Appendix G

Dredged Material Characterization Summary

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ANCHOR QEA

Memorandum

May 2, 2017

To: Philip Hegji, US Army Corps of Engineers – Mobile District

From: Karin Olsen, P.G., Anchor QEA

cc: Elizabeth Calvit, CH2M; Wendell Mears, Anchor QEA

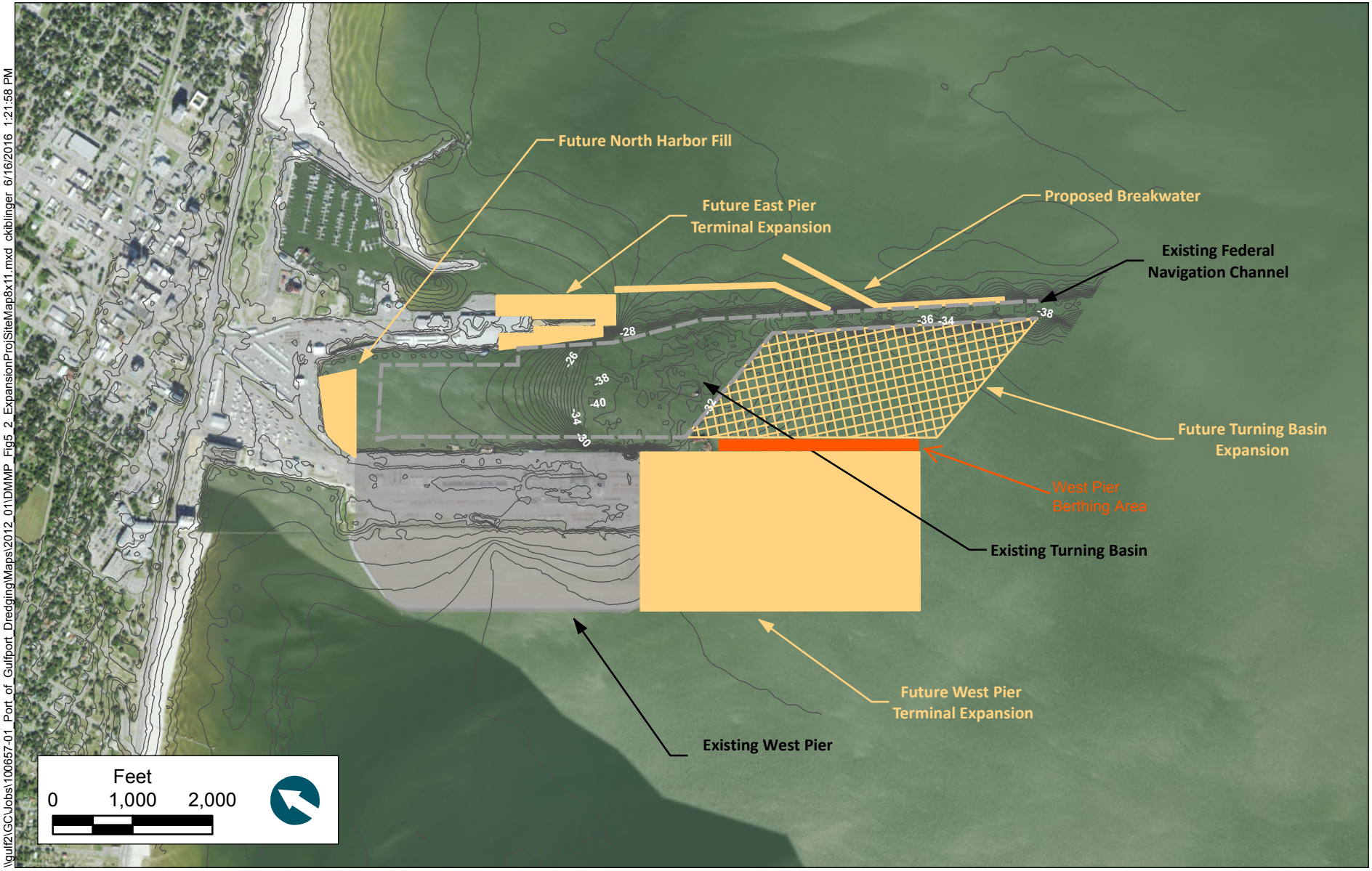
Re: Gulfport Turning Basin Expansion and West Pier Terminal Expansion – Dredged Material Characterization Summary

