San Jacinto River Waste Pits Superfund Site

Comments
of
International Paper Company
and
McGinnes Industrial Maintenance Corporation
on
Environmental Protection Agency Region 6
Proposed Remedial Action Plan

Appendix C

Comments on the United States Environmental Protection Agency's Proposed Remedial Action Plan for the San Jacinto River Waste Pits Superfund Site
by
Ancil Taylor and Craig Vogt

January 12, 2017

Comments on the United States Environmental Protection Agency's Proposed Remedial Action Plan for the San Jacinto River Waste Pits Superfund Site

PREPARED FOR:

INTERNATIONAL PAPER COMPANY

AND

MCGINNES INDUSTRIAL MAINTENANCE CORPORATION

BEAN CONSULTING LLC

619 ENGINEERS ROAD

BELLE CHASSE, LA 70037

ATTN: ANCIL TAYLOR

ATAYLOR@CFBEAN.COM

JANUARY 11, 2017

Comments on the United States Environmental Protection Agency's Proposed Remedial Action Plan dated September 2016

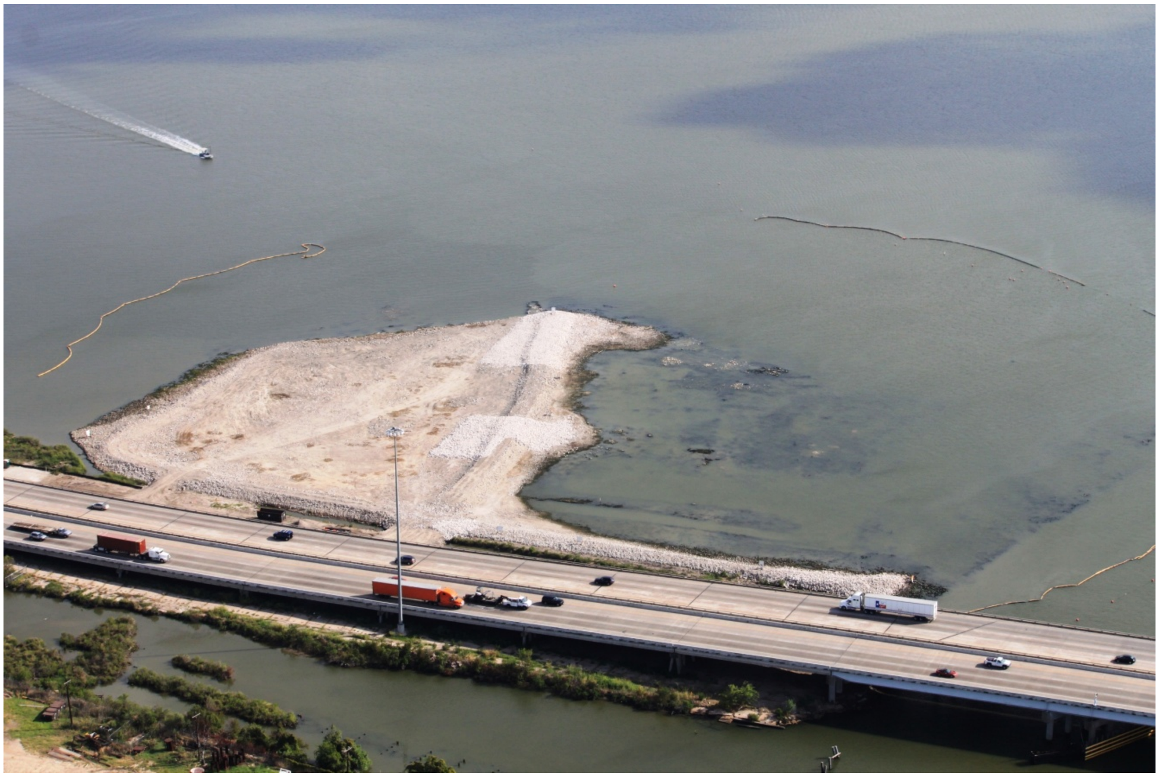

Figure 1. Northern Impoundments

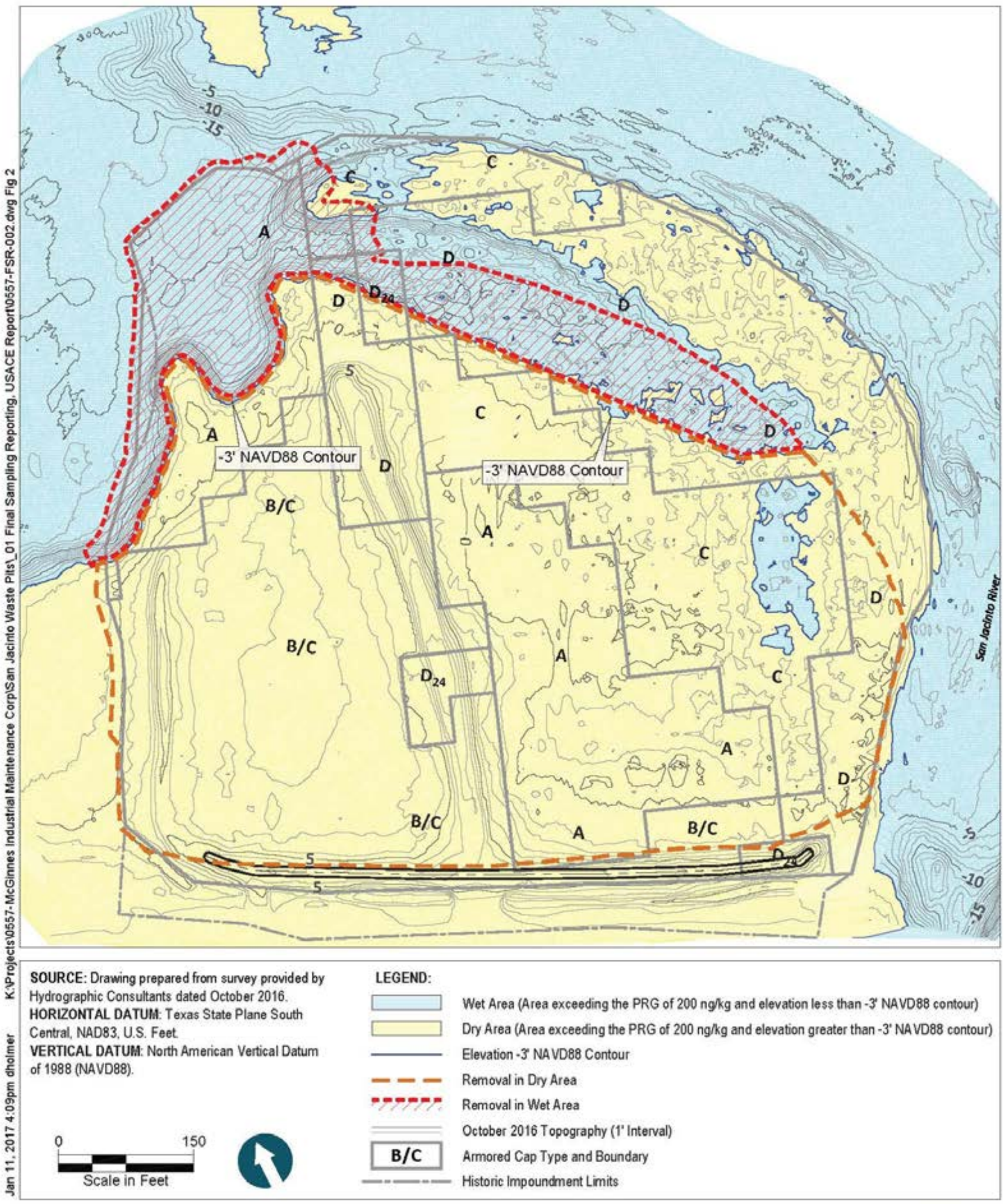

Figure 2. Proposed Plan Removal in the Dry and Wet Areas Using an Approximate -3 Foot NAVD88 Elevation

Contents

List of Acronyms

BCLLC	Bean Consulting Limited Liability Company
BMP	Best Management Practices
ERDC	Engineer Research and Development Center
FS	Feasibility Study
MNR	Monitored Natural Recovery
NAVD88	North American Vertical Datum of 1988
PPE	Personal Protective Equipment
PRAP	Proposed Remedial Action Plan
SJRWP	San Jacinto River Waste Pits
TCRA	Time Critical Removal Action
USACE	United States Army Corps of Engineers

Executive Summary

Fundamental to the EPA's selection of preferred Alternative 6N is EPA's conclusion that "This alternative will utilize Best Management Practices to reduce and control the re-suspension of waste material and sediment (PRAP, page 28)." EPA's position is very misleading. The reality is that Alternative 6N will result in much higher levels of releases of resuspended waste materials and residuals than EPA estimates. In addition, EPA ignores or minimizes the challenges to implementing Alternative 6N and of removal of an existing engineered armored cap and underlying waste material (itself something that has not previously been attempted).

- EPA's approach to best management practices (BMPs) is to presume now and later determine how effective BMPs will be during Remedial Design. Describing a BMP in the Proposed Remedial Action Plan (PRAP) and tagging it with *if practicable, if necessary,* or *if feasible* means that EPA does not know whether the identified BMPs will actually work or are implementable to control release of dioxin/furans and other contaminants into the San Jacinto River.

- EPA's seemingly simple and theoretical approach to remove the rock cap and geotextile is technically flawed. There is no precedent for removal of an engineered armor rock cap and the underlying geotextile. As stated by Dr. Todd Bridges, the U.S. Army's Senior Research Scientist for Environmental Science and Director of the Center for Contaminated Sediments at the Engineer Research and Development Center (ERDC) with respect to the proposed removal of the rock cap and geotextile at the Site, "*It's never been done. It will result in a huge mess of turbidity, re-suspended sediments, and residuals"* (Dr. Bridges, Personal Communication, November 2016). ERDC is the U.S. Army Corps of Engineers (USACE) Center that performed the evaluation of the remedial alternatives for the Site on behalf of EPA Region 6. EPA has not demonstrated an understanding of the technical challenges (e.g., underwater removal of the rock, how to peel back the rock and geotextile to install sheet pile, how to remove the geotextile from the entire site, how to pick it up without creating a large dispersion of residuals and suspended sediments, how to remove the cap and geotextile in small sections, and how to deal with the cement used to treat and stabilize the waste in the western area) nor evaluated the environmental ramifications associated with the actual removal of the cap and geotextile.

- Even if EPA's assumptions about the effectiveness of BMPs were supportable (which they are not), EPA has significantly underestimated resuspended levels of dioxin/furans and residual levels of dioxin/furans from excavation and dredging and application of BMPs. EPA underestimated the releases from a number of sources and, more importantly, did not consider at least two additional major sources of releases for this project: (1) It is estimated that about one half of the dredge's buckets will come to the surface blocked open with rocks from the cap, releasing the wastes back into the water column; and (2) ancillary vessels such as tug boats and service boats cause significant propeller wash and erosion of bottom sediments, resulting in large amounts of resuspended sediments.

The USACE estimated releases of dioxin/furans to the San Jacinto River from Alternative 6N was 2.0-2.37 grams, which is 0.34% of the total dioxins/furans to be removed from the pits. By just considering the additional releases from blocked open buckets spilling their contents, the total released to the San Jacinto River from dredging in the Northwest Area and the deep water portion of the Eastern Cell would be 32 grams, which is greater than 5% of the dioxins/furans in the pits. The actual releases will be substantially higher due to other sources not considered in the evaluation.

<u>The Short Story: Rocks from the Cap versus Mechanical Dredging in the Wet</u>

- When the geotextile is removed, any remaining armor rocks on top of geotextile will sink into the wastes below.
- Rocks block open dredging buckets.
- Dredging of the waste pits would likely result in one half of buckets blocked open, losing much or all of the dredged waste in the bucket to the water column.
- Losing the waste from half the buckets in the Northwest Area and the deep water of the Eastern cell would mean that 32 grams of dioxins/furans (i.e., >5% of the total to be removed) would be resuspended into the water column and released to the San Jacinto River.

The result of EPA's "to be determined later" approach to BMPs and inadequate assessment of resuspension and residuals is a fundamentally flawed assessment of risks and prediction of the short and long term impacts of Alternative 6N.

The USACE stated that *Alternative 6N would "still" <u>set back the natural recovery of the site to existing conditions by up to a decade</u> considering the time required for design, construction and assimilation of the releases into the sediment bed below the bioactive zone* (USACE 2016 page 5). Importantly, this statement does not take into account the additional significant sources of resuspended contaminants and residuals that were not adequately considered in the release calculations, i.e., releases from dredging and auxiliary vessels, geotextile removal, more dredging passes, and loss of residuals under silt curtains. If these releases were adequately addressed, how many more decades would the recovery be set back?

EPA has not adequately identified and evaluated the implementation challenges associated with Alternative 6N. To assess whether the project is practicably constructible and whether EPA's cost estimate and schedule reflect the potential complexity and challenges associated with its implementation, much more information is needed on BMPs, including descriptions of where proposed sheet piles will be installed.

Attempted implementation of Alternative 6N will result in an extended construction time line due to several real-world implementation issues:

- Due to the ambiguous identification of the proposed BMPs and their location, the constructability of Alternative 6N cannot be determined. These are critical to understanding the technical feasibility of 6N, the extent of impacts to the San Jacinto River, and the costs. These are not areas for research and development at the Remedial Design stage. If they don't work, that would mean that Alternative 6N has been selected and justified on a faulty basis.

- The anticipated schedule appears to be set based upon installation of BMPs as stated in the PRAP, except without considering any of the questions regarding "where feasible," "if practicable," or "as appropriate." If just one of the many assumed BMP applications about the site is not feasible or practicable, what happens then? Redesign, reorder equipment, get new approvals, and try something else? These take time and effort, and there appears to be no contingency built into the 19 months listed in the PRAP as the construction period (PRAP, page 28).

- More time to conduct the dredging will be needed, given the smaller bucket size, the additional dredging passes, and the increased number of bucket loads (due to blocking open by armor rocks), as will be discussed further in this report.

- Excavation in the dry is a misnomer for this project. For example, excavation of the first two feet or so in the Western Cell will be in the dry, being above the river level. Below that level, the wastes will start to become water logged and saturated. Pumps will attempt to dewater the wastes, and keep up with the seepage through the sheet piles, but the wastes will remain saturated. The other source that will keep the wastes in a wet condition is the seepage from upwelling from below the waste pits. The depth of the wastes in the pits was estimated to be 10 feet (USACE 2016, page 99).

> The excavation dynamics in the "dry" section will be very similar to the experience we have all had when we go to the beach and attempt to excavate a hole down a foot or so and it simply caves in because of the water table.

- Excavation of this waste will initially be accomplished by bulldozers and dry land excavators, but as the removal gets deeper, the removal will likely need amphibious vessels that can work in the muck and mud.[1] As the waste material is removed from the deeper depths, the ability to effectively dewater the site becomes more difficult. In order to continue operations, the equipment will need the capability to work in both flooded and semi dry conditions. This is a real complicating factor, resulting in extra time and cost working in and attempting to remove the muck (i.e. the saturated waste materials), and will result in serious construction issues including impacts on the schedule. While amphibious equipment provides the ability to operate under more adverse conditions, it is less productive. This very time intensive work will result in the disturbed waste being exposed for long periods of time even if the armor cap and geotextile are removed in sections.

- Transport of 13,300 to 17,500 truck loads of dioxin/furans wastes through crowded neighborhoods and a highly populated county (Harris County) on the way to the disposal site (undetermined at this point) will result in transportation safety issues and environmental threats.

- What is the impact of safety and personal protection gear on project efficiency and schedules? This was not addressed in EPA's timeline.

- Storms and flooding events are also not adequately considered in the EPA's 19 month construction period. No doubt, no crystal ball exists to predict the weather, but the USACE considered storms to be a real threat during construction. The USACE suggested that construction only occur during the off-season for hurricanes and tropical storms, i.e., when there is a lower probability of tropical storms and flooding conditions (USACE 2016, page 186). Due to the

[1] These are excavators that can essentially float on top of the muck without getting stuck.

many implementation issues, the disturbed waste will be exposed for longer periods of time than contemplated by EPA.

Please note, that comments in this report that refer to "dredging" mean removal that is conducted in the wet. "Excavation" refers to removal in the "dry."

For clarity, regarding the comments in this report, Table 1 provides a summary of the sources of releases of resuspended sediments and residuals for excavation in the "dry" and dredging in the wet. More detailed discussion on these sources and releases is presented in this report.

Table 1. Sources of Releases

Sources of Resuspended Waste Materials and Residuals		
Source	**In the "Dry"**	**In the Wet**
Armor Rock and Geotextile Removal	X	X
Sheet Pile Installation	X	X
Sheet Pile Removal	X	X
Dewatering Waste Materials	X	X
Dewatering Waste Pits to Operate in the "Dry"	X	
Risks of Spillage from Barging to Off-loading Site and Trucking to the Landfill	X	X
Blocked Dredging Buckets by Armor Rock Spilling Wastes into Water Column		X
Increased Number of Dredging Passes: Smaller Buckets and Blocked Buckets		X
Resuspension from Auxiliary Vessels		X
Silt Curtains		X

Introduction

The objective of this report is to provide comments on EPA's Proposed Remedial Action Plan for the San Jacinto River Waste Pits Site in Harris County, Texas (PRAP) (USEPA September 2016). These comments focus on the ambiguous identification of BMPs, the materially underestimated releases of dioxin/furans to the San Jacinto River during underwater removal of the cap and geotextile and excavation/dredging of the waste material, and the practical and engineering constructability challenges of full removal of the wastes in the pits, either in the "dry" or in the wet. Of particular importance is EPA's vague, and unsubstantiated, hope that nearly three-fourths of the removal action can be achieved in the dry, without dredging.

Experience of Bean LLC and Craig Vogt Inc.

Mr. Ancil Taylor has more than 38 years of experience in the field of dredging and related marine activities. This experience involves a broad range of equipment and project types, including the application of dredging to environmentally sensitive projects. Mr. Taylor is the Vice President of Bean Consulting LLC (BCLLC), a seven-year-old subsidiary of C.F. Bean, LLC (BEAN) headquartered in Belle Chasse, Louisiana. BEAN traces its history back to the 1930's originating in south Louisiana as a full service dredging contractor. With more than seventy years of operations accomplishing more than $1.7 billion of contracting across the globe in virtually every aspect of the dredging and related marine industry, BEAN brings a wealth of experience into its consulting capacity. This portfolio includes coastal restoration, marsh renourishment/creation, and navigation, capital improvements in ports and waterways and sensitive environmental dredging challenges. Much of that experience has been gained along the Gulf Coast for the United States Army Corps of Engineers in the Mobile, New Orleans, Galveston and Jacksonville Districts along with numerous local public and private entities. Mr. Taylor designed, patented and implemented dredging solutions for one of this nation's largest Superfund sites, Bayou Bonfouca (see Appendix D for the resume' of Ancil Taylor).

Craig Vogt is a former USEPA environmental engineer who for 20 years was Deputy Director of EPA's Ocean and Coastal Protection Division at EPA headquarters, following which he initiated Craig Vogt Inc, Environmental Consulting on Coastal and Ocean Issues.

Craig Vogt Inc. provides environmental consulting for regulatory and non-regulatory issues dealing with a wide range of ocean and coastal environmental issues. Issues include such areas as dredging and dredged material management, sediment management, and beneficial use of dredged material; mine tailings pipeline transport and marine disposal; port-related activities; cruise ship environmental issues; coastal watershed environmental management; and coastal and wetlands restoration. Prior to consulting, Craig Vogt was employed at U.S. EPA from 1971-2008 as an environmental engineer, the last 20 years of which were in EPA headquarters as Deputy Director of EPA's Ocean and Coastal Protection Division. Responsibilities included regulatory and non-regulatory programs for ocean and coastal water protection with a focus upon dredged material management. Mr. Vogt co-chaired the interagency National Dredging Team from 1995 to 2008, the objective of which was to resolve issues among U.S. agencies on dredged material disposal (see Appendix E for the resume' of Craig Vogt).

Available Background Information

BCLLC was asked to review EPA's proposed remedial alternative for the so-called Northern Impoundments and aquatic area, Alternative 6N. The PRAP provides a brief description of the San Jacinto River Waste Pits Site. (PRAP, p. 1) A more detailed history of the areas within the EPA's Preliminary Site Perimeter, its environmental setting, and land uses are provided in the RI Report (Integral and Anchor QEA 2013). The Northern Impoundments are the waste impoundments located just north of the I-10 Bridge at the Site. (*See* Figure 1.)They were the subject of a Time Critical Removal Action (TCRA) in 2011, as a result of which an engineered armored cap was constructed over the Northern Impoundments. The documents that were reviewed include those listed in Appendix C. A site visit was conducted on Thursday, October 13, 2016, of the TCRA armored cap and the surrounding area to better understand the location of the Northern Impoundments and surrounding infrastructure.

