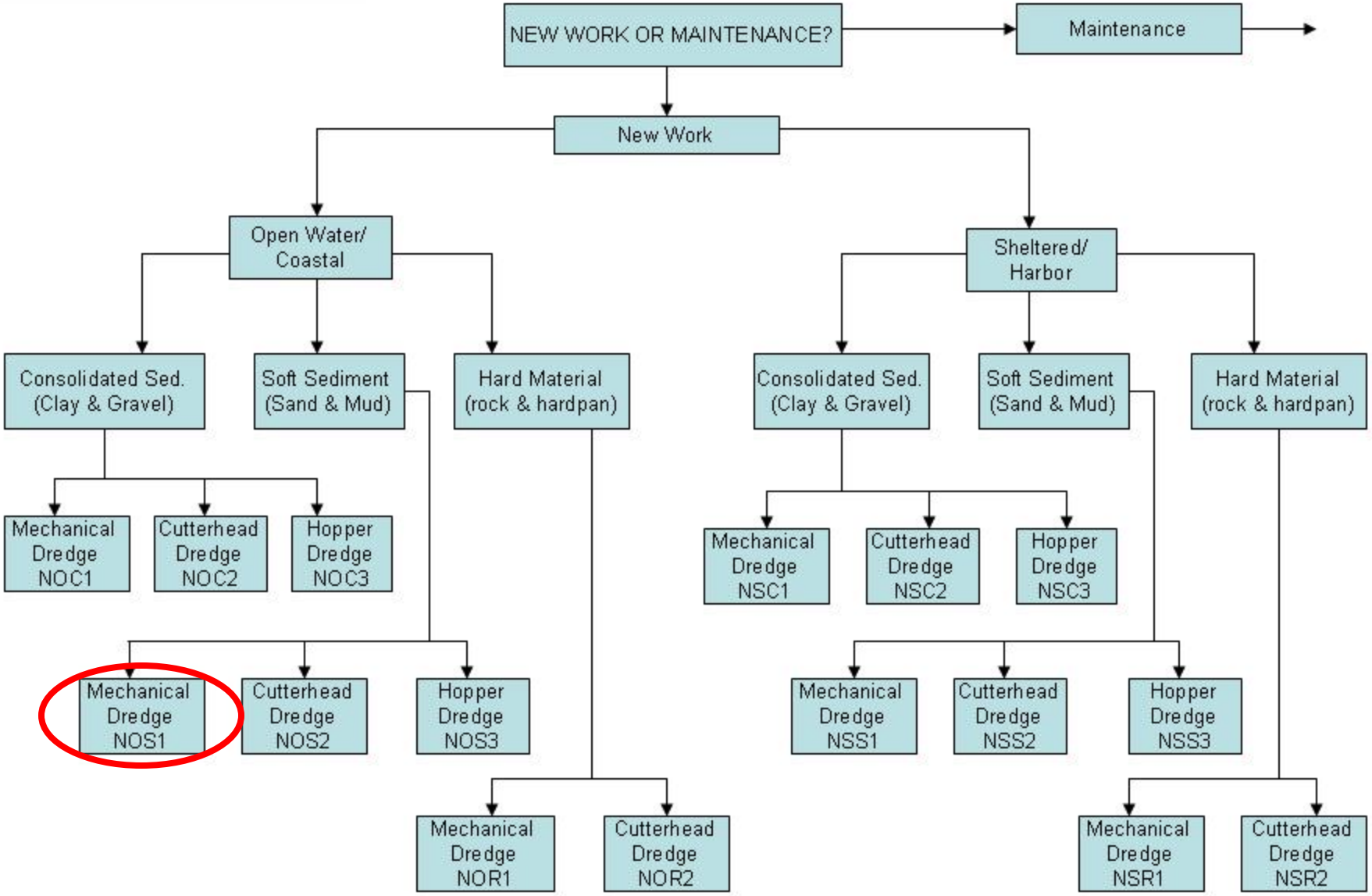


NOS1

Definition: New work dredging of soft dredged materials with mechanical equipment in exposed open-water conditions.

Considerations: Mechanical equipment is not normally used because of significant down time due to rough seas. Soft sediments also tend to move around and shoals shift in some open-water situations.

Expectations: Expect a high degree of inaccuracy in dredging depth, and a very uneven bottom when done. The dredge operator will dredge at least 2 ft below maximum pay depth (with an allowable overdepth of 2 ft) to ensure achieving required grade. If less than 2 ft of allowable overdepth is specified, the dredge operator will dredge at least 4 ft below required depth to achieve grade. However, if the environment is conducive to shifting shoals, expect some infilling to occur in areas already dredged.