The Port of Gulfport, Mississippi, is a bulk, break-bulk, and container seaport centrally located on Mississippi's Gulf of Mexico coastline. Recognized as the region's third busiest container port, the Port of Gulfport is developing long-term management and expansion plans. To facilitate the proposed future expansion of the Port of Gulfport, the Mississippi State Port Authority (MSPA) is proposing to conduct new work dredging within a proposed Turning Basin Expansion and as part of the expansion of the existing West Pier Terminal.

The proposed Turning Basin Expansion is immediately adjacent and south of the existing Turning Basin footprint. The proposed project is new work dredging that includes an 85-acre expansion to the existing turning basin (Figure 1). Current project design includes new work dredging to increase the navigational depths within the Turning Basin Expansion to -40 feet mean lower low water (MLLW). This represents a design depth of -36 feet MLLW plus a 2-foot advanced maintenance, plus 2 feet of allowable overdepth (tolerance). Based on a bathymetric survey completed in June 2016, the total volume of material that will be dredged from within the Turning Basin Expansion is approximately 3.8 million cubic yards (cy).

The footprint of the West Pier Terminal will be expanded approximately 3,500 linear feet to the south, which will add 155 acres to the existing facility (Figure 1). Dredging in the West Pier Berthing Area will connect the West Pier Terminal Expansion and the Turning Basin Expansion (Figure 1). The West Pier Terminal Expansion is a new work dredging project to -20 feet MLLW dredging depth. Based on bathymetric data collected in June 2016, the average water depth within the project footprint is 11 feet. The total dredging volume for the 155-acre expansion is approximately 2.4 million cy. The West Pier Berthing Area (Dredging Units 16 and 17) is a new work dredging project to -38 feet MLLW dredging depth. The total dredging volume for this area is 543,000 cy, also based on the bathymetric data collected in June 2016.

Because of the large quantity of material that would be dredged as part of the expansion project, placement of dredged material from the Turning Basin Expansion and West Pier Terminal Expansion and Berthing Area in U.S. Environmental Protection Agency (USEPA) Region 4 designated Zone B of the Pascagoula Ocean Dredged Material Disposal Site (ODMDS) was evaluated as a placement site.



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Bathymetry: NOAA 2008, MLLW Feet.

ANCHOR QEA

Figure 1
Project Site Map
Gulfport Turning Basin and West Pier Terminal Expansion Dredged Material Evaluation
Mississippi State Port Authority - Port of Gulfport

Dredged material was characterized with regard to physical, chemical, and ecotoxicological characteristics to determine compliance with the limiting permissible concentration (LPC) as defined by Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA).

Due to the presence of soft silts and clays in the majority of upper strata sediments in the Turning Basin Expansion and West Pier Terminal Expansion and Berthing Area, the suitability of material for beneficial use in support of marsh re-establishment or expansion was also considered.

Although both the Turning Basin Expansion and West Pier Terminal Expansion and Berthing Area are located at the Port of Gulfport, they were evaluated as two separate dredging projects.

LPC Compliance Requirements

Compliance with Section 103 of the MPRSA requires determination of LPC compliance in four areas:

- Water Quality Criteria (WQC)
- Water column toxicity
- Benthic toxicity
- Benthic bioaccumulation

If LPC compliance is not met in one or more of these components, then ocean placement requirements are not met. Each of the above components involves a series of steps to determine whether the tested sediment meet LPC requirements, as described in the Southeast Regional Implementation Manual (SERIM; USEPA and USACE 2008). Concurrence from USEPA Region 4 that ocean placement of dredged material is a suitable option for the Turning Basin and West Pier Terminal Expansion and Berthing Area sediment is contingent upon the approval of the MPRSA Section 103 evaluation.