Organization of this Report

The report summarizes EPA's preferred alternative, Alternative 6N. The report presents the following topics:

- Our understanding of EPA's preferred alternative.
- Our assessment of constructability, implementation and contaminant release issues associated with the preferred alternative.
- Our concerns with EPA's evaluation of Alternative 6N.
- Our review of USACE's prediction of contaminant releases to the river.
- Our summary of our assessment of EPA's preferred alternative.

Five appendices support our assessment:

- Appendix A provides the list of references used in this report.

- Appendix B provides a brief overview of mechanical and hydraulic dredging as well as dredged material management.
- Appendix C lists the documents reviewed.
- Appendix D provides Ancil Taylor’s resume.
- Appendix E provides Craig Vogt’s resume.

EPA's Preferred Alternative

This section describes EPA's preferred alternative, Alternative 6N, and discusses the major elements of working in the "dry" and working in the wet at the Site.

Description of Alternative 6N

EPA's preferred approach is Alternative 6N. As stated in the PRAP, Alternative 6N includes: removal of waste materials exceeding cleanup levels, monitored natural recovery (MNR), and institutional controls. The EPA estimates of cost and time to completion are the following:

- Estimated Capital Cost: $77 million
- Estimated In-Direct and Operation & Maintenance Cost: $10 million
- Estimated Total Present Value Cost: $87 million
- Estimated Construction Time: 19 months

Extracted directly from the EPA PRAP, Alternative 6N includes the following description:

> *This alternative involves the removal of all waste material that exceeds the Preliminary Remediation Goal of 200 ng/kg regardless of depth in the northern waste pits. Sheet piles will be used around all areas to be removed to reduce resuspension of the waste material. Monitored Natural Recovery (MNR) will be used for the sediment in the sand separation area. This would involve removal of the majority of the existing armored cap and the removal of 152,000 cubic yards of material. Alternative 6N includes Best Management Practices recommended by the Corps of Engineers.*
>
> *This removal alternative will utilize Best Management Practices to reduce and control the re-suspension of waste material and sediment. While the Best Management Practices identified below were recommended by the Corps of Engineers and were used for costing purposes, the final use and design of Best Management Practices will be determined during the Remedial Design. The Best Management Practices may include, but are not limited to, the following:*

- *The removal will be completed in stages or sections as appropriate to limit the exposure of the uncovered sections of the waste pits to potential storms.*
- *Raised berms and sheet piles in addition to dewatering and removal in the dry where feasible will be used to reduce the re-suspension and spreading of the*

removed material.

- *The berms would be armored on both sides with armor material removed from the areas that have geotextile present.*
- *Approximately three-fourths of the waste material will be excavated in the dry behind sheet pile walls. An excavation dewatering and water treatment system will operate on any day of excavation.*
- *Residual concentrations of contaminants following excavation and removal will be covered by at least two layers of clean fill to limit intermixing of residual material with the clean fill.*
- *Removal of submerged waste materials in the Northwest area will include isolation of the work area with berms/sheet piles if practicable.*
- *Excavated waste material would be dewatered (decanted) and stabilized by addition of Portland cement or other additive at the offloading location, as necessary, to eliminate free liquids for transportation and disposal. Some operations, such as water treatment, may be barge mounted. In the Northwest area only, the residual concentrations of contaminants following excavation and removal will be covered by at least two layers of clean fill to limit intermixing of residual material with the clean fill, and armored. The protective berms will be left in place after construction to provide a barrier, limiting barge and boat traffic over the site. Institutional controls will be used to prevent disturbance of the sediment residuals below the residual cover layers.*

This alternative entails removal of approximately 152,000 cubic yards of waste material from the waste pits footprint, which would require a relatively large offloading and waste material processing facility to efficiently accomplish the work. Additional activities would include management and disposal of dewatering effluent, including treatment if necessary. Material that is removed would be transported in compliance with applicable requirements and permanently managed in an approved permitted facility cleared by the Environmental Protection Agency's regional offsite rule contact. Approximately 13,300 truck trips may be required to transport the waste material to the off-site approved permitted facility; however, capacity of roads to handle the loads will impact the truck size that can be used. The method of transportation and number of trips will be determined during the Remedial Design, as well as other transportation alternatives, including rail transport. The material will require dewatering by removal and/or treatment so that there are no free liquids.

The PRAP, page 28, states "*Excavated waste material would be dewatered (decanted) and stabilized by addition of Portland cement or other additive at the offloading location, as necessary, to eliminate free liquids for transportation and disposal. Some operations, such as water treatment, may be barge mounted. An excavation dewatering and water treatment system will operate on any day of excavation*." At page 29, the

PRAP states "*Additional activities would include management and disposal of dewatering effluent, including treatment if necessary*."

The PRAP (page 29) also states that a number of institutional and engineering controls would be implemented, stating that these controls would essentially be permanent measures.

Description of Removal Actions in the "Dry" and in the Wet

Alternative 6N envisions removal of the armor cap and underlying waste from two distinctly differing environments. EPA describes removal in the "dry" as removal of the waste in the portions of the site that may be within a sheet pile wall. The USACE Report (USACE 2016, page 132) suggested the wall alignment may follow the -3.0 foot contour and encompass three quarters of the waste on the site. This is depicted in Figure 2. The balance of the armor cap and underlying waste would come from outside of the sheet pile wall and from water depths mostly in excess of 10 feet. The application of excavation and dredging technology is envisioned for the removal activity, depending upon whether removal is in the dry or in the wet. Both of these settings - wet and "dry" - involve people and equipment engaging with the physical removal process at various phases of the remediation. These phases include:

- Site characterization
- Mobilization and Site preparation
- Installation of BMPs
- Execution
- Demobilization

Each of these phases requires the interruption of the undisturbed in-situ condition of the armor cap and the underlying waste by people and equipment. The degree to which this interruption occurs varies with the phase and the risk of release is a function of the type of engagement or involvement with the armor cap and sediments or waste.

Site Characterization

The first phase, site characterization, involves the mobilization of positioning and soil sampling equipment. It requires the crews to establish acceptable protocols for personal protection and proper handling of the waste that are sampled and removed during the soil sampling procedures. Sampling is required to more completely characterize geotechnical conditions of the material to be removed. The existence of the armor cap presents extraordinary challenges for conventional mobile sampling equipment. Penetration of the armor cap and geotextile will require substantial and robust equipment to traverse the upland undulating armor cap. Transitioning from the upper elevations of dry land to and through the tidal zone and into the deeper water will require two more types of testing equipment setups, i.e., support vessels and equipment. Needed will be an amphibious setup (commonly called the spread), capable of working in water depths of 0 to 4 feet and a marine based setup, capable of working in 4 to 15 feet of water. Whether land based, amphibious, or marine based, the testing protocols will involve removal of contaminants from beneath the armor cap if penetrable, which poses a risk of human exposure.

Mobilization and Site Preparation

After the site has been characterized and the construction implementation plan is completed, mobilization of the initial site facilities, such as site management offices, truck manifest and equipment decontamination facility, parking and security, environmental protection BMPs (such as controls for fugitive dust) will begin, along with the site preparation. Equipment and personnel on land will begin a more expansive engagement with the site to ready the site for remediation. Equipment and personnel that will be working in the exclusion zone(s) will require an area where contaminants can be removed from clothing and equipment surfaces. These decontamination facilities will reduce the migration of contaminants from the site and will require water handling and treatment. The decontamination facilities will be located on the perimeter of the exclusion zone(s).

This phase will also involve the preparation for sheet pile wall installation. The preparation of the site along the alignment of the sheet pile wall to accommodate the large equipment that will be required to drive the sheet pile will depend upon the site specific conditions along the alignment. Preparation for removal of the armor cap and geotextile will be necessary. Locating the appropriate areas where the armor cap and geotextile will be temporarily stored to limit collateral contamination is important. This removal effort will likely occur in the amphibious zone of the site where water depths are approximately 4 feet along the -3.0 feet contour. It will also occur along the alignment surrounding the Western Cell, where elevations are about +2.0 feet.

Installation of BMPs

The next phase, BMP installation, will include removal of the armor cap and the underlying geotextile in the locations where BMPs will be installed. That action will include penetration into the waste. This specific construction area will become an exclusion zone requiring a higher level of personal protection equipment (PPE) to engage with the sediments.

Execution

The execution phase in the "dry" includes the movement of mechanical excavation equipment, trucks, bulldozers, and other associated support equipment across the site to perform the excavation phase. Amphibious excavation equipment will continually cast waste to be loaded on transport equipment to ultimately be moved off-site. Temporary stockpiling of the armor cap, geotextile, and underlying waste will likely occur on the remediation site prior to transport off-site. Surveying, geotechnical sampling and confirmatory testing will be occurring continuously within the exclusion zone(s). Movement of water around the site will be a continuous operation. Water from the waste, storm water, seepage through the sheet piles, and upwelling from ground water will require handling and treatment. Drainage and removal of water from the ponding areas within the sheet pile wall will require pumps and piping to a water treatment facility. As the bathymetry of the site will be continuously changing with the excavation, these facilities will require continuous modifications and protection from the traffic on the site.

Constructability, Implementation and Associated Contaminant Release Issues with EPA's Preferred Remedial Alternative

This section focuses on the constructability, implementability, and associated contaminant releases that will occur if EPA's preferred remedial alternative is implemented. The following issues are presented in this section:

- Construction concerns and environmental impacts of removal operations in the dry
- Construction concerns and environmental impacts of removal operations in the wet
- Environmental releases from auxiliary and ancillary equipment needed to implement EPA's preferred remedial alternative that were not considered by EPA
- Environmental impacts that will happen when storms occur during the extended time period of implementing EPA's preferred remedial alternative
- Dredging efficiency impacts from the required safety measures with EPA's preferred remedial alternative that were not considered by EPA
- Challenges of handling the significant amount of dredged material generated by EPA's preferred remedial alternative
- Significant concerns with the inadequately developed construction schedule for EPA's preferred remedial alternative
- EPA's ill-defined BMPs and significant releases to the river
- Summary of constructability concerns and environmental impacts of EPA's preferred remedial alternative

Construction Concerns and Environmental Impacts of Removal Operations in the "Dry"

Removal operations in the "dry" require the removal of the armored cap and underlying geotextile, installation of sheetpiles, water management during "dry" work, management of excavated materials, management of residuals, and removal of sheetpiles. In Alternative 6N, excavation in the "dry" is proposed for the Western Cell and the shallow water portion of the Eastern Cell.

General Considerations related to Excavation in the "Dry"

Excavation in the dry is a misnomer for this project. For example, sheet piles are proposed to be placed around the Western Cell. Excavation of the first two feet or so, will be in the dry, being above the river level. Below that level, it will start to become water logged and saturated. Pumps will attempt to dewater the wastes, and keep up with the seepage through the sheet piles, but the result in terms of "dry" wastes is unknown. They will remain saturated. The other source that will keep the wastes in a wet condition is the seepage from up-welling from below the waste pits. The depth of the wastes in the pits was estimated to be 10 feet (USACE 2016, page 99). For the shallow waters of the Eastern Cell, there will be no "dry" wastes, as the wastes are below river water level, and subject to the same leakage and upwelling factors as the Western Cell.

While suggesting that the sheet piles could be installed in such a manner to facilitate sealing joints to reduce potential leakage through the walls, the USACE recognized this implementation issue: "*The seepage through walls and the foundation pose large uncertainties in the implementability of excavation in the dry*" (USACE 2016, page 112).

Excavation of the material in the Western Cell will initially be accomplished by bulldozers and excavators, but as the removal gets deeper, the removal will likely need amphibious vessels that can work in the mud and muck. This is a real complicating factor, given the relative difficulty of working in muck and mud with amphibious vessels which will take more time and is much more challenging in moving equipment around the site and removal of wastes compared to excavation by bulldozers and dry land excavators.

Cap and Geotextile Removal

The USACE recommended removal of the cap rocks and peeling back the geotextile to allow the sheet pile to be installed:

> *Instead, it is recommended that a portion of the rock armor be removed from the sheet pile footprint, and the geotextile or geomembrane cut and peeled back to avoid damage or shifting during sheet pile installation* (USACE 2016, page 121).

Further, to access the capped wastes for removal, the USACE recommended removing the cap rocks and then removing the geotextile entirely before starting excavation (USACE 2016, page 118), unless sheet pile containment walls are not to be used:

> *In these circumstances* [where sheet pile containment walls are not used]*, it would be advisable to perform the removals in small sections at a time such that*

> *the armor stone and geotextile within the small section would be removed, and then the sediment removed and a thin layer of sacrificial fill placed before advancing to the next section and repeating the process* (USACE 2016, page 186).

Not directly taking the above USACE advice, EPA stated in the PRAP that sheet piles would be used around all areas of waste removal, and added that the *removal will be completed in stages or sections as appropriate to limit exposure of the uncovered sections of the waste pits to potential storms* (PRAP, page 28).

Removal of the rock and geotextile will not be a simple action, given the water environment. EPA assumed in its selection of Alternative 6N that geotextile removal will be a straightforward effort; EPA did not appreciate or factor into the release analysis the complexities and difficulties of such an effort.

It is unclear how USACE addressed installation of sheetpiles in the areas where work is proposed to be conducted in the "dry". The issue here is that removal of the rocks and geotextile will not be a simple "grab and go" operation. As explained below, removal of the geotextile will result in releases of contaminants beyond those considered by the USACE.

Sheetpile Installation

The construction effort associated with segregating the dry excavation from the wet excavation in itself presents a significant risk to the surrounding environment primarily due to the existence of the armor cap. Layout of the sheet pile alignment along the -3.0 foot contour and around the Western Cell will require the removal of the armor cap and its underlying geotextile in the water. During the installation, these areas will be subject to erosion of contaminants from storms and high water.

Turbidity, resuspension and residuals resulting from this marine based operation cannot be practically contained; silt curtains would be the only possible control, and as discussed later in this document, EPA considers silt curtains to be essentially useless at this site. Even with silt curtains, currents from tidal movement allow the sediment to simply move around the site unabated. Therefore, any released contaminants will not be contained.

Water Management

Construction efforts on the "dry" side of the sheet pile wall are considered amphibious based, except for about the top two feet of waste removal. Below that, the wastes will be saturated, needing special amphibious equipment for removal of wastes. These are excavators that can essentially float on top of the muck (i.e., the saturated waste) without getting stuck. The site must be prepared to utilize equipment that can excavate and operate in flooded conditions. As much of the material will be removed from below the water surface in shallow waters, the excavation effort cannot be limited to working in dry conditions only. Dewatering of the removed waste for transport to a landfill will be challenged with the upwelling of ground water, the occasional rainfall along with the anticipated storm events, and any leakage through the sheet pile walls, all of which could effectively overwhelm the dewatering plant capacity. [2] The water pumped from the pit will be highly turbid containing wastes from the pits, and will require dewatering. The USACE recognized the large uncertainties in excavation in the "dry" due to seepage through the sheet pile walls and bottom of the pits. What is not addressed is the extent of the need for dewatering of the waste pits to keep out the river water. This source of contaminant-laden water, in combination with unanticipated storms overwhelming the water treatment facilities, was not considered in addressing sources of releases of dioxin/furans to the San Jacinto River.

Dewatering and treatment are serious implementation issues. What volume needs to be dewatered, what volume of water will result, how much needs to be treated, what is the treatment, what discharge standards must be achieved to discharge to the river, and where are these dewatering and treatment facilities placed? Dealing with dioxin/furan wastes will lead to concerns from the public regarding treatment and discharge to the river.

Sheetpile Removal

EPA stated that sheet piles will be placed around all areas to be dredged. On removal of the sheet pile, sediments that are stuck to the sheet pile will be washed into the river and released. For sheet piles used to enclose the Western Cell where removal will be conducted in the "dry," removal of those sheet piles will also result in washing contaminants into the river.

Construction Concerns and Environmental Impacts of Removal Operations in the Wet

Removal operations in the wet, i.e., dredging, requires the removal of the armored cap and underlying geotextile (where present), installation of sheet piles or berms (possibly

[2] It would be impractical to design and build a water treatment plant that could accommodate all storms. Similar to sewerage treatment facilities, under extreme conditions they cannot handle the incoming load and must bypass or dump the excess load through an overflow structure.

use of silt curtains), management of excavated materials, management of residuals, and removal of the sheet piles and removal of silt curtains, if used.

EPA's seemingly simple and theoretical approach to remove the rock cap and geotextile is technically flawed. There is no precedent for removal of an engineered armor rock cap and the underlying geotextile. As stated by Dr. Todd Bridges, the U.S. Army's Senior Research Scientist for Environmental Science and Director of the Center for Contaminated Sediments at the Engineer Research and Development Center (ERDC) with respect to the proposed removal of the armor rock cap and geotextile at the Site, "*It's never been done. It will result in a bloody mess of turbidity, re-suspended sediments, and residuals*" (Dr. Bridges, Personal Communication, November 2016).

The TCRA cap was designed and constructed to prevent releases of dioxins/furans to the San Jacinto River using engineering design parameters normally used in building a cap to ensure stability and protection for the long term. Such a design does not take into account possible future removal of the cap. This is reasonable since no such cap has ever been removed to the best of our knowledge. These design elements that ensure that the cap is stable also contribute to the challenges if it were ever to be removed.

General Considerations for Dredging in the Wet

The PRAP suggests opening an area, achieving "clean," and then covering that area with clean fill before another area is opened to limit exposure to storms and hurricanes and other climatic events. There are two constructability issues related to this concept: (1) the physical removal of the geotextile by pulling, ripping, and dragging will not lend itself to opening nice and neat small areas, and (2) assuming that an area of geotextile can be removed, it is likely that the freshly cleaned bottom is within the area that will be impacted by subsequent dredging in the vicinity leaving residuals; cleanup passes may then include removal of new sediment that has been recently contaminated. Before that cleanup pass is accomplished, the residuals are subject to release to the river.

Dredging for environmental cleanup would not normally involve complete removal to the clean underlying sediment until the "final" pass over the entire dredge area. Opening small sections and achieving "clean" is short lived in EPA's procedure. This will result in multiple subsequent clean up passes of areas that were once clean but have since been contaminated by the adjacent dredging operations.

Cap and Geotextile Removal

The PRAP approach to rock and geotextile removal would be to move the rocks off the geotextile, and then cut the geotextile along the line where the sheet pile is to be installed (PRAP, page 28) to facilitate removal of the wastes in small sections. The actual method to accomplish this will exacerbate resuspension, because cutting the geotextile in a precise manner and peeling back the geotextile is technically impractical underwater.

As described below, the challenge of armor cap and geotextile removal underwater is much more difficult than EPA recognizes.

- The first step in sheet pile installation or dredging will be to remove as much of the rock covering the geotextile as possible, because whatever is not removed will mix with underlying waste and result in more issues of non-closed buckets when dredging.
- Using high-resolution digital terrain models to understand the undulating depth and dimensions of the armor rock cap and the underlying geotextiles would be beneficial. In an effort to preserve as much of the integrity of the geotextile and limit mixing of the armor cap with the underlying sediments, the rocks would be removed first. Due to the inaccuracy of the underwater armor removal equipment, there is a risk of inadvertently grabbing the geotextile. Snagging the geotextile, would result in an increase in the number and volume of armor rocks falling into the underlying wastes.
- After the layer of rocks is removed, the bucket will then attempt to grab the geotextile and pull it up from the bottom. It is expected that the geotextile will rip apart, but not necessarily at the seams as they are installed and rated to be as strong as the geotextile. This will not be a simple process, given the tensile strength of the geotextile. The thrashing about of the geotextile, and agitating the surface layers of the waste pits will expose the remaining cap and the water column to additional contamination. As the remaining rocks spill into the underlying wastes, the subsequent removal effort of the waste becomes more complicated.
- The envisioned concept of peeling back the geotextile underwater in a neat line to install the sheet piles is impractical and in reality will be very messy. EPA states that removal of the armor cap will be done in stages or sections to limit exposure to potential storms (PRAP, page 28). This can be accomplished. although these sections will be determined by whatever pattern is created by the unpredictable ripping and tearing of the geotextile as it is removed.
- One negative aspect of conducting the removal and dredging in sections is that after removal of the waste in one section, subsequent removal in the adjacent sections will create residuals contaminating the "clean" section. This recontamination will occur during both the "dry" excavation as well as the underwater removal on the wet side of a sheet pile wall.