Recommendations: Dredged material should be characterized to a depth of not less than 6 ft below required depth. Depending on the severity of conditions found in open water, an additional 1 to 3 ft (or perhaps more in extreme situations) should be added to the recommended characterization depth. See the earlier description of the impacts of severe conditions found in open water on surveying inaccuracies and on the dredge and operator.

Characterization Depth Recommendations

- There is a scarcity of quantitative data to answer questions on dredge excavation accuracies and how to determine adequate characterization depth.
- Recommendations based on current available data, and USACE and Contractor experiences.
- Provided with the understanding that on any given dredging project that the depths characterized may vary by a margin of error of less than a foot or more than several feet.

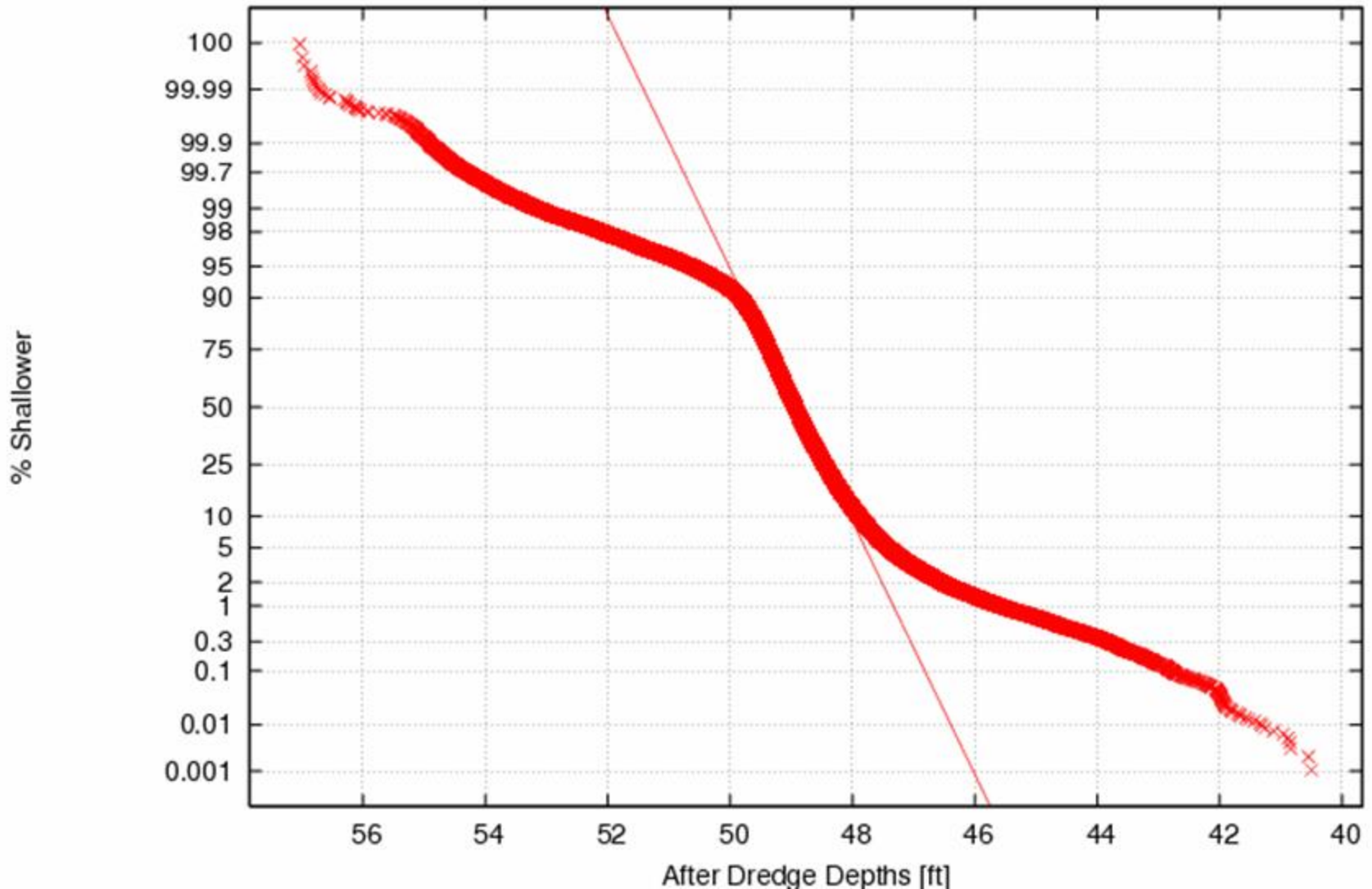
Overdepth Dredging Analysis Tool Data Input