Meeting the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation indicates that ocean placement is a potential dredged placement option that will not result in unacceptable benthic effects. Another option for placement of dredged material from the project is beneficial use. If the material is suitable for ocean placement, it also is suitable for beneficial use at the Biloxi Marsh Complex. The Biloxi Marsh Complex Beneficial Use site would provide needed fine-grained sediment for shoreline nourishment, would provide shoreline protection along the Mississippi and Louisiana coasts, and would offset impacts to Essential Fish Habitat. Additional discussion of beneficial use is provided below.

Water Quality Criteria and Water Column Toxicity

To determine whether the sediment from the Turning Basin and West Pier Terminal Expansion and Berthing Area meets the acute WQC and water column toxicity LPC requirements, Short Term Fate (STFATE) modeling was conducted using the placement site specification (e.g., dimensions and water

column properties) to determine if the standard elutriate concentrations would meet the LPC for ocean placement.

The LPC for the WQC is the concentration which:

- Does not exceed the WQC outside the boundary during the first 4 hours, and
- Does not exceed the WQC anywhere in the marine environment after 4 hours

The water column toxicity testing program consisted of 96-hour water column bioassays with mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*), and 48-hour water column bioassays with Atlantic purple sea urchin (*Arbacia punctulata*). The bioassays evaluated the effects of exposure to the elutriate samples on a survival or normal embryo development of test organisms. Median lethal concentrations (LC_{50}) or mean effective concentration (EC_{50}) were calculated for survival and effect data, respectively.

The LPC for the water column toxicity is the concentration that does not exceed 0.01 of the median LC_{50} or EC_{50} value of the most sensitive test species within a 4-hour mixing period inside the boundary of the placement site. STFATE modeling was used to determine the dilution factor of the plume at 4 hours after placement.

Grain size and other physical characteristics of the sediment were used as input parameters. STFATE modeling determined the dilution factor of the plume at 4 hours after placement, and how far the leading edge of the plume would travel within 4 hours of placement to ensure that the plume stayed within the boundaries of the placement site. Additional STFATE model scenarios were conducted to determine the maximum placement volume per placement event that would comply with the LPC for WQC and the LPC for water column toxicity.

The STFATE results (i.e., distance that the plume travels within a 4-hour time period and placement/barge volume) should be considered when determining the material placement plan within the ODMDS to ensure that the plume stays within the site boundary and maintains compliance with the LPC for water column toxicity.

Benthic Toxicity

Whole sediment bioassays were conducted to evaluate the benthic toxicity LPC. Ten-day whole sediment bioassays were conducted using amphipods (*Leptocheirus plumulosus*) and polychaetes (*Neanthes arenaceodentata*). Five replicate chambers of each species were set up for each sediment sample and a reference. Dredged material does not meet the benthic toxicity LPC when mean test organisms mortality is statistically greater than in the reference sediment and test mortality exceeds mortality in the reference sediment by at least 10 percent (or 20 percentage points for amphipods)

Benthic Bioaccumulation

Whole sediment bioaccumulation studies were conducted to evaluate the potential for uptake of constituents from the sediment into organism tissue. Worms (*Nereis virens*) and clams (*Macoma nasuta*) were exposed to sediment from the Turning Basin Expansion and West Pier Terminal Expansion and Berthing Area for 28 days. When tissue contaminants of concern in organisms exposed to dredged material statistically exceed those of organisms exposed to the reference material, the dredged material has the potential to result in benthic bioaccumulation of contaminants.

Dredged material does not meet the benthic bioaccumulation LPC if the tissue concentrations are greater than U.S. Food and Drug Administration's (USFDA) Action/Guidance/Tolerance Levels. If the tissue concentrations statistically exceed the concentrations in organisms exposed to the reference site, then tissue contaminant are further evaluated to assess bioaccumulative potential and effects and to determine if placement of dredged material is likely to impair the health of benthic organisms.

Data Analysis

Sediment Chemistry

Sediment Quality Guidelines (SQGs) relate the concentrations of contaminants in sediment to some predicted frequency or intensity of biological effects (Batley et al. 2005), and are intended to either be protective of biological resources or predictive of adverse effects to those resources, or both (Wenning and Ingersoll 2002). The SQGs were developed as non-regulatory guidelines for use in interpreting chemical data from analyses of sediments. Concentrations of detected analytes in sediment samples were compared to SQGs for marine sediments to assess the sediment quality of the material proposed for dredging. The Effects Range-Low (ERL) and Effects Range-Median (ERM) were used to identify potential adverse biological effects associated with contaminated sediments (Long et al. 1995).