The USACE resuspension and residual calculations were based upon removal of the armor rock and rip rap before removing the geotextile, stating "*removing the rock rip rap will result in negligible amounts of sediment resuspension* (USACE 2016, Page 90)." The USACE approach is a very academic view, which misses the reality of the difficulties in how the cap will be removed, as well as the extent of agitation and release of the dioxin/furan wastes from the sediments into the water column. USACE recognizes, however, the complexity and difficulties of removing the geotextile in noting that "*[i]t is difficult to understand how the armor cap material could be readily removed without snagging and disturbing the geotextile and sediment, particularly if performed underwater.*" (USACE 2016 page 118).

The USACE states that "*the geotextile removal will result in considerable resuspension from sediment* [i.e., waste] *adhering to the geotextile and washing off as it is pulled through the water column*" (USACE 2016, page 90). The calculations assumed the wastes in the pits to be slightly to moderately sticky with a thickness of 3.375 mm. It was also assumed that only the top soft layer of waste would adhere to the geotextile, and that 50% of the waste would wash off during removal, and that all waste that was washed off would be lost to the river. The use of 3.375 mm thickness of waste was the same as used in the calculations for releases due to sheet pile removal. This is equivalent to about 1/8" thickness. This thickness of waste sticking to the geotextile is likely low for the following reason: the shallow water environment will effectively allow the geotextile to remain in contact with the bottom until it is entirely removed from the water. While its initial removal may have only had 1/8" of waste adhering to it, the fact that it remains in contact with the bottom, sweeping and dragging across the seabed will exacerbate its impacts to resuspension.

In conclusion, the dynamics associated with the geotextile removal in this shallow water environment will far exceed washing off of 50% of 1/8" of sediment adhering to the fabric, as calculated by the USACE. The USACE release calculations did not account for the resuspension that will occur as the wastes are disturbed upon removal of cap materials in contact with the contaminated sediment. In submerged areas, contaminated sediment that is resuspended into the water column has the potential for transport off site or for contamination of the areas of the pits for which wastes have been removed and covered with clean fill. The USACE recognized that removal of the cap will result in resuspended material, and assumed that all resuspended materials would be lost to the river (USACE 2016, page 136-137), even with the use of BMP sheet piles and silt curtains.

During the geotextile removal in the deep water of the Eastern Cell, the only attempts at protection from far field contamination would be silt curtains, if determined to be needed on-site. Construction of berms and sheet piles in these deeper water areas may not be practical.

Effectiveness of Silt Curtains

The intention of installing silt curtains is to control releases of suspended sediments. Silt curtains may reduce migration of fines at and near the surface with the intent to control releases of sediments to the river and surrounding areas, but sediments near the bottom freely flow with the river currents and under the bottom of the silt curtains into the wider riverine environment.

For operations on the wet side of the sheet pile wall, the assumption that collateral contamination can be practically contained at all by silt curtains is fallacious. In fact, it is unlikely that a responsible remediation contractor will even respond to a solicitation that expects practical BMP's to be installed that can contain the resuspension and residuals that will be created.

The PRAP does not explicitly propose use of silt curtains as part of the BMPs for Alternative 6N, although they are described in the 2014 Feasibility Study. USACE (2016), in its analysis of enhanced BMPs, recommended silt curtains as part of the BMPs to be used in the Northwest area. *Install silt curtains in deeper waters above the armored cap outside the footprint of the area to be dredged, connecting to existing or newly constructed berms and enclosing the area* (USACE 2016, page 133) (see Figures 9 and 10).

The PRAP stated that *Removal of submerged waste materials in the Northwest area will include isolation of the work area with berms/sheet piles if practicable.* EPA stated that silt curtains are the least effective controls. The issue is whether silt curtains will be determined to be part of BMPs during the Remedial Design phase because sheet piles and berms will be determined to be not feasible or practicable, for example, if it is not practicable to install sheet pile walls in water outside the -3 contour.

USACE (2016) evaluated the use of silt curtains to control turbidity. Key points from that report on silt curtains include the following (many of which were based upon the 2005 USACE Technical Note on Silt Curtains (Francingues and Palermo 2005)):

- Silt curtains and silt screens are flexible barriers that hang down from the water surface using a series of floats on the surface and a ballast chain or anchors along the bottom. Silt "curtains" are made of low permeability materials, and as such, redirect water flow around the enclosed area. Silt "screens" are made of permeable geotextile fabrics, which allow a significant fraction of the water to flow through, but retain a large fraction of the suspended solids. Both are generally referred to as silt curtains.

- Silt curtains are not very effective at current velocities > 1 1⁄2 knots (2.5 feet/sec) and are best deployed in environments where the current speeds are less than 1 feet/sec. Application at higher velocities would require special designs. The velocities in the river are normally between 0.5 and 1 foot per second, but can reach 4 feet per second during a 5-year-return-interval flood.
- At depths greater than 10-12 feet, loads on the curtains and mooring systems become excessive and could result in failure (such as in the deeper waters of the Northwest area) and possibly the deeper waters of the Eastern Cell.
- Hydrodynamic and climatic conditions that reduce effectiveness of the silt curtain include strong currents, high winds, fluctuating water levels, excessive wave height (including vessel wakes), drifting ice and debris, and movement of equipment into or out of the area.
- Generally, silt curtains are most effective in relatively shallow, quiescent water without significant tidal fluctuations. These attributes do not accurately characterize this Site.

The TCRA Final Removal Action Completion Report (Anchor QEA 2012) summarized issues that were experienced with the use of a turbidity curtain during the TCRA implementation. The turbidity curtain was installed around the water-side armored cap placement activities (Anchor QEA 2012, page 22). The turbidity curtain was subjected to river currents and tidal fluctuations, and regularly shifted into and out of the work areas with the incoming and outgoing tides. To combat the movement of the turbidity curtain, additional anchors were added. Repositioning and management of the curtain was needed on a regular basis. The strain resulted in detachment from the anchors, and tearing of the floating boom from the submerged skirt. Turbidity curtain management was required throughout the duration of in-water construction activities. It was noted in the 2012 Anchor QEA report (page 22) that in some situations, the curtains can cause more resuspension than if the curtain were not there. The USACE stated that despite the problems, the silt curtain was considered effective, whereas the Anchor QEA report said the silt curtains were functional. There is a subtle but distinct and important difference between effective and functional; “effective” is an overstatement of how the silt curtains functioned. The Anchor QEA report said that future projects in a river environment as that in the San Jacinto River should consider alternatives to use of a turbidity curtain (Anchor QEA 2012, page 75).

JBF Scientific Corporation (1978) conducted an assessment of the effectiveness of silt curtains; This JBF report is considered a significant assessment of silt curtains and remains pertinent today.

The bottom line of JBF Scientific Corporation (1978) is that while the silt curtain provides an enclosure where some of the fine-grained material may flocculate and/or settle, most of this fine-grained suspended material in the water column escapes with the flow of water and fluid mud under the curtain. The silt curtain does not indefinitely contain turbid water but instead controls the dispersion of turbid water by diverting the flow under the curtain, thereby minimizing the turbidity in the upper water column outside the silt curtain.

Even while recommending use of silt curtains for the Northwest area, the USACE still assumed that all resuspended material would be lost through the silt curtain including the releases from the removal of the rock cap and dredging activities. The USACE stated that they expected another 20% of the generated residuals would be lost through the bottom due to currents. The basis for the loss of 20% is suspect, given the JBF study conclusion that *most of this fine-grained suspended material in the water column escapes with the flow of water and fluid mud under the curtain.* JBF's statement is about suspended materials in the water column, which would include resuspension and generated residuals. These results are consistent with this author's experience with silt curtains. While aesthetics might be improved at the water surface and aerial photographic evidence might indicate a capture of turbidity on some projects, the net improvement of conditions with a silt curtain are accurately represented by the 2012 Anchor Report of activities on this site.

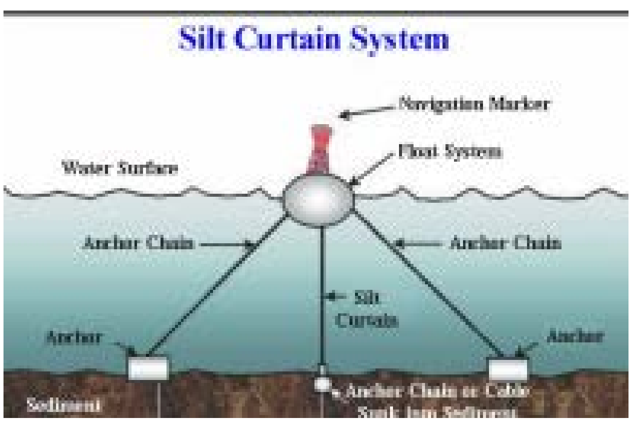

Figure 3. Silt Curtain System. Maximum depth 10-12 feet. Not effective in tidal waters or in currents above 1 foot per second. Credit: http://www.acecentro.com/products/atlantic/silt-curtains-turbidity-barriers.html

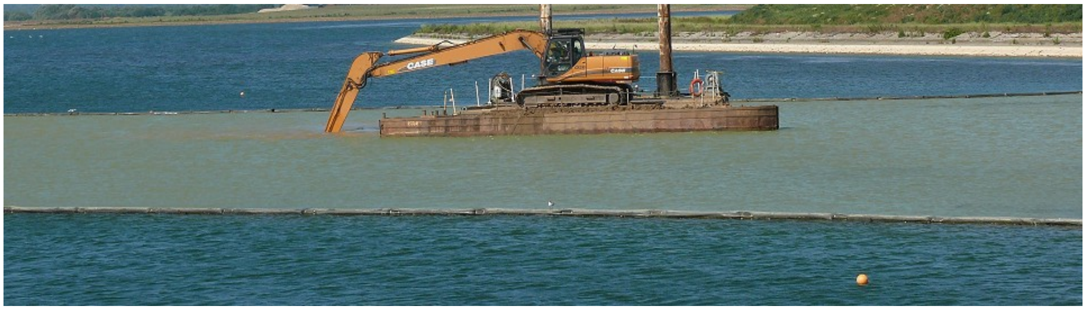
Figure 4. Dredging and Silt Curtain. Looking good on the surface, while resuspended sediments and residuals are carried by currents under the silt curtain into the surrounding waters. Credit: http://www.skimoil.com/turbidity-curtains.html.

The USACE presented the results of a number of studies on silt curtains that essentially said they are useless and impractical in deep waters with currents and tides, such as the Northwest area.

The EPA correctly stated the silt curtains are the least effective of the BMPs under consideration, and went on to recommend use of berms/sheet piles, as practicable. The USACE stated that the most practical method of controlling resuspended material would be the use of a turbidity (i.e., silt) curtain in the Northwest Area (USACE 2016, page 137); the EPA did not follow this advice when they include berms/sheet piles if practicable for the Northwest Area (PRAP, page 28). The USACE stated that it was assumed all resuspended material would be lost through the turbidity curtain, which would apply to removal of the cap and dredging (USACE 2016, page 137).

The bottom line on silt curtains and isolation of the Northwest area is that there appears to be no practicable BMPs available to completely isolate the deeper waters of the Northwest area from the release of resuspended and residual dioxins/furans into the San Jacinto River. The USACE suggested silt curtains. EPA said that BMPs may include sheet piles/berms for the Northwest Area if practicable (PRAP, page 28). Thus, under Alternative 6N, if the USACE is correct, there will be no engineering controls (i.e., BMPs) that would be effective to prevent the release of dioxin/furans into the San Jacinto River during geotextile removal or dredging of the waste materials from the Northwest Area, or the areas of the Eastern Cell outside of the sheet pile along the -3 feet contour.

As with sheetpiles, silt curtains may also have some sediment stuck to them that would be released upon removal.

Residuals Management Issues

The EPA recommends pulling up sections of the geotextile and excavation or dredging section by section to minimize exposure of the waste to storm events (PRAP, page 28).

This can be attempted, but is the opposite of a practical approach to environmental dredging; the process of removing the rock and geotextile has been discussed previously. Sections of geotextile will be removed by ripping and tearing, creating unpredictable irregular shaped sections making dredging and placing clean fill following dredging more challenging. The wastes will then be removed, and clean fill placed. That freshly placed clean fill will then be subjected to contamination by residuals from subsequent dredging in the proximity. For the same reasons that dredging will create resuspension and collateral contamination of surrounding areas reaching well into the San Jacinto River, the areas that have been dredged to “clean” and re-capped with clean fill will also be re-contaminated. Removal of contaminants and waste by dredging typically involves the removal of the upper layers of the sediments leaving a “dirty blanket” over the area exposed to subsequent dredging residuals and resuspension. On some projects, this might involve the removal of 80% of the contaminated sediment before the final pass and removal to the clean underlying sediment. That final pass, representing a foot or so of material and a corresponding lower volume of waste poses a lower amount of resuspension and residuals to the exposed clean areas. In this case where EPA’s desire is to reduce exposed areas to adverse climatic events, their proposed remedy results in never achieving a clean surface and exposure to multiple removals of freshly placed clean fill due to the adjacent dredging operations.

Resuspension and Releases during Wet Removal

In general, all dredging operations resuspend sediments into the water column and also create residuals on the site and vicinity of the site. Depending upon the properties of the waste materials and local site conditions, such as currents, the wastes will either disperse with the currents or settle within the dredging footprint.

<u>At least 24% (and possibly more if removal in the “dry” is not feasible or practicable) of the work under Alternative 6N will involve removal “in the wet” which will result in releases.</u> Note that while the Northwest Area and the deep water of the Eastern Cell only contain one fourth of the waste, the release of dioxin/furans into the river will be disproportionately higher than excavation in the “dry” because of the greater issues in geotextile removal and dredging in the wet. Dredging and removal of wastes will occur in the area outside of the sheet pile wall along the -3.0 foot contour in the Eastern Cell and in the Northwest Area.

Resuspension and Residuals

Resuspension and creation of residuals will occur in every dredging project (Palermo 2008).

Resuspension is the process whereby the waste materials are dislodged and dispersed in the water column by the dredging operation. The resuspended waste particles may settle in the dredging area or be transported downstream.

Residuals are contaminated sediments remaining in or adjacent to the dredging footprint after completion of the removal/dredging operation. There are numerous potential causes for residual sediment contamination, but residuals can be broadly grouped into two categories: 1) undisturbed residuals (also commonly termed undredged inventory), and 2) generated residuals.

In general, compared to hydraulic dredging, less agitation and suspended sediments can occur with environmentally sensitive mechanical dredging and removal.

Resuspension and residuals still result from mechanical removal, however. If the bucket is lowered beyond the depth that exceeds the bucket's volumetric capacity when closed (dredge operators can control this to a degree, but it depends on external factors such as tides, waves, wind, and accuracy of the pre-dredging survey data), sediment will be extruded from the bucket as it closes. Controlling where that material is displaced to underwater is beyond the control of the dredge operator. It may extrude to the sides of the bucket, or if the bucket has water vents, it may extrude through the vents.

Resuspended sediments and residuals will also occur as the sediments overflow or are washed out of the bucket as it is lifted to the surface and to the barge. Resuspended sediments and residuals also occur from washing cohesive sediments off the bucket when it is raised through the water column. Currents in the dredge area as well as the characteristics of the sediment (e.g., fine grain sizes do not settle rapidly) determine how far upstream (i.e., tidal effects) or downstream in the San Jacinto River the contaminated sediments will migrate.

The degree of resuspension of contaminated dredged material, subject to being distributed through the water column, is a function of a number of factors that include (Palermo 2008, NRC 2007):

- Sediment properties such as in situ dry bulk density (solids concentration, solids content or water content), organic content, particle-size distribution, and mineralogy.
- Site conditions such as water depth, currents, waves, and presence of hardpan or bedrock.
- Nature and extent of impediments, such as debris, loose cobbles, boulders, and obstructions.

- Operational considerations such as the thickness of dredge cuts, dredging equipment type, method of operation, and skill of the operator. Resuspension and contaminant release by mechanical dredges may result from the dynamic impact of the bucket with the bottom sediment, sloughing of material into the cut, washing of sediment from the bucket exterior as the bucket is raised (Figure 5) and lowered through the water column, and leakage from the bucket (either from the top of an open bucket or from the lips of the bucket if closure is not complete due to debris) (Palermo 2008).


Figure 5

- The shape of the bucket, which will reshape the bottom surface. Many mechanical dredge buckets are scallop shaped, and will create a depression into the sediments below. Some of the suspended contaminated sediments agitated and released into the water column may settle onto the undisturbed sediments below the dredging cut. This becomes an issue when the last dredging pass occurs and contaminated residuals settle onto what is targeted to be clean sediments. In addition, level cut environmental buckets plow and remold the sediment, increasing the potential for the formation of a sediment slurry that is more difficult to capture in the bucket, increasing the residual layer (Palermo 2008).

The most significant cause of suspension of sediments back into the water column results from the lack of bucket closure. This non-closure can be due to:

- Bucket design such as a conventional open clamshell bucket, as shown in Figure 6. It is open on top and sediments are free to overflow the bucket through the water column and continues to do so as it is lifted and placed in the barge, or
- Debris dredged from the bottom (along with the sediment) that keeps the bucket from closing, blocking the


Figure 6

bucket open. Even the most sophisticated "environmental" buckets can be blocked open, losing all or part of the load in the bucket, re-suspending the sediments in the water column.

EPA (2005) stated that there is potential for significant contaminant losses through resuspension, and generation of residual contamination is likely to be greater in dredging that encounters debris, cobbles, boulders, hardpan, bedrock, and rock outcroppings. These pose problems of resuspension because they can prevent closure or seal of the clamshell, causing significant leakage or loss of dredged material to the water column. In the case of the SJRWP, remnants of the armor cap would represent an extraordinary presence of debris (i.e., rocks from the cap), far exceeding projects with naturally occurring debris and rock fragments. Some resuspended fine particles have low settling velocities and can remain suspended in the water column for hours or days, and the suspended sediment particles and associated contaminants will be transported with currents from the dredging area into the surrounding environment (Palermo 2008).

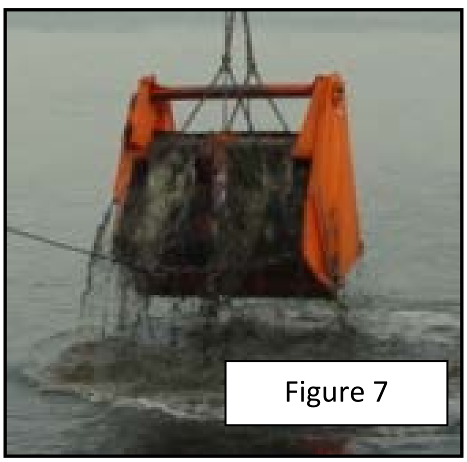

Figure 7

Enclosed buckets (sometimes called environmental buckets) are advertised as preventing the release of sediment from the bucket as it is pulled up through the water column, reducing the contribution to resuspension and contaminant release throughout the depth of the water column (Figure 7). Use of enclosed buckets does generally decrease the loss of captured water and sediment from the bucket as it is pulled up through and out of the water column, reducing the resuspension and contaminant release at the water surface compared to open buckets (Fuglevand and Webb 2006). However, as the environmental bucket is pulled up from the bottom through the water column, contaminants are released by washing the surfaces of the dirty bucket. In addition, there is some drainage and release of water from the vents after the bucket breaks the surface; these losses are typically much smaller than the losses from a conventional clamshell. The presence of debris, such as armor rock used for the TCRA cap, can keep the jaws from closing and cause the loss of much of the bucket contents (Palermo 2008).

On many sites, the presence of naturally occurring organic and inorganic debris presents challenges to safe and effective removal of sediments from the bottom. The USACE (2016) stated that "Little debris should be present in the contaminated sediment due to the nature of the San Jacinto waste pits being a confined waste storage facility, its remoteness, and its lack of commercial or navigation activities at the site (USACE 2016)." However, the USACE (2016) suggested a debris survey and possibly conducting a debris removal sweep at SJRWP, which is not uncommon in many dredging operations to remove identifiable large intact debris, such as shopping carts, cable, detached pilings, pieces of timbers, and rubber tires. These types of items may not be present to any significant extent at the SJRWP. But in the case of SJRWP, the known "debris" is the armor rock cap intentionally installed as part of the TCRA.