Parameter Selections

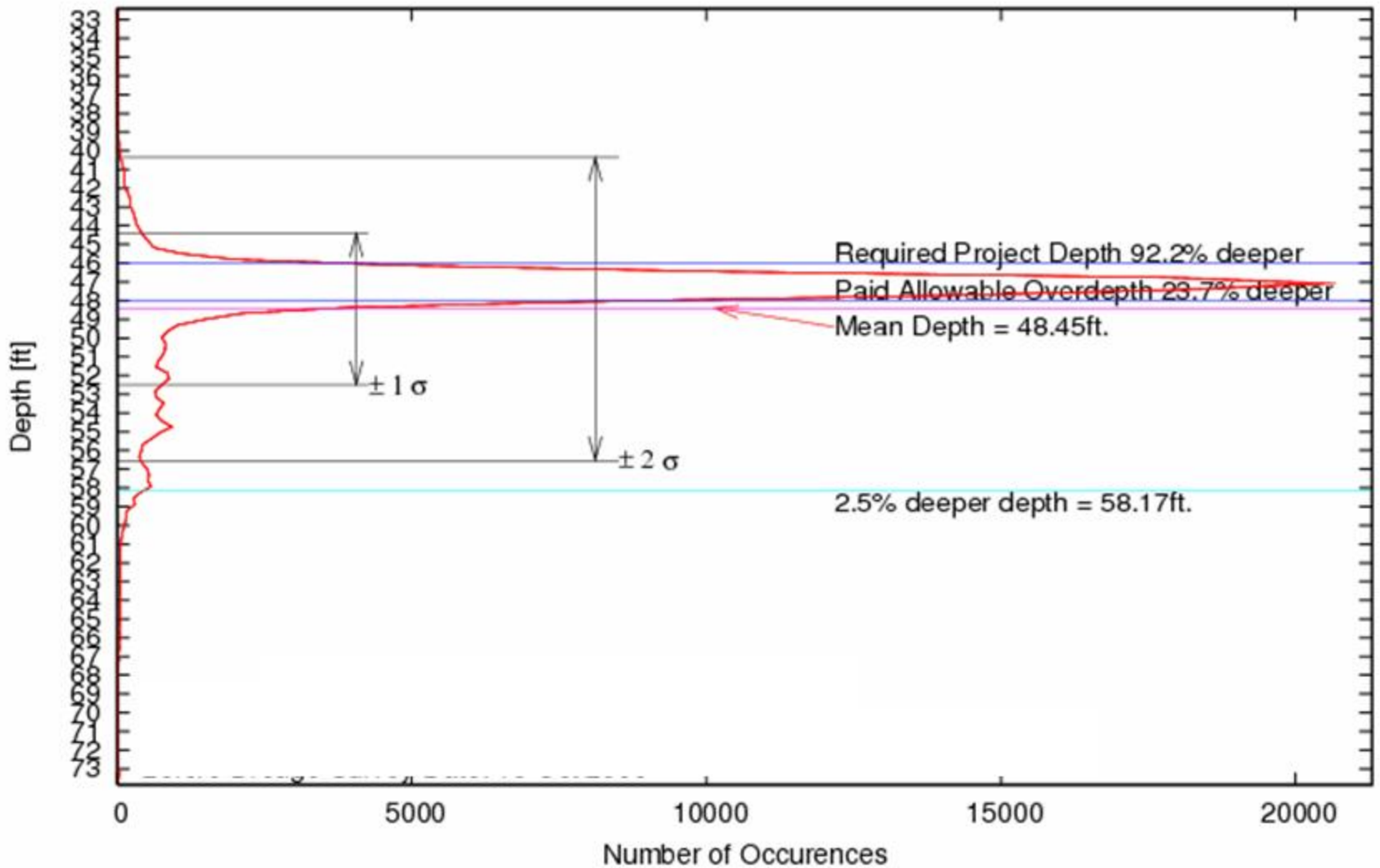
Project Name	Columbia River	Reach (Assignment)	Reach 1
Before Dredge Survey Date	070801	After Dredge Survey Date	070805
Before Dredge Survey Filename	CR-Reach-1-4B	After Dredge Survey Filename	CR-Reach-1-4A
Wave Conditions	Sheltered/Harbor	Bottom Material	Clay
Type of Dredge	Cutterhead		
Type of Dredge Project	Maintenance		