Standard Elutriate Testing

Section 304(a)(1) of the Clean Water Act required USEPA to develop, publish, and periodically revise criteria for water quality accurately reflecting the latest scientific knowledge. WQC developed under Section 404(a)(1) are based solely on data and scientific judgement on the relationship between previously published criteria that are unchanged, criteria that have been recalculated from earlier criteria, and newly calculated criteria based on peer-reviewed assessments and data.

Analytes detected in the site water and full-strength standard elutriates were compared to USEPA saltwater acute WQC (USEPA 2016) and Mississippi State Water Quality Standards (MDEQ 2016). If an

analyte exceeded its WQC, STFATE modeling was conducted to determine if the dilution required to meet WQC LPC requirements would be achieved.

Water Column Bioassays

Three species representing phytoplankton or zooplankton, crustacean or mollusk, and fish are required for water column bioassay testing. The three species chosen for testing were mysid shrimp (*Americamysis bahia*), inland silverside (*Menidia beryllina*), and purple sea urchin (*Arbacia punctulata*). These species represent different phyla and cover a range of differing species sensitivities. According to the Ocean Testing Manual (OTM) (USEPA and USACE 1991), after considering water column bioassay test results and expected mixing at the placement site, one of the following conclusions is reached:

- Toxicity in the 100 percent dredged material elutriate bioassay is not statistically higher than that in the dilution water (laboratory control), indicating that the dredged material is not predicted to be acutely toxic to water column organisms.
- The concentration of dissolved plus suspended contaminants, after allowance for mixing, does not exceed 0.01 (1 percent) of the LC_{50} or EC_{50} concentration beyond the boundaries of the placement site within the first 4 hours after placement or at any point in the marine environment after the first 4 hours. This finding would indicate that the dredged material is not predicted to be acutely toxic to water column organisms.
- The concentration of dissolved plus suspended contaminants, after allowance for mixing, exceeds 0.01 (1 percent) of the LC_{50} or EC_{50} concentration beyond the boundaries of the placement site at any time and/or within the placement site after the 4-hour initial mixing period. This results suggest that the dredged material may have the potential to be acutely toxic to water column organisms.

In the water column tests, survival was the endpoint for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) tests. The endpoint of the purple sea urchin (*Arbacia punctulata*) test was normal embryo development. Toxicity within the 100 percent test elutriates were statistically compared (single-point comparison) to results of the laboratory controls as per the OTM evaluation protocols, not to the results for the placement site or reference area. For the elutriate testing, an EC_{50} or LC_{50} was calculated for each test species. Additionally, if normal development or survival in the 100 percent elutriate concentrations was at least 10 percent lower than the dilution water control, then a statistical comparison (t-Test) was performed between the 100 percent elutriate concentration and the control.

Whole Sediment Bioassays

Bioassays with whole sediment are designed to determine whether the dredged material is likely to produce unacceptable adverse effects on benthic organisms by exposing the organisms to the

sediment for ten days. Dredged material is predicted to be acutely toxic to benthic organisms when mean test organism mortality is statistically greater than the reference sediment and when test organism mortality exceeds mortality in the reference sediment by at least 10 percent (or 20 percentage points for amphipods). In the whole sediment tests, survival was the endpoint for the amphipod (*Leptocheirus plumulosus*) and polychaete (*Neanthes arenaceodentata*) tests.

The data were evaluated to determine if the mean mortality of the five replicates for each composite sample exceeded the mean mortality in the reference sediment by at least 10 percent for the polychaetes (*Neanthes arenaceodentata*) or 20 percent for the amphipods (*Leptocheirus plumulosus*). Whole sediment benthic bioassays of contaminants in the dredged material will result in one of the following possible conclusions:

- Mean test organism mortality in the dredged material is not statistically greater than in the reference sediment, or does not exceed mean mortality in the reference sediment by at least 10 or 20 percentage points for polychaetes and amphipods, respectively. If this finding is observed, the dredged material is predicted not to be acutely toxic to benthic organisms.
- Mean test organisms mortality in the dredged material is statistically greater than in the reference sediment and exceeds mortality in the reference sediment by at least 10 percentage points (or 20 percentage points for amphipods). In this case, the dredged material has the potential to be acutely toxic to benthic organisms and does not meet the LPC for benthic toxicity.