Figure 8

The presence of significant amounts of riprap and rock placed upon the waste pits as an armor cap adds to the already challenging removal effort on both the "dry" and wet side of the sheet pile wall. The armor cap and geotextile exacerbates the issue of bucket closure, loss of sediments, and the generation of resuspended contaminants and residuals. In the context of dredging, Figure 8 depicts a bucket that is a very robust, hydraulically powered environmental clamshell bucket removing sediment from a seabed. The bucket in this photo could not close due to the presence of rock and other debris and therefore, much of the sediment was lost through the water column as it was lifted to the material barge. The lighter "environmental" Cable Arm® type of bucket is too lightly constructed to effectively close on these sediments and would have significantly increased losses well above those depicted in this photograph.

Due to the existence of the armor rock in the sediment and waste, resuspension will be so extraordinarily high that achieving clean might only be achieved by resuspending the sediment and allowing dispersion and dilution into the far field environment. This result is not what EPA intends but is what is likely to happen. There would appear not to be a removal approach that can address this real problem of residuals and resuspension.

More Dredging Passes Means More Releases of Contaminants

The USACE calculated resuspension and residuals based upon using a bucket size of 7.65 cubic meters (i.e., 10 cubic yards) (USACE 2016, page 96). The practical size limit for use on this project is a mechanical dredge using a 2 to 3.5 cubic yard bucket, primarily because of the size, weight, and draft of the vessels that can move into the shallow water around the impoundments. A smaller bucket means more trips of the bucket through the water to grab wastes and take them to the disposal barge, about 3 to 5 times more bucket dips than used in the USACE calculations. Figures 9 and 10 provide perspective on the size of the buckets.

In addition, since about one half of the buckets are likely to be blocked open losing some or all of their load, that means up to double the number of bucket dips will be needed to accomplish the dredging anticipated by the USACE.

Overall, the smaller bucket and the rock-blocked bucket will mean that 6 to 10 times more bucket dips will be needed to complete the dredging.

Finally, the USACE estimated four dredging passes with the 7.65 cubic meter bucket (USACE, page 102, page 96)**.** Using a bucket of 2 to 3.5 cubic yards means many more bucket scoops of waste material as noted above, and it may also means more passes.

More passes and more buckets means more turbulence and agitation of the waste resulting in more resuspension/residuals and releases to the river. Therefore, EPA's analysis of the Alternative 6N is incorrect, because the number of buckets and size of the buckets used in the calculations of releases was wrong, and the number of passes was also incorrect. This is just one more factor indicating EPA's resuspension and residual calculations are far off the mark.

Figure 9. Photo comparison of the size of dredging buckets. On the left is a two cubic yard bucket.
Figure 10. On the right is a clamshell bucket closer to the one used in the USACE release calculations. Credit: Anvil Attachments. http://www.anvilattachments.com/news-0/topic/4-rope-clamshell

Environmental Releases from Auxiliary and Ancillary Construction Equipment

Propeller wash causes a great deal of sediment resuspension from the tugboats pushing the dredge into place and then moving it again, as well as moving the dredged material barge(s) alongside of the dredge. Other service boats, moving crew and equipment and supplies also contribute to propeller wash and resuspension of sediments into the river.

Called a "spread," mechanical dredging equipment includes the dredging vessel, the dredged material scows or barges, towing vessels, and smaller boats for surveying, scientific and analytical assessments, ferrying equipment and crew around the site, and managing turbidity curtains. If a sheet pile wall were to be placed around the dredging operation, physically separating the navigation area from the dredging vessel, then additional vessels would also be required to service the dredge inside the sheet pile wall in the loading zone. The loading zone for trans-loading waste over a sheet pile wall from the dirty area to the clean waterway outside of the wall will be another source of re-suspension and residuals. The procedures for conveying the dredged material out of the loading zone would likely include another deck barge vessel to facilitate that trans-loading operation. This additional equipment is also exposed to contamination and subject to spills.

Each spread will typically include the following floating plant:

- Marine based sheet pile installation:
    - A deck barge with crane for hanging and driving sheet piles with hydraulic power units.
    - A deck barge (supply vessel) for delivery and storage of sheet pile segments.
    - A tow boat for positioning the crane barge and moving the supply vessel to and from the installation site.
    - A crew boat and/or survey vessel for ferrying personnel and minor supplies to and from the floating plant.

- Dredge Operation:
  - A dredge, in the context of the SJRWP site, would be a vessel with length of 140 to 160 feet, a width of approximately 40 feet and a draft of about 3 feet minimum to carry an excavator with a bucket capacity of approximately 2 to 3.5 cubic yards. Ancillary equipment includes winches and spuds or anchor handling equipment, containers for personnel, positioning equipment, spare parts and consumables, and fuel.
  - The number of material barges will be a function of where the dredged material will be hauled. The dimensions of these vessels will be determined by the draft limitations of the operating area, i.e., the loading zone. The barges will need to be positioned close enough to the dredge so the dredge's bucket can be placed in or on the barge.
  - A tow boat with sufficient horsepower will be required in the vicinity of the loading zone to manage and maneuver the barge around the dredge.
  - Each barge that transits the navigation waterway will also have a tow boat with sufficient capacity to safely transport the material barge.
  - A crew boat and or a survey boat will be necessary for ferrying crew and minor supplies to and from the various floating vessels.

Tug boats positioning barges for loading and subsequent transport to the placement area is a continuous operation. Significant erosion of bottom sediments and turbidity occur around the vessels as propeller torque is utilized to position barges safely and effectively, especially in shallow water. These support vessels can be a significant source of resuspension (Palermo 2008, EPA 2005).

Mechanical dredges employ various anchoring means to control their position on the sea-bed. In most cases, a combination of spuds embedded in the sea-floor provide that positioning control for the dredge. Spuds are steel poles of varying diameters and weight to permit the dredge to advance positions or hold one end of the dredge in a fixed position. The spud must embed itself into the sea bottom to provide sufficient counter force to the other forces acting on the dredge hull from the dredging actions. The spud will penetrate softer sediments until it reaches either an equal resistance to penetration at the spud tip or from skin friction along the outside wall of the spud. In many cases, each spud penetration extends through the sediments being targeted for excavation and into the underlying

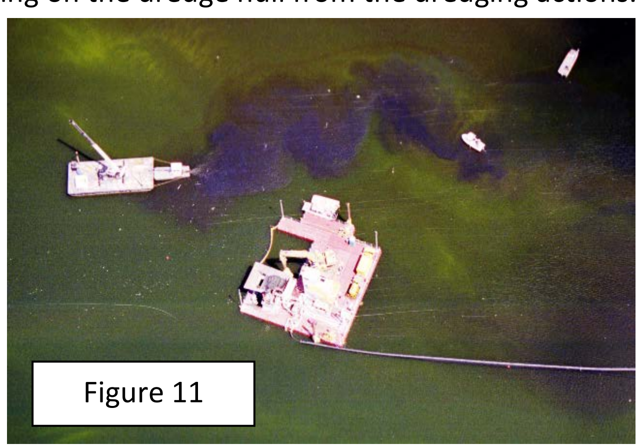

Figure 11

sediments, providing a pathway for mixing the upper sediments into the underlying clean layer. The spud penetrations, depending upon the dredge dimensions can be from 2-10 feet apart along a dredge cut.

The USACE did not consider the resuspension and releases from the spread of these auxiliary or ancillary vessels. This is a major oversight, given that dioxins/furans are in the pits where the dredging is happening and on the river bottom in the vicinity of the waste pits, both subject to propeller wash. In the vicinity of the waste pits, increased levels are expected from the resuspended sediments and residuals created during the waste removal activities. Figure 11 depicts a small barge and boat moving through a dredge area where "hot spot" dredging for PCB contaminated sediments targeted for removal is occurring. Notice the propeller wash turbidity occurring behind the vessel.

In addition, the propeller wash from the auxiliary vessels will all cause additional resuspension and dispersion of residuals generated during removal of the cap and geotextile and the dredging action.

Environmental Impacts from Storms during Construction

The risk of storms during the EPA estimated 19 months of construction is quite real, and even more pronounced if EPA had used a more realistic construction period that reflects the issues raised in this document, including the increased numbers of bucket dips that will be needed, the increased number of dredging passes, and the many implementation issues associated with the work in the "dry". The risks from storms are to safety of the workers working in the "dry" behind sheet piling, and also to the scouring of dioxin from the exposed areas of both the Western and Eastern Cells, and the Northwest Area. In particular, exposure to storm events during sheet pile installation, during cap and geotextile removal, and during waste removal is a potentially serious threat which could result in significant releases of contaminants to the river.

The USACE recognized that erosion would be expected even with the installation of sheet pile walls. The real question is how much erosion and release of resuspended wastes and residuals would be transported downriver.

> *Without complete isolation by containment structures (i.e., where water exchange is permitted to equilibrate the water surface elevation on both sides of the containment structure) or when the containment elevation is less than about +5 NAVD88, erosion of recently formed dredging residuals by the bottom shear stresses resulting from flow through the gaps and over the walls, depending on the magnitude of the flooding, would be expected; however, very limited erosion of exposed sediment*

would be expected. Recently formed residuals could contain up to about 1% of the contaminant mass (USACE 2016, page 186).

Significant storm events will likely overwhelm the water treatment facilities resulting in significant runoff beyond the protection of the sheet pile walls. Contaminant laden sediments will migrate beyond the site footprint. The extent to which contaminants migrate will be a function of the length of time of the flooding and current velocities around the site.

The BMPs that will be used will not eliminate migration of these contaminants from the project site, only help to reduce the levels that will occur during a significant storm. Throughout the duration of the "dry" excavation, the exposure of the upland "dry" area to significant storm events will inhibit the ability to achieve a clean remediated site. Storm water run-off will plague the site continuously and may require subsequent clean–up efforts in areas that have previously been deemed acceptable.

For protection from storms, the PRAP states that BMPs can successfully mitigate and control resuspension of sediment from storms and floodwaters (PRAP, page 35). This assurance backed up by the qualification of these BMPs as "if practicable" is extremely misleading regarding the potential extent of further contamination of the San Jacinto River as a result of the removal actions in Alternative 6N. The PRAP identifies possible approaches, but the specifics are to be determined later. This continuing, "to be determined later," approach does not provide confidence that EPA has a credible basis, anchored in real world experience with dredging projects, to conclude that key aspects of the BMPs are feasible or practicable under the specific conditions at this Site.

Dredging Efficiency Impacts from Required Safety Measures

Providing the necessary protection for personnel could provide incremental and/or significant impacts to the overall operating efficiency while increasing the project cost and duration. This has not been addressed by EPA.

Personnel on site working with the dredge and ancillary equipment will come in contact with excavated and dredged material containing dioxins/furans and other contaminants. Given the nature of these sediments, responsible handling of the dredged material will require a level of personal protective equipment (PPE) that

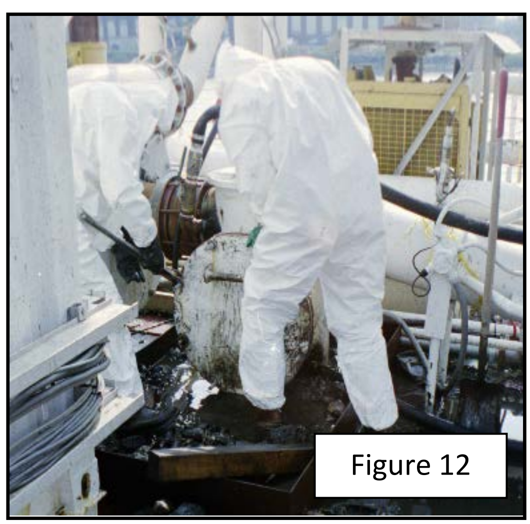

Figure 12

protects the individuals from exposure (Figure 12). This requires special exclusion zones with decontamination areas on board to maintain the integrity of the PPE for the crew. Navigating through the exclusion zones will impact excavation and dredge productivity and crew cost efficiency. Accommodating the work environment limitations with increased levels of PPE will impact crew cost and numbers. This aspect of the remediation costs needs to be reconciled with the premise of operating in Modified Level D PPE.

Safety Issues: Level D or Modified Level D

Level D - A work uniform affording minimal protection: used for nuisance contamination only. The following constitutes Level D and Modified Level D (1) equipment; it may be used as appropriate:

1. Coveralls.
2. Gloves. (1)
3. Boots/shoes, chemical-resistant steel toe and shank.
4. Boots, outer, chemical-resistant (disposable). (1)
5. Safety glasses or chemical splash goggles. (1)
6. Hard hat. (1)
7. Escape mask. (1)
8. Face shield. (1)

As noted in the text box, Modified Level D Personal Protective Equipment is the highest level of protection assumed to be required for personnel working on and around the Site. Establishing this basis is important to properly characterizing the working conditions and operating efficiency of equipment and personnel. While Modified Level D entails a higher degree of protection than Level D, considering even higher levels of Personal Protective Equipment (PPE) may be appropriate (i.e. Level C, Level B, and Level A).

The impact upon the project schedule of the requirements for PPE has not been addressed by EPA in the PRAP.

The Challenges of What to do with Dioxin/Furan Waste after Removal

After excavating and dredging, there are several complications related to managing the material removed, including challenges related to the offsite staging area, environmental impacts associated with managing the material, and challenges associated with transportation to the disposal facility.

Offsite Staging Area Challenges

Alternative 6N entails removal of approximately 152,000 cubic yards of wastes from the TCRA footprint, which would require a relatively large offloading and sediment processing facility to efficiently accomplish the work. This would require barge unloading, sediment re-handling, dewatering, stockpiling, trans-loading, and shipping to the off-site landfill facility. Additional activities would include management and disposal of dewatering effluent, including treatment if necessary. Locating a facility along the river with sufficient space and availability for the project duration of 19 months (or more) for use for staging, offloading, and sediment processing is considered to be a significant challenge to the implementability of Alternative 6N. The availability of a staging area with sufficient capacity is a real unknown. Finding a staging area for construction of the cap was very difficult. One was eventually found about two miles upstream of the site, and this staging area was for clean rocks for the cap. Storing dioxin/furan wastes at a site to be trans-loaded onto trucks and sent to a landfill will surely be much more challenging issue. A willing owner will have to be found and all necessary environmental permits will need to be obtained. This could take a number of years to accomplish. Engineering and institutional controls will be needed for the staging areas if contaminated material is to be stored there. Perimeter fencing and warning signs will be necessary. Silt fences will be necessary to control surface water runoff, along with coverage of stockpiled contaminated materials.

Environmental Impacts Associated with Material Management

This alternative is estimated to require at least 15,500 hours of heavy equipment operations and at least 13,300 truck trips (PRAP, page 29) (the Feasibility Study says 17,500 truck trips (EPA FS 2016, page 108)), resulting in significant greenhouse gas and PM, ozone generating emissions, and traffic impacts. Potential sources of suspended contaminants include the dewatering of the dredged wastes at the staging area.

Transportation Challenges

Off-site transport of materials for disposal presents a significantly higher risk for spills and accidents compared to other alternatives, which could result in exposure of these materials to the general public. These trucks are carrying wastes containing dioxin/furans, something the public is incredibly concerned about. This is likely to cause an uproar regarding not in my backyard, or in this case, not on my roads. Is this really implementable? If material is transported off site via truck, special precautions would be required to reduce collateral contamination, such as possible collisions due to increases in truck traffic, along the highways with other vehicles traveling the same roadways.

EPA's Assumed Schedule is Unrealistic

EPA's estimated duration of the dredging project is 19 months.

Attempted implementation of Alternative 6N will result in an extended construction time line due to several real-world implementation issues:

- EPA assumed that excavation in the dry is straightforward and not difficult. That might be true for actual excavation in the dry, but his project will only have dry excavation for the first two feet of ten feet of wastes to be removed. Working in waterlogged wastes and muck will be much more challenging and take much longer than EPA anticipated.
- More time to conduct the dredging will be needed, given the smaller bucket size, the additional dredging passes, and the increased number of bucket loads (due to blocking open by armor rocks). EPA's evaluation of Alternative 6N assumes an average excavation and dredging production rate of 800 cubic yards per day, which is unrealistically high considering the complicated nature of the proposed excavation and dredging.
- The anticipated schedule appears to be set based upon installation of BMPs as stated in the PRAP, except without considering any of the questions regarding "where feasible," "if practicable," or "as appropriate." If just one of the many variables at the site turns out not to be feasible or practicable, what happens then? Redesign, reorder equipment, get new approvals, and try something else? These take time and effort, and there appears to be no contingency built into the 19 months listed in the PRAP as the construction period (PRAP, page 28).
- Storms and flooding events are also not adequately considered in the construction period. No doubt, no crystal ball exists to predict the weather, but the USACE considered storms to be a real threat during construction. The USACE suggested that construction only occur during the off-season for hurricanes and tropical storms, i.e., when there is a lower probability of tropical storms and flooding conditions (USACE 2016, page 186). While not stated in the USACE report, this would mean no excavation or dredging for 4-5 months per year. Mobilization and demobilization are not included in the cost estimate nor in the length of the construction period. While the "hurricane" season may only be from June to November, there is still exposure to storms outside of that window. Spring time is also subject to winds and storms so avoiding climatological impacts will not be possible.

- The expectation that subsequent re-dredging and removal of recently installed clean fill over the excavated or dredged areas has not been considered in the dredging duration. The EPA has not recognized the higher levels of resuspension and residuals that will occur on this site due to the armor cap. Therefore, it has not considered the consequential impacts to schedule due to the re-dredging and additional clean-up efforts.
- The location and permitting of an offsite staging facility could take over 2 years as previously mentioned. No work could begin until a waste permit was obtained.

Alternative 6N has not been Properly Evaluated

It is clear that EPA does not have an understanding of how Alternative 6N will be accomplished and still meet relevant environmental criteria, such as being protective of human health and the environment and not releasing dioxins/furans into the surrounding area and river. This is a product of the fact that no such remedy (the removal of an existing engineered armor rock cap and underlying waste, adjacent to and in a dynamic riverine environment) has ever been attempted, to our knowledge.

EPA's Description and Evaluation of Alternative 6N is Incomplete and Unclear

The PRAP (page 28) states that "Raised berms and sheet piles in addition to dewatering and removal in the dry where feasible will be used to reduce the re-suspension and spreading of the removed material." The structures are to be protective from a 25-year or 50-year flood stage (PRAP, page 35). The PRAP also indicates that approximately three-fourths of the wastes are anticipated to be removed in the dry, if feasible (PRAP, page 28). The USACE in the list of enhanced BMPS states that: "Remove contaminated sediment in the dry to the extent practicable (USACE 2016, page 133)."

The extent of dredging or excavation in the dry behind sheet piles is quite unclear and is based upon those key phrases "where feasible" and "to the extent practical." Consistent with the PRAP, the USACE states that: *"A sheet pile wall is recommended for both portions* [the shallow portion inside of the -3.0 foot contour and the deep water portion outside of that contour] *of the Eastern Cell as a means to control sediment releases during remedial actions; however, both sections of the Eastern Cell will be dredged in the wet"* (USACE 2016, page 137). This statement indicates that USACE thought that removal of wastes in the shallow areas of the Eastern Cell would be conducted by dredging in the wet. However, the USACE also stated that removal in the dry could be carried out for the shallow portions of the Eastern Cell; this inconsistency is confusing.

The USACE 2016 report provides as follows:

> *All activities completed in the dry, having a sheet pile wall barrier protecting the water from interacting with contaminated sediment will result in very small amounts of resuspension, and will have limited exposure to the water before the permanent cap is placed over the residual layers.* (p. 103)

> *If sediments from the entire site are removed in the dry, the contaminants releases would be limited to releases from construction of the containment structures and fugitive dust losses which would amount to about 0.1% of the contaminants removed.* (p. 154)
>
> Referring to the western cell: *Installing the sheet pile walls at the top of the berms would provide more support for the wall, facilitate sealing joints between the sheet piles above the berm, and reduce the potential leakage through the wall and berms since the wall would not be exposed to the water column except during very high flow conditions. Excavation and backfilling in the dry will eliminate potential resuspension and residuals releases.* (p. 134)

Two points to understand from the above quoted USACE quoted material:

1. Removal in the dry will be conducted where feasible or practicable, and EPA hopes that will be in the Western Cell and the shallow water portion of the Eastern Cell. However, EPA does not actually know if dredging behind sheet pile walls in the shallow water portion of the Eastern cell can be accomplished. If it cannot, the estimates of releases of resuspended contaminants and residuals are wrong, and the basis for selection of Alternative 6N is erroneous.

2. The USACE presumes that removal in the dry will release almost nothing to the river environment in the way of contaminants. This may be true for some remediation sites, but it is just plain incorrect for this site, given its characteristics as discussed previously.