Required Project Grade	40
Paid Allowable Depth	40
Advanced Maintenance Depth	40
Characterization Depth	40

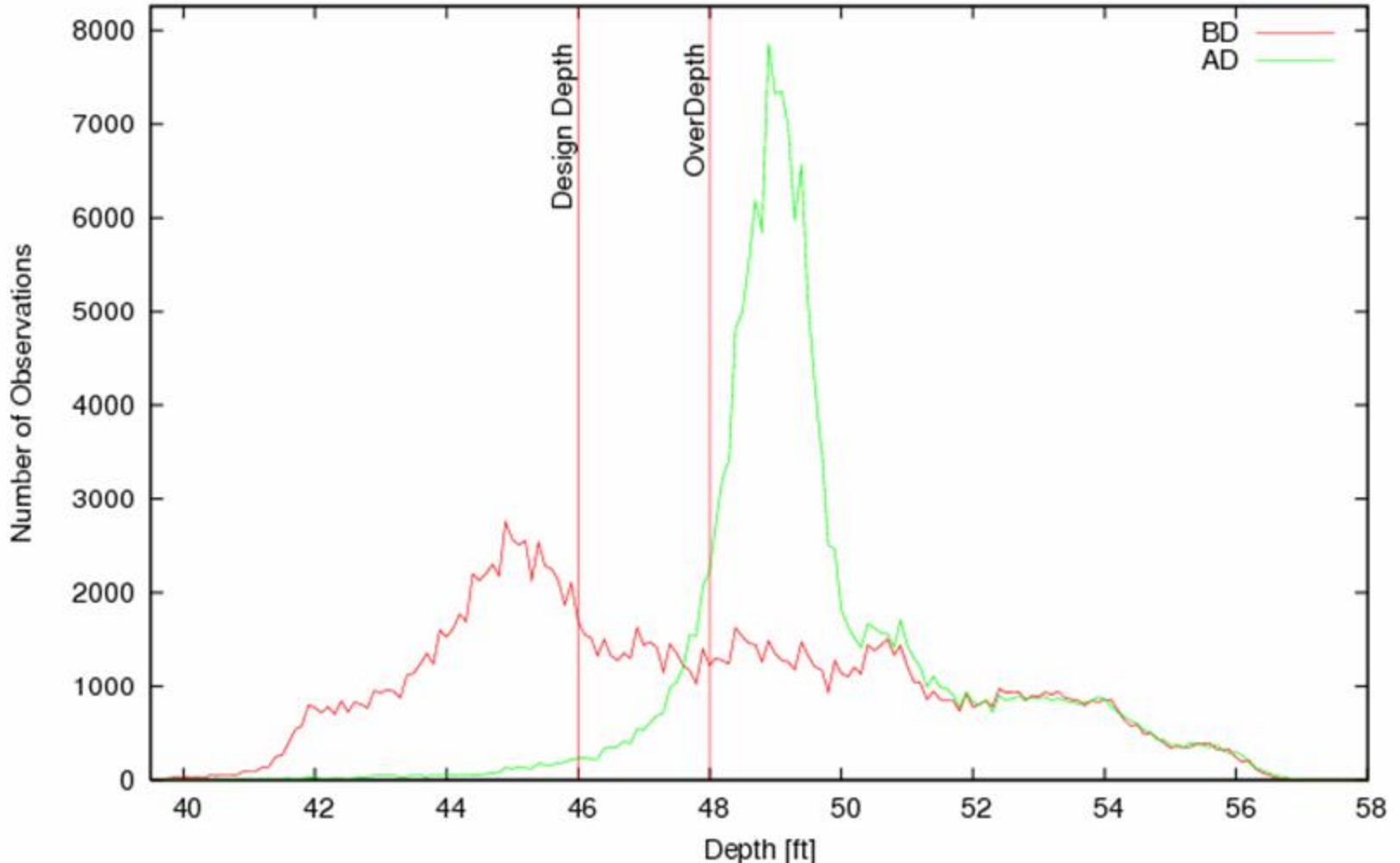
Normal Probability Plot
After Dredging



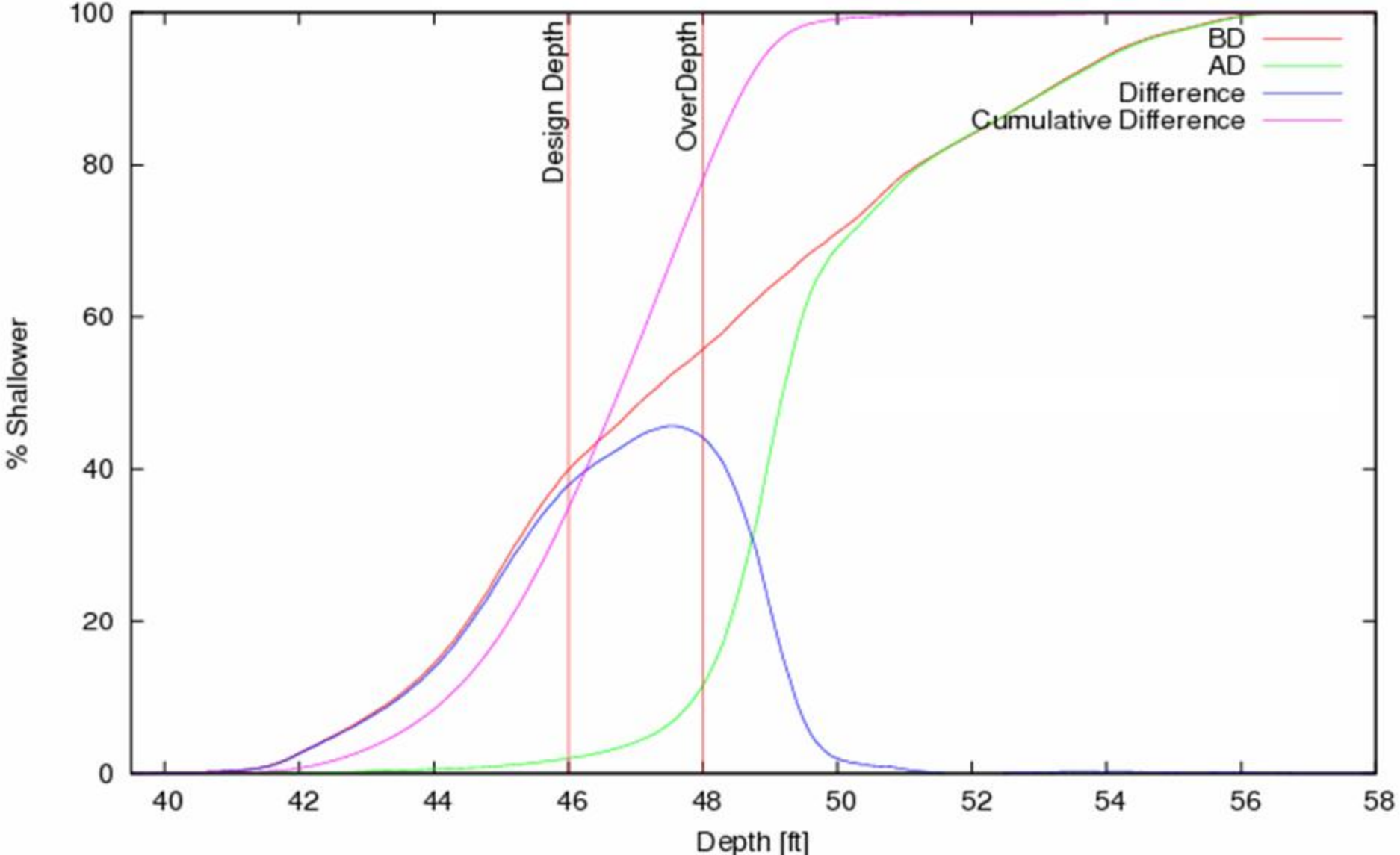
Dredged Material Probability Distribution Function



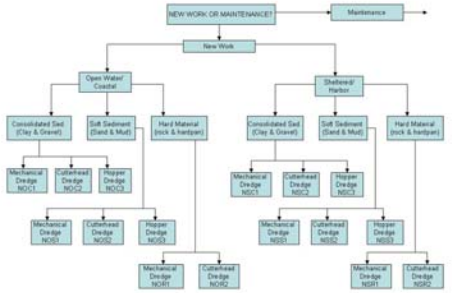
Before Dredge / After Dredge Histogram



Before Dredge / After Dredge Cumulative Distribution



Technology Transfer



- **Quantify different types of dredges vertical construction accuracies.**

- **Tools and guidance documentation to calculate overdepth dredging.**

- **Peer-reviewed journal article.**