Benthic Bioaccumulation

Statistical analyses were performed on the survival data from the bioaccumulation tests to determine if exposure to any of the sediment samples resulted in lower survival ($p=0.05$) of the test organisms as compared to the reference sediment. If survival in a test sample was lower than the percent allowable difference (10 percent) for the reference, then a t-test or Wilcoxon's Two-Sample Test (depending on normal or non-normal data distribution) was performed to compare the single test sample to the reference to determine if the difference was statistically significant.

Prior to performing the statistical protocols to evaluation whether organisms exposed to sediment from the Turning Basin Expansion and West Pier Terminal Expansion and Berthing Area accumulated higher concentrations of analytes in tissue than those exposed to reference site sediment, several procedures were used to prepare and analyze the raw tissue data. Statistical analyses of survival data and tissue chemistry data were performed according to the following guidelines:

- The laboratory reporting limit was substituted for non-detected constituents as a conservative estimate of potential uptake.
- Individual replicates were statistically analyzed to determine if there were any outliers.

- Concentrations of metals in the clam (*Macoma nasuta*) and worm (*Nereis virens*) tissue were compared against USFDA Action/Guidance/Tolerance Levels to determine if analyte concentrations in tissue were significantly higher than USFDA Action/Guidance/Tolerance Levels.
- Results of the organic analyses were lipid-normalized.
- Mean concentrations were calculated for each chemical in each dredging unit using the replicate concentrations.
- Chemicals that were not detected in any tissue project samples (none of the replicates in any of the DUs or the reference site) were not carried forward in the analysis.
- Concentrations of target analytes in the bent-nose clam (*Macoma nasuta*) and sand worm (*Nereis virens*) tissue were statistically compared to pre-test (Day 0) tissue concentrations.

If chemical concentrations in the clam and worm exceeded pre-test concentrations, then chemical concentrations in organisms exposed to Turning Basin Expansion and West Pier Terminal Expansion and Berthing Area sediment were statistically compared to chemical concentrations in organisms exposed to reference sediment to determine if uptake of contaminants was significantly higher in organisms exposed to the Turning Basin Expansion and West Pier Terminal Expansion and Berthing Area sediment.

If chemical concentrations in organisms exposed to project sediment were not statistically elevated above chemical concentrations in reference sediment-exposed organisms, then placement of the dredged material at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Alternatively, if chemical concentrations in organisms exposed to Turning Basin and West Pier Terminal Expansion and Berthing Area sediment were statistically greater than chemical concentrations in organisms exposed to reference sediment, then comparison to Region 4 Background Concentrations and Ecological Non-Specific Thresholds would have been conducted. However, these comparisons were not required for this project, as summarized in the following sections.

Turning Basin Expansion

This section summarizes the sampling methods, results, and LPC compliance for the characterization of dredged material from the Turning Basin Expansion.

Sampling and Analysis Overview

The technical approach for the Turning Basin Expansion dredge material characterization was designed to provide information regarding chemical and ecotoxicological data to assess potential impacts related to ocean placement at the Pascagoula ODMDS, and to document compliance with Section 103 of the MPRSA. This investigation consisted of collecting sediment cores and site water at specified locations within the Turning Basin Expansion footprint; conducting sediment grab sampling