The challenge in providing comments is that EPA's description of BMPs includes significant inconsistencies in the description of which BMPs should be used and where the BMPs should be placed. Because EPA apparently does not know how effective BMPs may be or whether they are practicable, the actual BMP determinations are left to the Remedial Design Phase.

The issue is which BMPs are to be used and where will they be placed? This is a complex site, and different BMPs would be appropriate in given areas of the site. Each must be evaluated separately to determine feasibility. Simply making lists of potential BMPs in both the USACE's report and EPA's PRAP does not constitute a proper evaluation of the actual steps to be taken; thus an accurate estimate of implementability, risk, release, and cost is not possible.

EPA has an Incomplete Understanding of Potential Releases, and has Mischaracterized their Understanding of the Effectiveness of Proposed BMPs

Fundamental to the EPA's selection of preferred Alternative 6N is EPA's conclusion that "This alternative will utilize Best Management Practices (BMPs) to reduce and control the re-suspension of waste material and sediment (PRAP, page 28)." EPA's position is misleading by mischaracterizing the effectiveness of proposed BMPs. And, of very serious consequence is the fact that EPA completely missed two major sources of releases to the river that will dwarf the EPA estimates. The reality is that Alternative 6N will result in much higher levels of resuspended sediments and residuals containing suspended waste materials than EPA estimated, most of which will be released to the San Jacinto River.

Further:

- EPA's approach to BMPs is to presume now and later determine what the BMPs actually will be during Remedial Design. Describing the BMPs in the PRAP and tagging them with *if practicable, if necessary,* or *if feasible* means that EPA does not know and has not adequately analyzed whether the identified BMPs actually work to control releases of dioxin/furans into the San Jacinto River.
- EPA has not demonstrated an understanding of the technical challenges (e.g., underwater removal of the rock, how to cut the geotextile, how to pick it up without creating a dispersion of residuals, how to remove the cap and geotextile in small sections, and how to peel back the rock and geotextile to install sheet pile) nor evaluated the environmental ramifications associated with the actual removal of the cap, geotextile and waste.
- Even if EPA's assumptions about the effectiveness of BMPs were supportable (which they are not), EPA has underestimated consequential releases of dioxin/furans and residual levels of dioxin/furans from dredging and application of BMPs. Previously in this report, two sources of releases during the "dry" excavation were presented; these included sheet pile installation/removal, and dewatering operations to maintain the dry conditions behind the sheet piles.
- In dredging actions, EPA did not consider at least two additional major sources of releases for this project: (1) It is estimated that about one half of the dredge's buckets will come to the surface blocked open with rocks from the armor cap, releasing the wastes to the water column; and (2) auxiliary or ancillary vessels such as tug boats and service boats cause a large amount of propeller wash and erosion of bottom sediments, resulting in significant amounts of resuspended sediments. Thus, the implementation of Alternative 6N will result in significantly

higher releases of dioxins/furans to the San Jacinto River during the construction period and also into the future following construction. EPA has not adequately addressed these releases in the PRAP.

The result is a fundamentally flawed assessment of risks and prediction of the short and long term impacts to the San Jacinto River from implementation of Alternative 6N, particularly in comparison to those associated with retaining the armored rock cap and enhancing it (Alternative 3aN).

EPA's Proposed BMPs are Vague, Ill-Defined, and Inconsistent with USACE Advice

The actual BMPs need to be defined and a site-specific analysis of their application and effectiveness is essential in order to support an assessment of the releases associated with Alternative 6N. It is not sufficient for EPA to state that final BMPs will be determined during the Remedial Design (PRAP at page 28). These future decisions could have an enormous impact upon the magnitude of releases of resuspended dioxin/furan contaminated waste materials and generation of residuals. In many instances, the PRAP assumes that BMPs will be used "if applicable" or "if appropriate" or "if practicable." From the PRAP at page 28:

> *While the Best Management Practices identified below were listed by the Corps of Engineers and were used for costing purposes, the final use and design of Best Management Practices will be determined during the Remedial Design. The Best Management Practices may include, but are not limited to, the following:*
>
> - *The removal will be completed in stages or sections <u>as appropriate</u> to limit the exposure of the uncovered sections of the waste pits to potential storms.*
> - *Raised berms and sheet piles in addition to dewatering and removal in the dry <u>where feasible</u> will be used to reduce the re-suspension and spreading of the removed material.*
> - *Removal of submerged waste materials in the Northwest area will include isolation of the work area with berms/sheet piles <u>if practicable</u>.*

In the discussion of the short-term effectiveness on page 35 of the PRAP, BMPs were again described such that it is clear that EPA does not know what or where to use the BMPs. In addition, also on page 35, EPA adds the possible use of caissons, nowhere else mentioned in the PRAP:

These methodologies may include armor cap removal in sections, raised berms, operational controls, etc. Substantial containment structures are needed to isolate the removal operations, residuals and exposed sediment. To control the sediment re-suspension during construction, the containment structures would consist of berms and sheet pile walls or caissons to an elevation of about +10 NAVD88 (protection from 25-year or 50-year flood stage) (underlining, added) (PRAP, p. 35).

EPA again says "may include" similar to previous statements "as practicable" or "where feasible." The last sentence in this statement that sheet pile walls or caissons to an elevation of +10 feet is very misleading as it is in conflict with the USACE report, as discussed subsequently.

The USACE identifies caissons as a possible engineering control, in the context that sheet pile walls may not be technically feasible, because they are not structurally sound for more than 10 feet of holding back the water pressure in the river. The USACE did not include caissons in the list of identified BMPs, because of their low cost-effectiveness (USACE 2016, page 159). By mentioning caissons only in the discussion of short-term effectiveness in the PRAP, EPA is again adding to the vagueness and ill-defined concept of BMPs. And, EPA did not include caissons in the project cost estimate and certainly not in the project schedule (caissons would take much longer to construct than sheet pile walls).

The USACE (2016) report provides river stage elevations for various return interval storms:

Under flooding conditions, the entire site can be underwater. A flood with a 5-year or 10- year return period would have a river stage of 5 ft NAVD88, while floods with 25-year, 50-year and 100-year return periods would have predicted stages of about 8 feet, 11 feet and 14 feet NAVD88 at the site, respectively (Table 4-4 Draft Final Interim Feasibility Study Report – Appendix B: Hydrodynamic Cap Modeling, San Jacinto River Waste Pits Superfund Site, March 2014) (USACE 2016, page 61).

It is unclear what level of storm protection will be provided by the BMPs EPA has described in the PRAP. EPA's identification of BMPs constructed to elevation 5 feet NAVD88 appears to be protective of storms with less than a 10-year return interval. BMPs constructed to elevation 10 feet NAVD88 might only be protective of a 25-year storm, which is inconsistent with EPA's statement that BMPs would provide protection from a 25- or 50-year return interval storm (PRAP, p. 35). Given these inconsistencies, EPA could not possibly have prepared an accurate evaluation of the impact of storms during construction of Alternative 6N.

EPA also ignored the advice of the USACE regarding the overall effectiveness of sheet pile walls by stating in the PRAP that all waste removal areas will be surrounded by sheet piles:

> *Enclosure of only shallow water areas (elevations above about -3 ft NAVD88) with a sheet pile wall and berm will reduce releases nearly as well as enclosing the entire TCRA cap area since the high sediment TEQ concentrations are nearly all in these shallow areas.* (USACE Report, p. 132.)

Moreover, EPA's simple listing of potential BMPs precludes the mandatory assessment by EPA, not only of short-term effectiveness, but of long-term reliability and cost effectiveness. If EPA, for example, directs the PRPs to use berms, then sheet pile walls, then caissons when previous efforts do not work, what releases to the river during these attempts will occur? How will cost be impacted in order to have the mandatory understanding of the proportionality of cost to environmental benefit? EPA should not just hand wave, ignoring the regulatory requirements for a detailed evaluation of remedial alternatives under the National Contingency Plan, and say that these significant issues will be addressed at the Remedial Design stage.

USACE Predicts Significant Releases to the River Even with the Use of Enhanced BMPs and These Predictions are Underestimated

Based on our significant years of experience with implementing practical excavation techniques and incorporating BMPs in marine environments, it is our opinion that Alternative 6N will result in significant releases of dioxins/furans to the San Jacinto River regardless of the BMPs utilized. These releases would be well above those releases calculated by the USACE.

Overview

The PRAP clearly states that the objective of the BMPs for Alternative 6N is to minimize the release of resuspended sediments and residuals to the San Jacinto River. The key word is "minimize", which is a relative statement and is a misleading term as it is used in the PRAP. Removal of the armor rock cap and excavation/dredging the underlying waste will inevitably result in releases of dioxins/furans to the river, and application of BMPs will control some of those releases, but certainly not all. The installation and presence of the armor rock cap has effectively rendered this site as a very poor candidate for subsequent removal of the cap's underlying waste. In the opinions of the authors of this report, the application of excavation/dredging on this site with the most appropriate dredging technology will result in extraordinary resuspension and residuals due to the presence of the armor rock cap. EPA has significantly underestimated the amount of releases to the river and does not know whether the BMPs will be able to be installed and how effective they will be.

Removal of the TCRA cap is unprecedented, world-wide. The TCRA cap was designed and installed to isolate the waste materials in the waste pits. EPA guidance on installation of interim measures like the TCRA cap requires that such measures be consistent with the final remedy. The cap was <u>not designed</u> to be removed; it was designed with EPA approval in accordance with engineering practices that would isolate the wastes from the river environment and withstand 100 year storms. Worldwide, caps have been successfully used for decades to isolate contaminated sediments, but no cap has ever been removed for remedial purposes. There is no experience from which to draw regarding the removal and the attendant generation and release of resuspended contaminants.

The USACE (2016) has provided a very good assessment of the remedial alternatives. However, in terms of resuspended sediments and creation and loss of residuals in the full removal action of Alternative 6N, the USACE's analysis underestimates the releases in their calculations. As explained in more detail below, the USACE underestimates the resuspended sediments and residuals in three areas: increased resuspension when removing the geotextile; a smaller dredging bucket will necessarily be used requiring more dredging passes; and loss of residuals under silt curtains. More significantly, they missed the two most significant sources: (1) loss of waste materials into the water column from rocks keeping the buckets from closing as they are bringing the wastes up from the bottom, and (2) the resuspension from the auxiliary boats servicing the dredge.

The predictive models used by the USACE are based upon empirical data about conventional excavation activities. In this case, the removal of an engineered armor cap consisting of rock and geotextile from impacted sediments has never been attempted, which means that there is no experience for estimating the resulting resuspension, residuals, and collateral contamination. However, experience on projects with similar attributes like the existence of some rock fragments and associated naturally occurring debris combined with the shallow water and riverine environment should have provided a reasonable foundation for extrapolating to anticipated results at this Site (Bridges et al. 2008).

USACE Calculations for Resuspended Sediments and Residual Calculations caused by Dredging

EPA recognized that there would be short-term impacts due to resuspension and residuals during construction:

> *Alternatives 4N, 5N, 5aN, and 6N each have short-term impacts associated with sediment residuals and re- suspension as well as a high-water event during construction. However, the actual impacts would be reduced to the maximum extent practicable by the use of Best Management Practices during construction, especially in Alternative 6N with the most extensive application of Best Management Practices (PRAP, page 34).*

As stated earlier, the effectiveness of EPA's BMPs are unknown, but more important is the fact that the USACE determination of resuspension and residuals greatly underestimates the potential releases of dioxin/furans in the water column and into the San Jacinto River. The formulas used by the USACE to estimate resuspension and residuals primarily addressed adhesion to the bucket, and do not consider the resuspension and residuals from buckets being blocked open, releasing some or all of the bucket's contents to the water column.

Professor Donald Hayes, Ph.D., author of the technical approach that was cited by the USACE to determine the amounts of resuspended sediments and residuals while dredging the San Jacinto Waste Pits, stated that the approach does not account for buckets blocked open releasing their contents into the water column, or for several other sources of resuspension and residuals. Dr. Hayes stated: *Several other actions associated with bucket dredging operations can also lead to resuspended sediment. These include debris, anchoring and resetting the dredge, "sweeping" the bottom sediment, barge overflow, and potentially other actions. The characteristic resuspension value* [i.e., from USACE calculations] *does not include contributions of these actions since they are not necessarily associated with all bucket-dredging operations* (Hayes 2016).

This resuspension of sediment from an open bucket far exceeds the suspension associated with adhesion to the bucket. Alternative 6N represents an unprecedented removal effort in that it involves an intentionally placed armor cap over the entire dredge area. Previously executed dredging projects have been performed in areas where much smaller volumes but varying degrees of rock fragments may exist. The presence of this armor cap and its remnants, in addition to other naturally occurring debris, will result in significant collateral contamination due to re-suspension. *This could result in half of the waste from the pits that will be dredged being released into the water column and the San Jacinto River* (emphasis added) (Bridges et al. 2008). The estimate of half the buckets being blocked from closing is based upon our experience in working many other dredging projects that have encountered debris in the material being dredged. The amount depends on the characteristics of the waste being dredged, whether they are like clay and are "sticky," or whether they are loose wastes (non-cohesive) easily dispersing into the water column from a jammed open bucket. The USACE stated they were slightly to moderately sticky (USACE 2016, page 92). The wastes are pulp mill wastes, described as containing wood fiber and not being very consolidated or cohesive, and therefore more likely to spill from an open bucket.

Based upon Table 12-19 in USACE 2016, if half the buckets were blocked open by cap rocks and spilled their contents into the water column in the Northwest area and Eastern cell deep water (dredging 24,500 metric tons of waste), a total of 32 grams of dioxin/furans would be released into the water column.[3] If the shallow water area of the Eastern Cell is also dredged and not excavated in the dry (a total of 58,000 metric tons of waste), the total released to the water column would be 72 grams. The USACE estimated that 2.0 to 2.37 grams of dioxin/furans would be released, as noted in Table 12-19 (USACE 2016, page 155), which is 0.34% of the total dioxins/furans to be removed from the pits. If the real release is 32 grams, that is over 5% of the total amount of dioxin/furans to be removed (Note that it is likely to be much higher as a result of the other underestimated sources discussed in this report.). As stated earlier, the USACE said that Alternative 6N would set the natural recovery of the site back by up to one decade, using the estimate of 2.0 to 2.37 grams (USACE 2016, page 166). How many more decades would the river be set back if they had included all of the sources of released contaminants?

[3] From Table 12-19: Total mass of dioxin/furans to be removed: 65 grams (NW Area is 44 grams and Eastern Cell Deep Water is 21 grams). Half spilled from blocked open buckets due to cap rocks is 32.5 grams.

Summary

Alternative 6N encompasses two general types of removal techniques: (1) “dry” excavation and (2) dredging or removal from beneath the water surface. While “dry” excavation may be performed within conventional BMP’s to reduce migration of particulates around the site or away from the site, EPA fails to adequately address the releases associated with all the sub-phases of this removal effort, including site preparation, mobilization of people and equipment, potential releases from storms, and the continual decontamination efforts on and around the site. More importantly, removal in the wet involving dredging wholly mischaracterizes the significant releases and expansion of the contamination footprint around the site by exposing the currently contained waste protected by the armor cap.

For Alternative 6N, the USACE (2016) estimated the amount of dioxins/furans released to the river system associated with most of the sources listed above. As shown in Table 12-19 in the USACE 2016, page 155, the total mass of contaminants released was 2.0 to 2.37 grams of dioxin/furans. Their technical estimating procedures were good. However:

- The USACE completely missed two significant sources of releases: (1) dredging/dredging bucket closure and (2) the spread of auxiliary and ancillary vessels servicing the dredge, barge, and site. These releases will dwarf the USACE estimated releases associated with bucket adherence and the other sources of release, such as sheet piles or silt curtains.

- In the dredging activities, the USACE also underestimated the amount of releases to the river from three of the sources, i.e., geotextile removal, a smaller bucket and more dredging passes, and loss of residuals under silt curtains.

- In excavation in the dry, the USACE did not consider the loss of residuals after the sheet piles are removed; while the excavated waste pits will be covered with two layers of clean fill, exposure to storms and flood waters will in time erode the clean fill into the river exposing the residuals to release to the River. In addition, exposure of waste materials to storm events during sheet pile installation around the Western Cell and Eastern Cell was not addressed. Finally, while dewatering facilities will be designed for a estimated volume for excavation in the “dry,” for the high turbidity water pulled from the pits due to seepage and upwelling, there is a great uncertainty regarding the volume to be dewatered and storms and flood waters may overwhelm the treatment plant, resulting in releases of contaminants.

Based upon dredging in the wet of the Northwest Area and the deeper waters of the Eastern Cell (24% of the removal project), releases to the water column are estimated to be over 10 times more than the USACE estimates. The USACE estimated that 2.0 to 2.37 grams of dioxin/furans would be released by Alternative 6N, or 0.34% of the total amount of dioxins/furans to be removed. This is in contrast to an estimate of 32 grams, or greater than 5% of the total dioxins/furans to be removed, based only upon the buckets being blocked open by the cap rocks. The other underestimated sources of releases detailed in this report would make this quantity much higher. The EPA should request the USACE to revise its estimates, and make this information available to the public.

<u>The Short Story: Rocks from the Cap versus Mechanical Dredging in the Wet</u>

- When the geotextile is removed, any remaining armor rocks on top of geotextile will sink into the wastes below.
- Rocks block open dredging buckets.
- Dredging of the waste pits would likely result in one half of buckets blocked open, losing much or all of the dredged waste in the bucket to the water column.
- Losing the waste from half the buckets in the Northwest Area and the deep water of the Eastern cell would mean that 32 grams of dioxins/furans (i.e., >5% of the total to be removed) would be resuspended into the water column and released to the San Jacinto River.

The USACE stated that "*The new Alternative 6N* with enhanced BMPs, despite its much smaller short-term releases compared to 6N would still <u>set back the natural recovery of the site back to existing conditions by up to a decade</u> considering the time required for design, construction and assimilation of the releases into the sediment bed below the bioactive zone*" (USACE 2016 page 5). Importantly, this statement does not take into account the additional significant sources of resuspended contaminants and residuals that were not adequately considered in the release calculations, i.e., releases from excavation in the dry, dredging and auxiliary vessels, geotextile removal, more dredging passes, and loss of residuals under silt curtains.

The opinion of the authors of this report is that Alternative 6N will result in significant releases of dioxins/furans to the San Jacinto River regardless of the BMPs utilized.

Finally, several significant implementability and constructability aspects of Alternative 6N were inadequately addressed or ignored by EPA. These include dredging in the "dry" and not actually addressing the seepage and amphibious removal actions (e.g., excavation of muck) behind sheet pile walls, determination of the BMPs in the Remedial Design Stage, cap and geotextile removal, installation of berms and sheet pile in the deeper waters of the Northwest Area or the Eastern Cell, more dredging passes and effort due to smaller and blocked buckets, impact of storms on construction actions, handling and transport of the many thousands of truck loads of dioxin/furans wastes through a highly populated county on the way to the undetermined location of the disposal site, and the impact of safety and personal protection gear on project efficiency and schedules.

Final Word

We thank you for the opportunity to share these observations with you. If you have any questions or if we can be of any further assistance to you, please do not hesitate to 0contact us.

Approved by:

____ Date: January 10, 2017

Ancil Taylor
Vice President
Bean Consulting LLC

____ Date:_January 10, 2017

Craig Vogt
President
Craig Vogt In

Appendices

Appendix A   List of References

Appendix B   Primer on Dredging and Dredged Material Disposal

Appendix C   List of Documents Reviewed

Appendix D   Resume’ of Ancil Taylor

Appendix E   Resume’ of Craig Vogt

Appendix A. List of References

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Appendix B. Primer on Dredging and Dredged Material Disposal

This appendix provides a general overview of dredging and how it may be applied to the San Jacinto site. The appendix is in four parts:

I Dredging Applications

II Mechanical Dredging

III Hydraulic Dredging

IV List of References

I Dredging Applications

Dredging options, in the context of this report, can generally be classified as either mechanical or hydraulic dredging. They each have their positive and negative attributes and properly weighing the implications of these various characteristics against the overall goal of the project is critical to achieving the desired outcome.

While it is expected that mechanical dredging would be used at the San Jacinto site in the implementation of Alternative 6N, hydraulic dredging is also described; the August 2016 USACE Report on the San Jacinto Waste Pits considered both mechanical and hydraulic dredging in its discussion. This section describes the operations and characteristics of mechanical and hydraulic dredging, including generation of residual contaminants in the water column, from real world practical experience and perspectives.