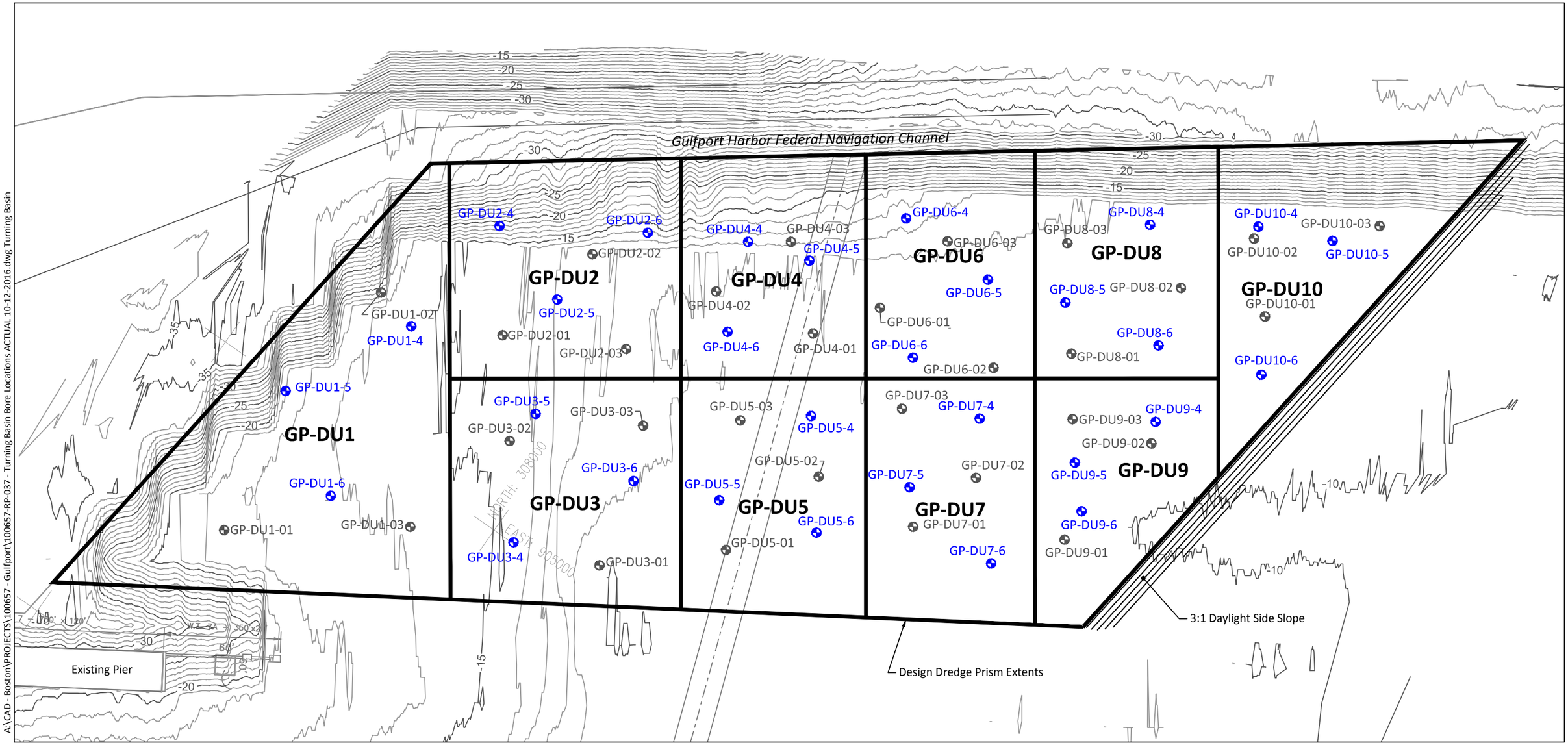
at a Pascagoula Reference Site; conducting analytical testing of sediments, site water, standard elutriates, and aquatic organism tissue; conducting ecotoxicological testing (water column, whole sediment, and 28-day bioaccumulation bioassays); and evaluating test results. A detailed description of sampling methods and analyses is described in the *Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP): Evaluation of Dredged Material for Ocean Placement, Gulfport Turning Basin Expansion* (Anchor QEA 2016a).

Sediments from the Turning Basin Expansion were sampled and tested based on a dredging unit (DU) approach. The dredging footprint was divided into ten DUs based on the total quantity of dredged material that will be removed from each DU (Figure 2). The DUs and expected dredged material quantities are summarized in Table 1. Sediment cores were collected from three locations within each DU and composited together to create one composite sample per DU (Figure 2). Site and reference sediments were submitted for physical, chemical, and ecotoxicological testing. Site water was collected from one location within the dredge prism and analyzed for chemical constituents and ecotoxicological testing and used for standard elutriate preparation.

Two separate field investigations were required to complete this testing program. The first field effort was conducted in November and December of 2012 and the second was conducted in August of 2016. The technical approach and sampling strategy was the same for both efforts. The sample locations for the 2016 field effort were different from the 2012 sample locations from the 2012 field effort, however, they were collected from within the same DUs (Figure 2).

The 2012 testing program included the physical and chemical analysis of sediment composite samples from each of the ten DUs that comprise the Turning Basin Expansion dredge prism (Figure 2) and reference site sampling from two sites – a Gulfport ODMDS reference site (RS-GP-C) and a Pascagoula ODMDS reference site (RS-PAS-A). The physical and chemical analyses included specific gravity, pH, pesticides, polychlorinated biphenyl (PCB) congeners, total petroleum hydrocarbons (TPH), and hexachlorobenzene. The composite samples were also submitted for water column bioassay testing and standard elutriate preparation. Site water was also collected from one location within the dredge prism and analyzed for chemical constituents and ecotoxicological testing and used for standard elutriate preparation. The water column bioassay testing program consisted of 96-hour water column bioassays with mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) and 48-hour water column bioassays with purple sea urchin (*Arbacia punctulata*). The acute water column bioassays evaluated the effects of exposure to the sediment elutriate samples on survival (mysid shrimp [*Americamysis bahia*], and inland silverside [*Menidia beryllina*]) or normal embryo development (purple sea urchin [*Arbacia punctulata*]) of the test organisms.

The 2016 testing program included the physical and chemical analysis of sediment composite samples from each of the ten DUs that comprise the Turning Basin Expansion dredge prism (Figure 2) and one surficial sediment sample collected from the Pascagoula reference site RS-PAS-C, because



SOURCE: Bathymetry from DIMCO, Inc. (June 27, 2016)
HORIZONTAL DATUM: Mississippi State Plane East, NAD83, U.S. Survey Feet
VERTICAL DATUM: Mean Lower Low Water (MLLW)

LEGEND:

- **GP-DU#-##** October 13, 2016 Actual Sediment Core Locations
- -15 Bathymetry Contour (1 ft)
- GP-DU#-## 2012 Sediment Core Locations

0 300
Scale in Feet

A:\CAD - Boston\PROJECTS\100657 - Gulfport\100657-RP-037 - Turning Basin Turning Basin Bore Locations ACTUAL 10-12-2016.dwg Turning Basin

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ANCHOR QEA

Figure 2
Turning Basin Sediment Core Locations
Gulfport Turning Basin and West Pier Terminal Expansion Dredged Material Evaluation
Mississippi State Port Authority - Port of Gulfport

Table 1

Approximate Dredging Volumes for Each Turning Basin Expansion Dredging Unit

Dredging Unit	Project Depth		2-foot Overdredge Depth Volume (cy)	Total Volume (cy)	Project Depth (feet MLLW)
	Design Depth Cut Volume (cy)	2-foot Advanced Maintenance Volume (cy)			
GP-DU1	366,700	59,800	47,800	474,300	-38
GP-DU2	303,000	31,000	24,800	358,800	-38
GP-DU3	380,800	31,000	24,800	436,600	-38
GP-DU4	290,100	25,600	20,500	336,200	-38
GP-DU5	347,900	25,700	20,600	394,200	-38
GP-DU6	280,400	23,500	18,800	322,700	-38
GP-DU7	328,200	24,300	19,400	371,900	-38
GP-DU8	308,700	25,800	20,600	355,100	-38
GP-DU9	291,200	17,800	14,200	323,200	-38
GP-DU10	355,400	25,400	20,300	401,100	-38
Total	3,252,400	289,900	231,800	3,774,100	-38

Notes:

Based on a bathymetric survey completed in June 2016.