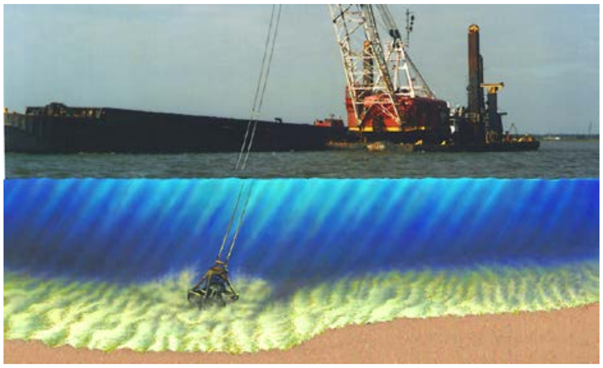
Selection of dredging equipment and the methods used to perform the dredging depends on the following factors (USACE 2004a):

- Physical characteristics of material to be dredged
- Level of contamination of the material to be dredged
- Quantities of material to be dredged
- Depth of material to be dredged
- Method of disposal or placement
- Distance to disposal or placement site
- Physical and hydrographical environment of the dredging area

- Dredge production capability
- Time, environmental, and economic limits of the project

The degree and significance of resuspension of sediments (and associated contaminants) and turbidity from dredging depends on four main variables:

- The sediments being dredged (size, density and quality of the material),
- Method of dredging,
- Hydrodynamic regime in the dredging and disposal area (current direction and speed, mixing rate, tidal state), and
- The existing water and sediment quality and characteristics (background suspended sediment and turbidity levels, and levels of contamination in water and in the sediments).




Mechanical Dredges. Credit: USACE and Great Lakes Dredge and Dock Company


Hydraulic Dredge and Pipeline Disposal. Credit: Ellicott Dredges unit of Baltimore Dredge Enterprises

II Mechanical Dredging

Characteristics of Mechanical Dredging

Mechanical dredging typically describes the use of excavation equipment that does not involve the use of water to entrain and move sediment. Excavation equipment varies from conventional clam shell buckets to fine grading excavation buckets with closing devices to reduce the escape of sediments and associated contaminants (i.e., residuals) during the excavation process. "Environmental" buckets of varying designs are touted for the benefits of removing sediments with limited sediment release. The effectiveness of these various mechanical buckets is very site dependent.

Productivity per unit of mechanical dredging equipment is usually lower than hydraulic dredging. Mechanical dredging is commonly used when some or all of the following project requirements are an important execution goal:

- Transport distance of the dredged material is beyond the economically feasible distance of pipeline transport of the sediments.
- Excess water or added water needs to be minimized in the removal and transport phase of the project.
- The existence of debris (e.g., armor rocks over the cap) involved with the sediments would be too extensive to be attempted by hydraulic removal.
- Real-time inspection of the sediments in the bucket at the point of removal is an important aspect of the project.
- The deployment of large cutting forces are necessary to dislodge the sediments from their in-situ position.

Transport of Dredging Material to the Disposal Site

Sediment transport in the mechanical dredging arena typically does not involve a slurry of dredged sediment and water. Dredged material is loaded into a hopper barge or scow to be moved to another location and unloaded. Optimizing transport cost usually includes reducing if not eliminating added water into the transport phase.

The transport sediment concentration in the barge by volume can exceed 80% and approach 100% if loading of the barge is carefully managed. This also depends upon the geotechnical characteristics of the material being dredged (e.g., consolidated clay materials verses unconsolidated materials such as is expected in the San Jacinto Waste Pits). This compares to the 6-15% concentration by volume for hydraulic dredging, described in the next section.

The barges carrying mechanically dredged sediment would generally fall into two categories in the context of the SJRWP project. Other types of barges certainly exist but may not be appropriate for application on this project.

- Deck barges with sealed coaming around the perimeter of deck will carry its load above the deck level. It will usually draft less than a hopper barge due to its lighter construction and generally smaller load. The loaded center of gravity will be higher than on a hopper barge making it less stable.

- Small sealed hopper barges, commonly used for bulk commodity transport on the Mississippi River and other major river systems, are often used when dredged sediment is expected to be unloaded rather than discharged by opening the barge bottom. Their dimensions vary from 195 - 200 feet in length while their width is typically 35 feet. Unloading can be performed mechanically or hydraulically, depending upon the project conditions. Their draft will be slightly greater than a deck barge and when loaded will be 9-10 feet.

Transporting mechanically dredged sediment via barge is an economical and relatively safe form of transport for non-fluid dredged sediment. While it may be wet, if the material is not a fluid mud, it is less likely to liquefy and cause violent shifts in the trim and tilt of the barge.

In rare instances, conveyors are used to move dredged material short distances around a project site. The mechanical dredge may load a hopper that feeds a conveyor. The conveyor transports the material to a more convenient location for bulk transport.

The conveyor option can also be configured to further reduce the added water being delivered to the bulk transport vessel. This water might be allowed to flow back to the point of dredging or captured for processing/treatment.

Creation of Residual Sediments/Waste Materials in the Water Column.

In general, compared to hydraulic dredging, less agitation and suspended sediments occur with mechanical removal. Residuals will result from mechanical removal. If the bucket is lowered beyond the depth that exceeds the bucket's volumetric capacity when closed (dredge operators can control this to a degree, but it depends on external factors such as tides, waves, wind and accuracy of the existing seabed elevation survey), sediment will be extruded from the bucket as it closes. Controlling where that material is displaced is beyond the control of the dredge operator. It may extrude to the sides of the bucket, or if the bucket has water vents, it may extrude through the vents. Residuals will also occur as the sediments overflow or are washed out of the bucket as it is lifted to the surface and to the barge. Residuals also occur from washing cohesive sediments off the bucket when it is raised from the water (Figure 1). Currents in the dredge area as well as the characteristics of the sediment (e.g., fine materials do not settle rapidly) determine how far in the San Jacinto River the sediments will migrate.

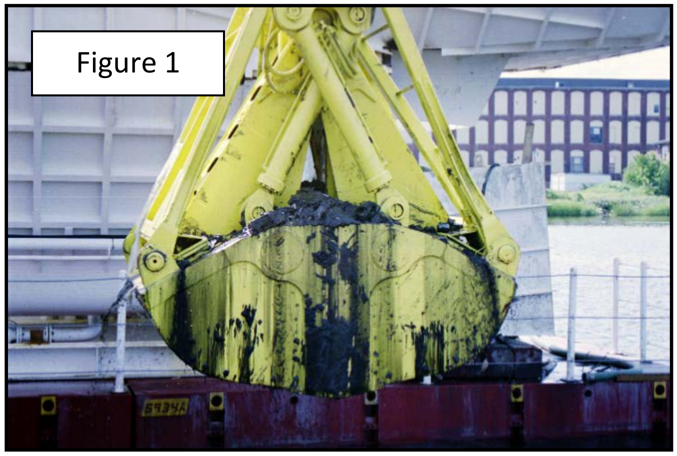


Figure 1

As noted above, sediments removed from the bottom with a mechanical bucket are subject to being distributed through the water column as the bucket rises from the bottom. These actions occur due to multiple causes.

- In the dredging of cohesive sediments like clay, adhesion to the bucket as it is removed from the bottom occurs. As the bucket moves through the water, these sediments are washed from the side of the bucket and into the water. Currents in the dredging area determine how far the fines settle from the dredging area.

- The most significant cause of suspension of sediments results from the lack of bucket closure. This non-closure can be due to bucket design as depicted in Figure 2 or from debris dredged from the bottom (along with the sediment) that keep the bucket from closing, jamming the bucket open. The bucket in Figure 2 is a conventional open clamshell bucket. It is open on top and sediments are free to overflow the bucket through the water column and continues to do so as it is lifted and placed in the barge. This bucket would not be considered an "environmental" bucket. In other cases, the most sophisticated "environmental" buckets perform with very similar results as depicted in Figure 3.

Environmental buckets are advertised to minimize resuspension of contaminants, effectively remove all sediments, minimize the amount of water removed, and reduce over-dredging. In some cases, these attributes are on target, but in other dredging situations, there are the same issues as with open bucket dredges. For example, these issues include debris blocking the bucket from closing releasing the contaminated sediments into the water column, and sediments washing from the outside and inside of the bucket when raising and lowering the bucket in the water column.

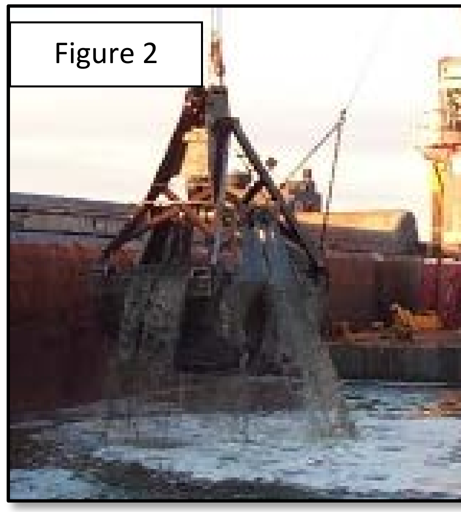


Figure 2

In the context of the SJRWP site, the issue of bucket closure and loss of sediments and residuals is even further exacerbated due to the presence of significant amounts of rock, trash and other debris. In Figure 4 this bucket is a powerful hydraulically powered environmental clamshell bucket removing sediment from a seabed. The bucket could not close due to the presence of rock and other debris and therefore, much of the sediment is lost through the water column as it is lifted to the material barge. Fortunately, the sediments were not contaminated. On many sites, the presence of naturally occurring organic and inorganic debris presents challenges to safe and effective removal of sediments from the bottom.

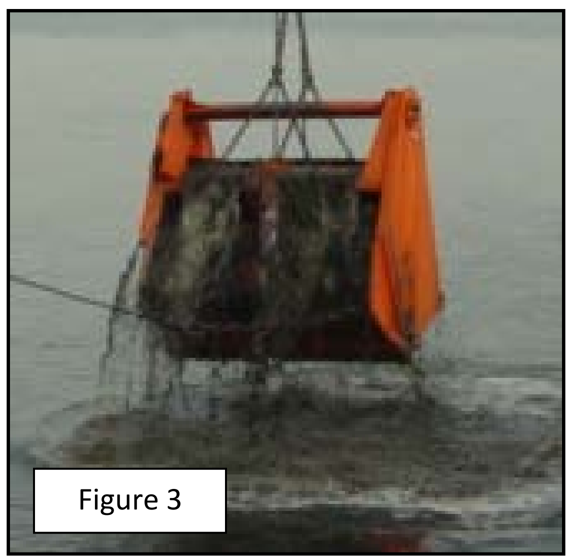


Figure 3

The addition of the armor cap to the SJRWP site greatly exacerbates this already challenging removal effort. The formulas applied to the resuspension calculations in the

USACE report do not consider these conditions. This resuspension of sediment from the bucket removal far exceeds the suspension associated with adhesion to the bucket. This open bucket condition while lifting through the water column could be expected on well more than ½ of the bucket grabs from the dredging footprint. This could mean that up to half of the waste from the pits that will be dredged could be released into the water column and the San Jacinto River. It depends on the characteristics of the waste being dredged, whether they are like clay and are "sticky," or whether they are loose wastes (unconsolidated) easily dispersing into the water column from an open bucket. The USACE (2016) assumed the wastes were slightly to moderately sticky, and the geotechnical data confirm that the wastes are fibrous pulp mill wastes that do not appear to be consolidated. Currents in the dredging area determine where and how far these sediments and residuals will migrate.

One additional note on the characteristics of mechanical dredging: the bucket will reshape the bottom surface, and if the mechanical dredge bucket is scallop shaped, it may have created a depression into the sediments below. Some of the suspended contaminated sediments agitated and released into the water column may settle onto the undisturbed sediments below the dredging cut. This becomes an issue when the last dredging pass occurs and contaminated residuals settle onto what is expected to be clean sediments.

Figure 4

Positioning of Mechanical Dredges and Barges, and Creation of Residuals

Called the spread, mechanical dredging equipment includes the dredging vessel, the dredged material scows or barges, towing vessels and smaller boats for surveying, scientific and analytical assessments, ferrying equipment and crew around the site, and managing turbidity curtains. Tug boats positioning barges for loading and subsequent transport to the placement area is a continuous operation. Significant erosion of bottom sediments and turbidity occur around the vessels as propeller torque is utilized to position barges safely and effectively, especially in shallow water.

Mechanical dredges employ various anchoring means to control their position on the sea-bed. In most cases, the combination of spuds and anchors embedded in the sea-floor provide that positioning control for the dredge. Spuds are steel poles of varying diameters and weight to permit the dredge to advance position or hold one end of the dredge in a fixed position. The spud must embed itself into the sea bottom to provide sufficient counter force to the other forces acting on the dredge hull from the dredging actions. The spud will penetrate softer sediments until it reaches either an equal resistance to penetration at the spud tip or from skin friction along the outside wall of the spud. In many cases, each spud penetration extends through the sediments being targeted for removal and into the underlying clean sediments, providing a pathway from the upper sediments into the underlying clean layer. The spud penetrations, depending upon the dredge dimensions can be every 2-10 feet along a dredge cut.

One other feature common in the mechanical dredging application is the use of spuds that actually power down into the bottom. As the excavator pulls a bucket through the sediment, the spud provides the anchoring necessary to keep the barge from being pulled to the bucket. The mechanical excavator is allowed to utilize its high breakout forces to dislodge sediment from the bottom.

Spread of Ancillary Equipment and Sediment Suspension in the River

Every hydraulic dredging operation usually comes with a spread of ancillary equipment. Tugs, pipelines, barges, boats and other floating equipment associated with the dredge are necessary to facilitate the dredging action. Turbulence from the equipment impacts bottom sediments. These impacts result in suspension of these sediments into the water column. Figure 5 depicts the impacts and resuspension of sediments caused by a barge and boat operating in the vicinity of a dredge. This occurred in an area that was yet to be excavated. The suspended sediments drifted and settled in an area that had previously been dredged to grade where a previously cleaned bottom once existed.

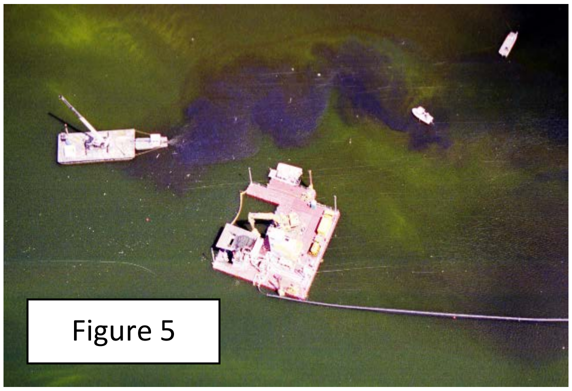


Figure 5

- Tugs or workboats are necessary

to maneuver floating equipment around a dredge site. In many occasions, the areas to be dredged are typically very shallow. In the context of the SJRWP, the draft will be restricted. Impacts from propulsion equipment, including bottom strikes with the propellers and rudders are practically unavoidable at these shallow depths. In every case, these impacts will result in suspension of sediments into the water column.

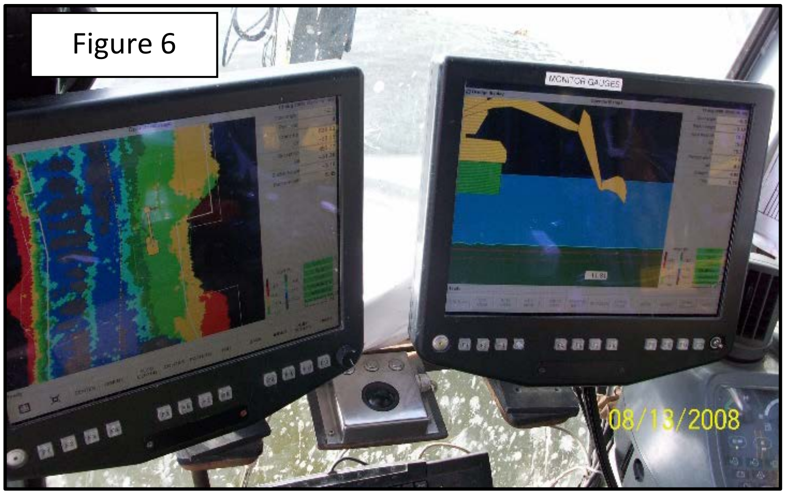
- Pipelines for conveying the material to its ultimate destination are also a necessary component of a hydraulic dredge. Pipelines can either be floating or submerged and lying on the bottom. If floating, they are typically held in position by anchors as described above. The floating pipelines may have pontoons or floating collars to provide sufficient buoyancy. In a shallow water environment, these pipelines and their associated flotation equipment also come in contact with the sediments and cause suspension.

- Various support barges for cranes, derricks and / or supplies are also typically complementing a dredge spread. They are also positioned with spuds and anchors in and around the dredge area to support the dredge vessel. Similarly, they impact the sea bottom and cause suspension of sediments in shallow water environments.

- Small vessels for carrying crew members, turbidity monitoring, surveying, turbidity curtain management, etc. are also important to the overall presence of the dredge spread. Similarly, these smaller boats also cause suspension of the sediments into the water column from their propulsion and strike impacts with the bottom sediments.

Accuracy of Mechanical Dredging

As with the hydraulic dredge, the location of dredging can be theoretically reported to the millimeter. In truth, the actual location may vary by more than a foot from what is being reported. Tidal measurements, trim and tilt of the vessel, accuracy of sensors and operator proficiency combine to multiply the errors, which result in the actual inaccuracy of the mechanical dredge. Re-animation of the mechanical equipment in relation to targeted dredge locations mitigates the inaccuracy of the dredging process by assisting the dredge operator in visualizing the process (Figure 6). Routine calibration of the equipment along with frequent surveys to update the digital terrain models is necessary to attain the maximum degree of accuracy.



III Hydraulic Dredging

Hydraulic dredging incorporates the use of water at the excavating point to entrain, lift, and carry excavated material in a slurry of sediment and water into a pipeline for disposal. Hydraulic dredges are identified by two primary types. They are the pipeline cutterhead dredge and the trailing suction hopper dredge. The hydraulic dredge works by dislodging bed sediment and hydraulic removal of the sediment from the bed of the waterway by suction pipe.

The hydraulic pipeline dredge has an active cutterhead that rotates and dislodges the sediment from the bed. This allows the suction, created at the cutterhead by the suction pipe and pump, to capture the sediment, pull it up the suction pipe, and then be pumped through the discharge pipeline to the disposal or placement site. A booster pump is used for extending distances to the disposal site. The pipeline dredge is not self-powered. It moves through the cut using the “walking” spud and the holding spud, thereby allowing the dredge to move forward as it swings the cutterhead from left to right and return.

Hopper dredges are ships designed for dredging. The trailing suction hopper dredge is a self-propelled seagoing vessel equipped with a suction pipe, which hangs over the side of the vessel or through a well in the hull. The sediment and water slurry is transported through the pumps just as the pipeline dredge, but when the sediment and water slurry passes through the pump to the discharge pipeline, it is discharged immediately into the hopper of the dredge. When the hopper is full, the sediment and water slurry are transported by the ship to the disposal site.

Productivity is a significant attribute of hydraulic dredging, which yields a relatively high ratio of production per unit of equipment and effort. That high ratio typically results in a favorable cost efficiency for dredging. That cost efficiency helps to offset the typically higher cost of a mobilization effort associated with non-hopper dredge hydraulic dredging. The larger the quantity of material to be dredged, the greater the opportunity to reduce fixed costs per cubic yard by amortizing mobilization cost over the larger quantity.

Transporting Hydraulically Dredged Material to the Disposal Site

Hydraulic dredging will generally continue to utilize the entrained water throughout the transportation phase, regardless of the transportation distance. The transportation phase could be as limited as transferring it to a nearby or onboard hopper compartment as in a hopper dredge or as distant as tens of miles through a pipeline to a remote location.

Hydraulic dredging is typically found where large volumes of water do not represent a significant challenge to the success of the project. Slurry pipeline transportation is an economically feasible mode of sediment transport under certain conditions. The carrying medium, usually water, must be accommodated at the terminal end of transport. Often, the water is allowed to simply return to a body of water after various degrees of effluent monitoring and control.

Sediment concentrations in the pipeline will vary significantly with project site specific conditions. Typically, concentrations are measured in % concentration by volume referencing the in place or in-situ volumetric measurement or % concentration by weight, referencing the % represented by the weight of the sediment particles in the slurry.

- In the context of the San Jacinto site, hydraulic dredge transport via pipeline, sediment concentrations by volume could average 6% – 15%. The water in the slurry would have to be separated from the sediments to allow for disposal, and that discharge would be considered added or free water that must be addressed as effluent.

- The added water is entrained in the suction when the sediments are pulled by suction from the sea-bed. The entrance velocity of the water scours the sediments and lifts the material into the suction pipe. Appropriate pipeline transport slurry velocity keeps the sediment suspended in the pipe to mitigate the risk of pipeline blockage and plugging. The larger or coarser the material being transported, the higher the transport velocity necessary to reduce risk of pipeline blockages. The higher velocity generally means higher volumes of water and more dilute sediment concentrations in the pipeline. With the existence of the rip-rap and rock cap from the earlier installed TCRA, this significantly exacerbates the risk of pipeline blockages and requires the use of significantly higher slurry velocity than would have otherwise been necessary without the rip-rap / rock armor cap.

Transport of Dredged Sediments by Barge

Barges are also used to accompany hydraulic dredging applications for long distance transportation. While the same pipeline blockages and dynamics discussed above still apply, the risk is minimized by the shorter pipelines used in a barge loading application. Sediment concentrations may remain comparable to those noted above for site-specific reasons; therefore, barge cargo efficiency will be very low if overflow of the slurry is not permitted. In the context of the San Jacinto project, barge overflow is highly unlikely due to the very high percentage of suspended sediments in the overflow effluent, which would contain dioxin and furans.

Transporting slurry by barge also comes with a significant risk of barge instability. Sloshing of the dredge material slurry within the barge hopper shifts the barge displacement, balance measurements and increases risk of loss of vessel integrity.

- In 1995, a barge carrying sediment unsuitable for ocean disposal removed from the Port of New York and New Jersey, spilled some of its load. The contractors' approach was to deliver the sediment via barge to Corpus Christi, Texas, where it was trans-loaded to rail and shipped to Utah. During one of the barge trips down the east coast, the barge carrying dredged sediment suffered an accidental loss of some of its cargo outside the Port of Charleston, spilling some of its dioxin laden sediment load across the seabed. https://incidentnews.noaa.gov/incident/7112

- In 2008, on the Miami River, a barge carrying dredged sediments (Figure 7), working in an area where unexploded ordnance, UXO, were discovered. The barge suffered a catastrophic structural failure and sank in the Miami River.

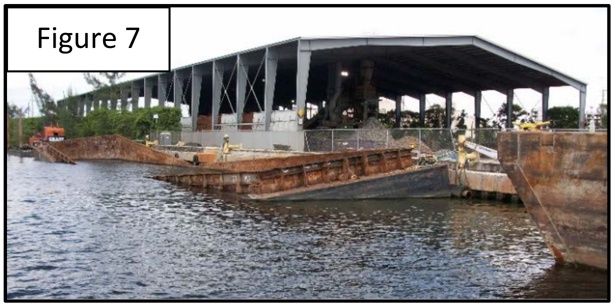


Figure 7

Creation of Residual Sediments/Waste Materials in the Water Column

The hydraulic process incorporates the use of direct excavation or scouring to dislodge the sediments from the seabed. Cutter heads, augers, water jetting or simply plain suction devices are tools used in this hydraulic application. These tools rotate at varying speeds as necessary to effectively excavate the sediment while attempting to minimize consequential releases of the sediments into the water column.

In all cases, sediments are dislodged and, unfortunately, when they are not entrained by the suction pipe, are suspended into the water column with varying deposition velocities. The action of excavating or agitating the bottom sediment (or in the case of San Jacinto site--the dioxin and furan wastes) at the suction mouth prepares the sediment to be lifted into the suction mouth. On average, approximately 70% of that sediment which is agitated is actually removed by the suction mouth. The remaining 30% is suspended in the water column or left behind as residuals, and will settle to the bottom eventually, but in the meantime are considered re-suspended solids in the water column. Depending upon the falling velocity of the particles, they may drop immediately to the bottom or they may drift in the water column as currents affect the resultant vectors on the particles.

The 70% factor can be improved to a higher removal effectiveness by remaining in one location with the suction mouth while more of the sediments are lifted to the suction mouth. Removal efficiency can be as high as 90% with significantly increased added free water and lower slurry concentration. Higher slurry concentrations can also be achieved with much lower removal efficiency and with residuals exceeding 50% of the sediments agitated.

This excavation and agitation process mixes overlying sediments with underlying sediments. For example, if the target layer of sediment to be removed is 5 feet thick and lies above a layer of clean sediment, the bottom of the excavation would technically 7.1 feet, causing a mixing of the upper and lower clean sediments. This is because only 30% of the targeted sediment for removal will not be pulled into the pipeline (i.e., (5/.7)-5) and the dredge will need to dredge deeper to ensure that the targeted five feet of sediment is removed. Unfortunately, that action has now resulted in 2.1 feet of previously clean sediment that has been mixed with the upper layer of contaminated sediment.

Figure 8

Resuspension of sediments by hydraulic dredging also occurs as a result of non-sediment obstacles like trash and debris, both organic and inorganic. Often, trash and debris obstructs the hydraulic transport by blockages in the suction pipe, the pumps and other appurtenances associated with the sediment transport or the discharge piping (Figure 9).

These interruptions typically result in reverse flow back wash events that disperse the previously removed sediments back through the suction pipe across the seabed (Figure 9). Depending upon the source of water for the back wash event, scour of bottom sediments can occur of previously un-impacted sediments from the bottom and suspend them into the water column as well. In the context of the SJRWP site, the presence of rock and rip rap remnants associated with the armor cap significantly exacerbates the frequency of these reverse flow back wash events in a hydraulic removal process.

Figure 9

<u>Positioning of Hydraulic Dredges and Creation of Residuals</u>

Hydraulic dredges, except for hopper dredges, employ various anchoring means to control their position on the sea-bed. In most cases, the combination of spuds and anchors embedded in the sea-floor provide that positioning control for the dredge.

Spuds are steel poles of varying diameters and weight to permit the hydraulic dredge to pivot around a fixed position or hold one end of the dredge in a fixed position. The spud must embed itself into the sea bottom to provide sufficient counter force to the other forces acting on the dredge hull from the dredging actions. The spud will penetrate softer sediments until it reaches either an equal resistance to penetration at the spud tip or from skin friction along the outside wall of the spud.

In many cases, each spud penetration extends through the sediments being targeted for excavation and into the underlying sediments, providing a pathway from the upper sediments into the underlying clean layer. The spud penetrations, depending upon the dredge dimensions can be every 2-3 feet along a dredge cut.

Anchors are also used to manage the position of a hydraulic dredge. They are attached to the swing wires to permit the dredge to swing from side to side to excavate its path through the material. Anchors may also be used on a “Christmas Tree” type of positioning system in the place of spuds.

Depending upon the type of anchors being deployed, penetration depths can exceed the depths of spuds in order to provide the same holding capacity. Anchors also drag across the bottom during the anchor setting process. Disturbing the sediment along the seabed is necessary for anchors to “set”. The wires and chains attached to the anchors also drag along the bottom as the dredge moves through its dredging procedure. These sediments are not entrained in the dredge’s suction pipe due to their remote location from the dredge, 10’s to 100’s of feet away. Some dredges avoid the use of anchors by the use of a swinging ladder technology. This technology employs more spuds to position the dredge, increasing the number of spud penetrations through the sediments into the bottom.

Some dredges also incorporate the use of remotely located anchoring devices, sometimes referred to as “dead-men” to attach the swing and stern anchoring wires to. While these dead-men are commonly positioned outside of a sensitive footprint, around the perimeter of a dredge area, they do not protect the sea-bed from the disturbances caused by the connected wires and anchors. In fact, because of the extra lengths of wires and chains associated with the remote distances to the perimeter of a site, the seabed areas impacted can far exceed the conventional applications of anchors and spuds.

Accuracy of Hydraulic Dredging

Hydraulic dredging accuracy depends largely upon the positioning technology employed by the dredge. Technology has come to a point where it can theoretically report the position of dredging to within millimeters.

In truth, due to numerous practical limitations, the vertical location of actual removal can usually be established within a foot or so with careful control by the operator. Water elevation, tidal impacts, operator proficiency, cutter or auger dimensions and effectiveness all combine to impact accuracy in the vertical plane.

Horizontal positioning is usually less accurate but can usually be determined within a few feet, depending upon the technology. In the context of the SJRWP, the vertical component of positioning is more critical to the effective removal of the sediment.

IV List of References for Appendix B

USACE (Earl Hayter, Paul Schroeder, Natalie Rogers, Susan Bailey, Mike Channell, and Lihwa Lin); Engineer Research and Development Center, Evaluation of San Jacinto Waste Pits Feasibility Study Remediation Alternatives, August 2016.

U.S. Army Corps of Engineers and U.S. Environmental Protection Agency (May 2004a) Evaluating Environmental Effects of Dredged Material Management Alternatives---A Technical Framework. EPA842-B-92-008.

Appendix C. List of Documents Reviewed

The documents reviewed include:

A. USEPA Action Memorandum and Appendix A Memorandum – April 2010

B. Revised Draft Final Removal Action Completion Report San Jacinto River Waste Pits Superfund Site – March 2012

C. Draft Final Interim Feasibility Study Report San Jacinto Waste Pits Superfund Site – March 2014

D. Evaluation of the San Jacinto Waste Pits Feasibility Study Remediation Alternatives – USACE August 2016

F. San Jacinto EA Cost Estimate – August 2016

G. San Jacinto EA Engineers Estimate – August 2016

H. Draft National Remedy Review Board Recommendations for the San Jacinto River Waste Pits Superfund Site—September 23, 2016

I. USEPA Proposed Remediation Action Plan (PRAP) – September 2016

J. USEPA Final Interim Feasibility Study (FS) – September 2016

Appendix D. Resume of Ancil Taylor

Education:

1974 – 1978   University of Southern Mississippi - Hattiesburg, MS
Bachelor of Science – Construction Management
President of Associated General Contractors (Student Chapter)

CURRENT POSITION

Vice President – Bean Consulting LLC

President – Bean Environmental LLC

Vice President – Bean Dredging LLC

Vice President – C.F. Bean LLC

Training & Accreditations:

Mr. Taylor has over thirty eight (38) years of direct experience in the field of marine dredging and related marine issues. His experience includes numerous coastal restoration projects along the Gulf and East coasts of the United States.

Mr. Taylor has also been involved in the maintenance as well as expansion of this nation's ports through the deepening and widening of many of the offshore entrance channels and navigation channels along all coasts of the United States.

As President of Bean Environmental, Mr. Taylor managed one of the most technically progressive and innovative marine dredging remediation companies in the United States. He has studied and developed science in the transportation of dredge slurries in addition to many aspects of the dredge production process. He holds a patent for development and implementation of the Slurry Processing Unit, SPU.

Mr. Taylor has served as the Chairman of the Board of the Western Dredging Association, WEDA. WEDA is the largest of three divisions of the World Dredging Association, WODA. Mr. Taylor also served as Chairman of the World Dredging Conference, WODCON. He has been consulted in various dredging sciences by the Marine Board of the National Academy of Science. Mr. Taylor was recognized and honored in 2011 by receiving the "Dredger of the Year" award for the western hemisphere as testimony to his outstanding and remarkable achievements in the dredging industry.

Mr. Taylor is currently serving as Vice President of Bean Consulting LLC (BCLLC) assisting its clients with developing solutions for a broad range of dredging challenges.

Mr. Taylor serves on a team of BCLLC experts as a specialist in dredge project characterizations, developing solutions for complicated and sensitive dredging applications and performing constructability reviews. His decades of experience in connecting the most challenging dredging requirements with science based practical solutions has resulted in a list of very successful projects for his clients. He identifies project needs and develops specific dredge equipment requirements to meet those needs and accomplish project goals.

PROJECT EXAMPLES and a BRIEF DESCRIPTION

- ***Bayou Bonfouca***, a Superfund Site in Slidell, Louisiana involved the removal and incineration of creosote from the waterway. Project value of $112,000,000

Background: A creosote plant began operations along the Bayou Bonfouca waterway in 1882. During operations, numerous releases of creosote occurred from spills, runoffs and discharges. In the early 1970's, a fire at the plant ruptured on-site storage tanks resulting in creosote flowing into the bayou and continuing about a mile downstream.

Challenge After a thorough site characterization, Bean and Mr. Taylor were asked by the successful offeror, IT/OHM, to identify, develop and implement solutions to the following project challenges:

1. **Removal Accuracy -** Remove the identified contaminated sediments from the water bottom with minimal incorporation of clean native sediments. The cost of incineration of these sediments required the absolute minimum removal and processing of the native clean sediments. A dredging solution needed to be developed that would slice through, segregate and separate the upper contaminated sediments from the underlying clean native material.

2. **Sediment Transportation Safety –** The contaminated sediments were to be transported to a dewatering facility on shore. Containment of the contaminated sediments during transportation was critical along this waterway and through this pristine neighborhood.

3. **Slurry Pre-processing –** The contaminated sediments were to be introduced into the dewatering plant to create filter cake for incineration. The optimum slurry for the client was identified as having a solids by weight concentration, $C_{w,}$ of 17% – 19%.

4. **Protection of the site environment –** Minimizing resuspension of the contaminants in the waterway was critical to the success of this source control project.

5. **Capping –** The capping strategy was intended by the client to re-shape the water bottoms after dredging to reinforce and stabilize the existing footprint of the bayou to protect the newly installed sheet-pile wall and surrounding property. Placement accuracy of the cap and safety was critical to achieve success.

Solutions Developing the right solution required the full integration of the entire project development team. The goal of remediating the largest Superfund Site awarded to that date while achieving an **Overall Outstanding Performance Evaluation** from the United States Army Corps of Engineers was achieved through combining innovation with proven practical applications.

1. **Removal Accuracy –** After a high resolution geotechnical investigation designed to identify the horizontal and vertical limits and extent of contamination was completed, a digital terrain model, DTM, was prepared to depict the required dredge excavation limits more clearly. The DTM created a model that more closely resembled an undulating golf course fairway than a typical river channel bottom.

   A dredging system that provided accuracy and stability to the excavation equipment while engaging the water bottom and removing contaminated sediments was necessary. The highest accuracy could only be achieved if the barge could be stabilized to counter the movements associated with winds, tides, currents, excavation forces and the like. Bean and Mr. Taylor designed, built and operated the nation's first marine excavator, the *Bonacavor,* for this project. This dredge was designed to excavate sediments with high accuracy (< 2inches) from the waterway. The first generation marine excavator monitoring system was developed by Bean for this project to re-animate the location of the bucket and the desired dredging limits on a computer screen for the operator to clearly navigate.

   The combination of the highly accurate bucket monitoring system and the high resolution DTM available to the operator on the computer screen resulted in an unprecedented average of 0.18 feet of dredging occurring outside of the design limits of the DTM.

2. **Sediment Transportation Safety –** After removal of the sediments from the bottom, it was necessary to transport the material to the site's processing plant up to ¾ of a mile away. While odor, volatiles and aesthetics were key design parameters, safety from unintended discharges was the primary concern. Bean and Mr. Taylor developed a slurry system composed of proprietary dual containment pipelines, flanges, and pressure sensors to provide two layers of protection for the local environment from the contaminated sediments. The slurry was successfully conveyed to the processing site with no loss of containment throughout the life of the project. This system was later referred to as the "Hybrid Mechanical / Hydraulic" dredging approach invented by Mr. Taylor.

3. **Slurry Pre-processing –** The client requested processed slurry for introduction into the dewatering facility from the dredge. While conventional hydraulic dredge systems typically convey slurry concentrations that may vary by more

than a magnitude; that level of variability would significantly increase the cost of water treatment on this project. The client determined that a slurry concentration of 17% – 19% C_w would be optimum due to viscosity characteristics. Mr. Taylor researched existing technology and combined new technology to invent and develop the patented Slurry Processing Unit, SPU. http://www.google.com/patents/US5269635

This new technology resulted in significantly less water and cost associated with the processing of sediments on the site.

4. **Protection of the site environment –** Along with the measures described above, additional protection along the waterway was installed. Turbidity curtains and log booms were continuously managed to reduce migration from the mixing zone of re-suspended solids around the waterway.

5. **Capping –** A capping strategy was requested by the owner and developed by Bean for the project. The placement techniques were based upon the dexterity, flexibility and accuracy of the marine excavator, *Bonacavor*. As a result of the unprecedented accuracy and effectiveness of the dredge and its crew as described above, the capping phase was deemed not necessary and never implemented.

Bean was awarded the coveted ***Overall Outstanding Performance Evaluation*** by the owner, the USACE. Remarkably, the science, technology and automation of the dredging and transportation applications were developed by Bean and Mr. Taylor almost 25 years ago.

- ***New Bedford Harbor, Pre-design Field Test (PDFT)***

Background: Foster Wheeler Environmental Corporation was contracted by the New England District of the United States Army Corps of Engineers to identify potential dredge solutions for the remediation and removal of PCB's from the New Bedford Harbor. http://www3.epa.gov/region1/superfund/sites/newbedford/ar/23780.pdf

Challenge: To develop a dredge solution to deliver highly accurate removal effectiveness of contaminated sediment, transport it safely to a confined disposal facility, CDF, while minimizing the amount of added water into the slurry creation and transportation phase.

Removal Accuracy – A high resolution geotechnical investigation identified the dredging limits. The digital terrain model, DTM, depicting the required dredge limits was combined with Bean's proprietary bucket monitoring system to provide the high accuracy removal. After dredging surveys conducted by the client revealed 95% of the measurements within ± 6 inches and 90% within ± 4 inches of the target elevations. This level of accuracy exceeded the expectations of the client and set new standards for accuracy and performance in the application of dredge technology in environmental remediation projects.

Transportation Safety and Effectiveness – as was described in the Bayou Bonfouca project, transportation safety is a critical design parameter for contaminated sediments. Ensuring maximum protection for the site and local environment was achieved through hydraulic transportation to the CDF. The volatiles were contained within the pipelines and the pipelines were successful in preventing unintended releases.

This project also had significant cost exposure to water treatment and it became evident after some investigation by Mr. Taylor that leveraging up on his patented Slurry Processing Unit, SPU, would be economically feasible for the USACE to implement on this project. Mr. Taylor developed a modified SPU that allowed Bean to effectively recirculate make-up water from the CDF back to the SPU located on the dredge. While the SPU delivered a steady slurry concentration of 13.3% to 16.3% C_w, the average overall concentration by volume, C_v, at the end of the project achieved an unprecedented level of 70% due to the newly patented recirculation system. This level of transportation efficiency in regard to added water is more than a magnitude greater than traditional applications associated with environmental projects.

According to the conclusions reached by the client, the hybrid mechanical / hydraulic dredging system developed by Bean and Mr. Taylor ***"demonstrated dredge performance values exceeding that which have been previously achieved in the New Bedford Harbor site in the areas of dredge production, accuracy and slurry solids concentrations."***

- ***International Paper / Port of Pascagoula – Moss Point, MS***

Background: The Port of Pascagoula, Mississippi developed an opportunity to beneficially use dredged material obtained from an expansion project within the Port to cap a legacy site from a plant closure associated with International Paper.
http://money.cnn.com/2001/04/25/news/ip/index.htm
This site in Moss Point, Mississippi included two settling ponds that required a cap to segregate the underlying sediments from the water column in the lakes.

Challenge To develop a dredge solution to excavate soft (So) to stiff (St) Clay (CL) and (CH) down to elevation -60 feet, safely transport the dredged material to a placement site approximately 21 miles away, prepare the dredged material for hydraulic transport and capping lake bottom sediments in water depths varying from 5 to 20 feet.

Solutions

Excavation, Loading and Transportation – To ensure the maximum transportation efficiency, the material removed during the expansion project should be loaded into barges mechanically. This minimized the amount of added water introduced during the excavation phase. Transportation barge drafts were limited by channel depths to the placement site so unnecessary tonnage associated with added water would reduce the amount of dredged material that could be loaded per barge.

Once a material barge was fully loaded with dredged material it was transported to the placement site along the 21 mile journey. The transportation route required maneuvering through narrow recreational waterways not accustomed to accommodating large boat and barge traffic. Safety of the public, surrounding property, our crews and equipment were paramount and resulted in zero incidents associated with the transportation phase throughout the life of the project.

Unloading, Slurry Processing and Capping – Upon arrival of the material barge at the unloading site; the dredged material was introduced into the Slurry Processing Unit, SPU. The CL and CH would be reduced to a slurry matrix and introduced into a pipeline for transportation through the final one mile distance to the lakes. The slurry exited the pipeline at the capping barge floating on the lake. The capping barge included a positioning system composed of multiple winches and wires, a control room for the operator, a monitoring room for tracking the cap placement location and accuracy. The capping barge also utilized a custom designed baffle configuration to address the unique slurry matrix composed of the various types of clay exiting the capping barge. The monitoring room provided the necessary accommodations for the on-site surveyor / engineer to quickly process survey data gathered throughout the day. The survey data was used to create differential charts, “Diff Charts”. These charts clearly depicted the thickness of the cap as it was created, continuously guiding the operator during his cap placement operation.

This project was an excellent example of utilizing a clean dredged material asset from the Port’s capital expansion project to execute a site close-out obligation on a legacy site more than 20 miles away. This project was performed On Budget and On Schedule.

In fact, the Port decided to capitalize on its success by adding additional scope to the project and perform additional work in the vicinity in the same manner.

- **Miami River – Miami, Florida**

Background: The Miami River was first dredged in the 1930's to facilitate small ship traffic ferrying cargo to and from various Caribbean destinations. The channel had never been maintained since its original construction and silted in with sediments, debris, and contaminants from surrounding properties and tributaries. The contaminants rendered the sediments unsuitable for ocean disposal therefore requiring alternate disposal options to be developed.
http://www.miamirivercommission.org/dredge.htm

Challenge

To develop a dredge solution to excavate soft (So) silty sediments and deliver these sediments to a suitable placement area while maintaining traffic flow on this very congested waterway through the heart of Miami, Florida. This project is at the foot of Miami International's (MIA) runway 8, introducing additional complexities to the project design.

Solutions

Bean Environmental chose a joint venture partner in Weston Solutions to pursue and execute this project. The Weston Bean JV (WBJV) was established and successfully completed this project in 2008.

Excavation, Loading and Transportation* –** Removal of sediments from the Miami River required excavation equipment with dexterity, maneuverability, accuracy and control. Bean and Mr. Taylor, once again, determined it would be economically feasible to design, construct, and deploy a dredge with the attributes necessary to accomplish this special mission. A marine excavator was chosen as the basis of the design. This type of machine afforded the ability to dredge under and around the numerous bridge abutments and obstructions along the waterway. Barge stability was achieved through the very robust spuds and winch machinery ensuring maximum control and safety for negotiating the marine traffic in the waterway. The marine excavator, ***Barredor del Rio, was designed, built and delivered on time to the project site and performed extremely well during the 4 year, $84 million project.

The *Barredor del Rio* loaded barges with dredged material along the 5.5 miles stretch of the river. The barges were safely transported to the unloading site that had been established along the river to process and expedite the processed dredged material to the selected landfills.

Towing operations along the Miami River are very unique when compared to other waterways around the nation. Due to the very restricted draft and widths in the river, local users of the waterway have become accustomed to passing vessels with only inches of separation. Proficiency in boat and barge handling operations was critical in virtually every move along the waterway. Remarkably, zero traffic incidents occurred throughout the project duration.

Unloading, Processing, and Delivery - As the barges arrived at the unloading site; the material was removed from the barges and introduced into the soil processing plant alongside the waterway. The WBJV contracted with the world renowned dredged material processor, Boskalis Dolman, an affiliate of Bean, to perform the soil processing. The dredge material was successfully and efficiently processed into its various constituents to ensure minimum tipping fees and charges at the selected landfills. The stockpiles of material at the site were routinely and continuously expedited by trucks to the landfills. Daily cover at the landfills was the most prominent and opportune use of the sediments from the Miami River.

Special Challenges Encountered – As dredging progressed down the river, a relic shipyard was encountered along the left descending bank. Apparently, the shipyard was a repair facility for World War II - US Navy Patrol Torpedo (PT) Boats. Unexploded ordnance (UXO) began appearing in the processed sediment debris stockpiles. Upon discovery, the WBJV immediately ceased operations and deployed the JV's UXO technicians to assess the situation. It was determined that operations could continue after numerous protection measures were installed and implemented around all exposed project operations to protect the personnel, equipment and the local community. Operations proceeded successfully and all UXO encountered were safely removed from the waterway and disposed of.

Conclusion - After more than 30 years of planning, permitting and funding challenges, the Miami River Commission was able to enjoy the fruits of their decades of labor and a successful project completion.

OTHER RELEVANT EXPERIENCE

Experience

2000 – Present

President – Bean Environmental

Responsible for overall management of the environmental remediation division of The Bean Companies. Provides services in project development and consulting, staff allocation and management, and continued research and development of innovative environmental dredging technology.

Works with clients to identify maximum project value through integration of project requirements and world-class dredging technology and equipment.

1998 – 2007

Vice President – Bean Stuyvesant

Responsible for marketing and estimating for the United States market.

Responsible for production engineering -dredge productivity and efficiency.

Responsible for monitoring national and global issues affecting the dredging markets.

1992 – Present

Vice President – Bean Dredging

Responsible for overall dredge operations, cutter suction, mechanical, hybrid and hopper.

Responsible for overall production and cost estimating, marketing, proposal and bid preparation.

Responsible for dredge automation, production engineering and equipment development.

Responsible for production on beach restoration, capital dredging, maintenance of navigation channels and environmental remediation projects.

Responsible for developing and patenting the High-Density Slurry Processing Unit, (SPU). This device revolutionized the slurry optimization and transportation of sediments for dewatering, processing and disposal.

Additional responsibilities include:

1. Safety and Regulatory
2. Personnel
3. Technical
4. Operations
5. Production
6. Reporting

1989 – 1992 – Bean Dredging

Manager of Estimating / Engineering – Bean Dredging

Responsible for project cost estimates, preparation and submission of proposals and offers.

Responsible for dredge automation and production engineering and development.

Responsible for production of beach restoration, capital dredging, maintenance of navigation channels and environmental remediation projects.

1982 – 1989 – Bean Dredging

Manager of Production Engineering – Bean Dredging

Responsible for dredge automation, production engineering and development.

Responsible for production of beach restoration, capital dredging, maintenance of navigation channels and environmental remediation projects.

Began the company's first research and development program for dredge technology including the development of dredge automation theory and implementation of cutter suction and trailing suction hopper dredges.

1978 – 1982 – Bean Dredging

Dredge Engineer (Survey) – C.F. Bean, Bean Dredging

Continued Studies in the Research and Development Department of Royal Volker Stevin of The Netherlands.

Assisted in the development of dredge theory, dredge automation, and new dredge design.

Assisted in the development of predicting behavior of viscous slurries in dredge pipelines.

Assisted in developing model tests of new dredge technologies.

Assisted in production engineering on various dredge types and on many different types of projects around the globe.

MAJOR ACCOMPLISHMENTS

- 1981 – 1982 Made significant contributions to the development of viscous slurry transportation science in the Research and Development Department of Volker Stevin Dredging of The Netherlands.

- 1984 – 1985 Pioneered, developed and implemented the first applications for automating the dredging functions of a 30 inch, 14,000 HP cutter suction dredge, the CSD *Jim Bean*.

- 1984 – 1987 Pioneered the use of remote monitoring and control with computer automation for dredging. This science and technology later became the foundation for the USACE's Silent Inspector and Dredge Quality Management, DQM program.

- 1991 – 1992 Invented and patented the Slurry Processing Unit, SPU. Patent No. 5,269,635. This invention provided the ability to process dredge slurry to pre-determined slurry concentrations for optimum transportation efficiency. This device was used in the largest Superfund project awarded to that date and contributed to Bean's award of an Overall Outstanding performance evaluation from the USACE.

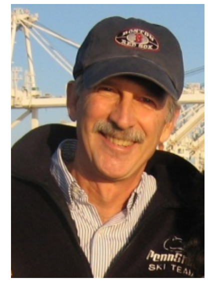
- 1991 Designed the production systems of this nation's first offshore dustpan dredge, the *Beachbuilder*, for use in the restoration of coastal protection systems and barrier islands.

- 1995 – 1996 Designed the production systems of a large cutter suction dredge, the *Meridian*, for use in the restoration of coastal protection and barrier islands, navigation channels and port development.

- 2010 Assisted the Governor's office in the State of Louisiana during the BP Deepwater Horizon Oil Spill. Mr. Taylor and his team developed and implemented a plan to construct a series of sand berms along the coast of Louisiana to protect critical estuaries from the oncoming oil. This action involved the use of approximately 300 vessels and more than 700 people over an eight month period. The equipment included virtually all of this nation's large domestic fleet of cutter dredges, hopper dredges and scows.

- 2011 Awarded the "Dredger of the Year" by the Western Dredging Association, an organization representing the western hemisphere's dredging stakeholders. *"Because of his outstanding contributions to the World Wide Dredging Industry and his unsurpassed initiative and knowledge of dredging,"*

Appendix E. Resume of Craig Vogt



Craig Vogt
Craig Vogt, Inc.
Ocean & Coastal Environmental Consulting
30373 Holly Shores Lane
Hacks Neck, VA 23358
USA
571-643-8241
Craig@CraigVogt.com

November 2016

Craig Vogt Inc provides environmental consulting for regulatory and non-regulatory issues dealing with the wide range of ocean and coastal environmental issues. Issues include such areas as dredging and dredged material management, sediment management, and beneficial use of dredged material; mine tailings pipeline transport and marine disposal; port-related activities; cruise ship environmental issues; coastal watershed environmental management; and coastal and wetlands restoration.

Prior to consulting, Craig Vogt was employed at U.S. EPA from 1971-2008 as an environmental engineer, the last 20 years of which were in EPA headquarters as Deputy Director of EPA's Ocean and Coastal Protection Division. Responsibilities included regulatory and non-regulatory programs for ocean and coastal water protection with a focus upon dredged material regulations and management. Mr. Vogt Co-Chaired the interagency National Dredging Team from 1995 to 2008, the objective of which was to resolve issues among U.S. agencies on dredged material management and disposal.

Experience

U.S. Environmental Protection Agency **1971-2008**

See next page for summary of responsibilities and actions

Craig Vogt Inc. Ocean & Coastal Environmental Consulting **2008-present**

- Provide environmental consulting and facilitation services for regulatory and non-regulatory issues dealing with the wide range of ocean and coastal environmental issues. Issues include such areas as dredging and dredged material management, sediment management, and beneficial use of dredged material; mine tailings pipeline transport and marine disposal, port-related activities, cruise ship environmental issues, coastal watershed environmental management, and coastal and wetlands restoration.

- Sample clients:

- U.S. Corps of Engineers, Institute of Water Resources; "*Effects of erosion and accretion on U.S. shorelines, including extent, environmental impacts, sediment management, and governance." 2012-ongoing.* Reports are being prepared for the California shoreline, each of the Great Lakes, Hawaii, and the Southeast Atlantic shoreline.
- Intelligence Group. *Willamette River Superfund Site--Regulatory/permit issues*. 2015.
- Environment Canada and International Maritime Organization, "*Development of Low Tech Low Cost Monitoring Guidance for Monitoring Ocean Disposal of Dredged Material*." 2014-5.
- Battelle. Participant on Independent Review Panel of U.S. Corps of Engineers dredging project. *Review of Environmental Aspects of Proposed Redwood City Dredging Project in SF Bay*. 2015.
- EPA. *Development of revised dredged material testing, evaluation, and management manual*. 2015.
- International Maritime Organization, Secretariat of London Convention 1972; "*Instructor, Workshop for Chilean government on international requirements and guidelines for disposal of dredged material in marine waters of the London Protocol*," Vina del Mar, Chile. November 2013.
- Environment Canada. "*Development of Site Selection Guidance for Disposal of Dredged Material in Coastal Waters;*" 2013.
- North American Port Infrastructure LLC, "*Independent technical review of environmental permitting issues (dredging, ESA, EFH, emissions, water and sediment quality) of coal export project: Columbia River*;" 2012.
- Hartman Associates/Port of Seattle, "*Preparation of the environmental parts of the engineering manual for dredging contaminated sediments from the Duwamish River at Terminal 117, a Superfund site*." 2011.
- International Maritime Organization, "*Update of the International Waste Assessment Guidelines for Dredged Material of the London Convention*." 2011-2012.
- U.S. EPA: "*Update of the National Dredging Team Action Plan (e.g., dredged material testing, beneficial use of dredged material, ESA, EFH)*." 2011-2012.
- Environment Canada: "*International Review of Use of Aquatic Confined Disposal Cells for Disposal in Ocean and Coastal/Estuarine Waters of Contaminated Dredged Material 2009.*"
- Corps of Engineers, Buffalo District: "*The Cleveland Harbor Dredging Summit 2010.*" Designed, facilitated, and prepared proceedings of two-day Summit. Cleveland's CDFs are almost full, and the summit addressed alternatives including lake disposal, CDF disposal and management, and beneficial uses.
- Great Lakes Commission (GLC): "*Beneficially Using Dredged Materials to Create/Restore Habitat and Restore Brownfields, and Team Collaborative Efforts that have Achieved Success. Examples/Case Studies.*"
- Corps of Engineers, Institute of Water Resources: "*Gulf of Mexico Shoreline Management.*" An initial assessment of shoreline and sediment management in the

Gulf of Mexico, to be one chapter in the National Shoreline Management Report to Congress. 2011.
  - Texas A&M Dredging Course. Invited speaker. *EPA and the Environmental Aspects of Dredging.* Speaker at the annual one-week course. 1992-present.

U.S. Environmental Protection Agency Washington, DC

Deputy Director, Oceans and Coastal Protection Division 1991-2008

- Manager/supervisor of a Division consisting of 50 scientists and technical and policy staff for implementing EPA's regulatory/non-regulatory responsibilities for protecting ocean/coastal water quality, including programs under the Clean Water Act, Ocean Dumping Act, and international treaties.
- Regulatory programs included: development of regulations for:
  - The national dredged material permit program, including water quality and sediment testing requirements, impact assessment, monitoring, and disposal site designation through NEPA and state partners under their equivalent programs, such CEQA in California;
  - The ocean dumping permit program (including international treaty negotiations);
  - Vessel discharges including cruise ships; vessels to artificial reefs; and
  - Wastewater discharges to coastal waters.
- Non-regulatory programs included: ports and the marine transportation system, monitoring and environmental assessment of coastal and ocean waters; restoration and enhancement of coastal and estuarine resources (e.g., the National Estuary Program (NEP) (e.g., Mobile Bay Estuary Project), including wetlands restoration); coral reefs; invasive species; and management of EPA's 225 foot Ocean Survey Vessel *Bold.*

Director, Marine Operations Division 1988-1991

- Managed Division of 25 scientists for above listed programs, except the NEP.

Deputy Director, Drinking Water Criteria and Standards Division (CSD) 1980-1988

- Managed Division of 40 chemists, engineers, and toxicologists.
- Responsibilities were to set national drinking water standards to protect human health.
- Standards were based upon technical and economic evaluations of treatment technologies for contaminants in drinking water and the potential toxicity of the contaminants.

Chief, Science and Technology Branch, Drinking Water CSD 1978-1988

- Managed 15 chemists and engineers.
- Responsible for assessing treatment technology for removal of from drinking water for use in setting national drinking water standards.

Environmental Engineer, Effluent Guidelines Division 1973-1978

- Developed national wastewater standards for the pulp and paper industry.
- Effectiveness/costs of industrial wastewater treatment technologies.

Other Work Experience

<u>Sanitary Engineer</u> U.S. EPA, Seattle, Washington 1971-1973

- Conducted monitoring and environmental assessment field work collecting samples from industrial and municipal wastewater discharges and from rivers, bays, and estuaries for CWA water quality permitting.

<u>Civil Engineer</u> U.S. Army Corps of Engineers Portland, Oregon 1969-1971

- Participated in the Civil Engineer Training Program, with emphasis upon water resources infrastructure including dams, levies, and sanitary sewer systems.

<u>U.S. Merchant Marines</u> 1965-1969

- Worked in engine room on freighters during the summers: South America, Eastern Asia.

Education

- Master of Science Degree: Environmental Engineering, Oregon State University, 1971
- Bachelor of Science Degree: Civil Engineering, Oregon State University, 1969
- Registered/Licensed Professional Engineer, Virginia, 1976 (expired)
- Coast Guard Licenses: Fireman-Watertender, Oiler (both long expired)

Notable Positions and Activities

- Chair, Scientific Group of the London Convention. 2004-2007. Facilitated negotiations between 30-40 countries implementing the London Convention Treaty to control dumping of wastes in the oceans. Elected by meeting delegates each year for maximum of four years.
- Head, U.S.A. Delegation, 1991-2003. Led a diverse team of federal government representatives to annual Scientific Group Meetings negotiating ocean dumping treaty implementation issues, with the primary focus upon dredged material management.
- Co-Chair with Corps of Engineers, National Dredging Team (NDT), 1995-2008. The NDT is a federal interagency partnership with objectives to be a forum for resolution of dredged material management issues. Issues addressed:
    - Dredged material testing and environmental assessment manuals (Green Book and Inland Testing Manual)
    - Beneficial use of dredged material and regional sediment management
    - Environmental windows, endangered species, and essential fish habitat
    - State coastal zone enforceable policies for dredged material
    - Regional Dredging Teams-facilitate and support operations
- Member, Interagency Committee on the Marine Transportation System (MTS), 1995-2004. Provided support for Cabinet Level CMTS, 2004-2008. Environmental aspects of the port operations and development, including water, air pollution, and solid wastes.
- Chair, Environmental Commission, Western Dredging Association, 1992-present
- Member, Board of Directors, Western Dredging Association, 1992-present

- Member, Board of Directors, Coastal America Foundation, 1998-present
- Chair, Environmental Commission, World Organization of Dredging Associations, 2013-present

Awards and Recognition

- IHS Dredging and Port Construction Magazine. Commendation for Contributions to the Dredging Industry. Awarded November 10, 2016. London, England.
- William R. Murden Award for Lifetime Public Service Achievement. Awarded by Dredging Contractors of America, May 2008.
- EPA Distinguished Career Award. January 2008.
- EPA Gold Medal. June 2007. Recognizing international efforts in the International Maritime Organization's London Convention's Scientific Group and policy meetings.
- National Leadership Award. Coastal America, 2004. Recognizing contributions in protecting and restoring coastal water resources.
- Dredger of the Year. Western Dredging Association (WEDA), 2000.
- Coastal America Lifetime Contributions Award. September 2008.
- Hammer Award from Vice President Gore, 1996, for contributions to "fixing" the U.S. government to make it more efficient and effective.
- Numerous Bronze & Silver Medals from U.S. EPA, 1973-2007.

Technical Papers

As an indicator of project experience, knowledge and expertise, relevant publications include:

- "The New Canadian Site Selection Guidance for Disposal at Sea." Presented at Western Dredging Conference, Toronto, Canada. June 2014.
- "Dredging Practices and Environmental Considerations." A section in the Springer Encyclopedia. Robert A. Meyers (ed.), Encyclopedia of Sustainability Science and Technology, DOI 10.1007/978-1-4419-0851-3, # Springer Science+Business Media, LLC 2014.
- "International Assessment of the Disposal of Contaminated Dredged Material in Ocean and Estuarine Waters;" Journal of Dredging Engineering, April 2011.
- "Making It Happen: Management of Dredged Material and Sediment in the Watershed;" Edited by Craig Vogt. International Dredging Review, 2008.
- "Rules of the Road: Thoughts on Dredging and Environmental Issues": Edited by Craig Vogt; International Dredging Review; July/August 2007.
- "The London Convention and the United States' National Dredging Team: Implementation Tools for Dredged Material Management"; Proceedings of the Western Dredging Association Conference; 2006.
- "Environmental Concerns Related to Dredging and Disposal and EPA's Actions for Protection of Aquatic Habitat"; Proceedings of Coastal Zone Conference; 2005.

- “The United States’ National Dredging Team’s Dredged Material Management Action Plan for the Next Decade”; Proceedings of the World Organization of Dredging Congresses International Conference; Hamburg, Germany; October 2004.
- “Dredged Material Management in a Watershed Context: Seeking Integrated Solutions”; Proceedings of the Western Dredging Association Conference; 2006.
- “National Dredging Team: Taking Action”. Interagency Team Implements National Dredging Policy so that Dredging of U.S. Harbors, Channels is Conducted in a Timely, Cost Effective Manner While Meeting Environmental Goals; Sea Technology Magazine; March 2000.
- “Overcoming Obstacles to Beneficial Use of Dredged Material”; Edited by Craig Vogt; published by the Environmental Commission of the Western Dredging Association; July 1997.
- “Dredged Material Management from a Watershed Perspective”; Proceedings of Watershed Conference 1996.
- “Evaluation of Dioxin-Contaminated Dredged Material;” Proceedings-Western Dredging Association 1995.