cy: cubic yards

MLLW: mean lower low water

the Pascagoula ODMDS was identified by USEPA as the preferred site for dredged material placement. The physical and chemical analyses included grain size, Atterberg limits, total organic carbon (TOC), total solids, metals, polycyclic aromatic hydrocarbons (PAH), pentachlorophenol, organotins, and dioxin and furan congeners. The composite samples and the reference sample were also submitted for ecotoxicological testing, including whole sediment and 28-day bioaccumulation bioassays. The whole sediment bioassays evaluated the effects of exposure to the sediment samples on survival of test organisms and were conducted with the polychaete (*Neanthes arenaceodentata*) and the amphipod (*Leptocheirus plumulosus*). The bioaccumulation tests evaluated the potential for chemical uptake as a result of exposure to the sediment samples and were conducted with the bent-nose clam (*Macoma nasuta*) and sand worm (*Nereis virens*). At the completion of the 28-day bioaccumulation exposure, organism tissue was submitted for the following analyses (discussions with USEPA Region 4 determined the level of tissue testing):

- Metals analysis on samples from DUs 1 through 10, reference site, and pre-test tissues
- PAH analysis on samples from DUs 2 and 3, reference site, and pre-test tissues
- Dioxin and furan congener analysis on samples from DUs 1, 2 and 3, reference site, and pre-test tissues

Based on consultation with USEPA Region 4, the data from both field investigations (2012 and 2016) will be used to determine LPC compliance with MPRSA Section 103, according to the following:

- WQC – standard elutriate results from the 2012 sampling effort
- Water column toxicity – water column bioassay testing from the 2012 sampling effort
- Benthic community – whole sediment bioassays from the 2016 sampling effort
- Benthic bioaccumulation – 28-day bioaccumulation testing from the 2016 sampling effort

Sampling Results and LPC Compliance

This section presents a summary of the sediment, standard elutriate, and ecotoxicological testing for the Turning Basin Expansion project. A summary is also provided in Table 2.

Turning Basin - Dredging Unit 1

Results of the 2016 grain size analysis indicated that sediment from DU1 consisted primarily of silty and clay (65 percent), with approximately 35 percent sand. The 2012 grain size analysis exhibited similar grain size composition, with 64 percent silt and clay and 36 percent sand. Metals were detected in the 2016 composite sediment sample at concentrations similar to or less than the concentrations reported at the reference site, and none were detected at concentrations greater than the effects range low (ERL). PAHs, SVOCs, PCB congeners, organotins, pesticides, TPH, and dioxin and furan congeners were either not detected or detected at very low concentrations in the 2012 and

Table 2
Summary of Results for Turning Basin Expansion Sediment, Standard Elutriate, Toxicity, and Bioaccumulation Testing

Dredging Unit (DU)	SEDIMENT	STANDARD ELUTRIATE[i]		BIOASSAY TESTS								BIOACCUMULATION TESTS			
				WHOLE SEDIMENT		WATER COLUMN[i]						*M. nasuta*		*N. virens*	
				10-Day Mean Percent Survival[f]		*Menidia Beryllina*		*Americamysis bahia*		*Arbacia punctulata*					
	Comparison to Regional SQGs[a] ERL < Concentration > ERM[b]	Comparison to Water Quality Criteria (Acute)[c,d]	Maximum Dilution Required for all Exceeding Constituents to meet LPC[e]	*Leptocheirus plumulosus*	*Neanthes arenaceodentata*	96-hour LC50 (% elutriate)	Dilution Required to Comply with 0.01 LC50 within 4-hr	96-hour LC50 (% elutriate)	Dilution Required to Comply with 0.01 LC50 within 4-hr	48-hour EC50 (% elutriate)	Dilution Required to Comply with 0.01 EC50 within 4-hr	Project Area Mean Statistically > Day Zero Mean (p<0.05)	Project Area Mean Statistically > Reference Mean (p<0.05)	Project Area Mean Statistically > Day Zero Mean (p<0.05)	Project Area Mean Statistically > Reference Mean (p<0.05)
Reference Site (RS-PAS-C)	None	NT	NT	89%	88%	NT	NT	NT	NT	NT	NT	NA	NA	NA	NA
DU1	None	None	None	77%	92%	>100	None	>100	None	>100	None	OCDD, 1,2,3,4,6,7,8-HPCDD	None	Total Dioxin TEQ (Fish and Mammal)	None
DU2	None	None	None	88%	96%	>100	None	>100	None	>100	None	None	None	None	None
DU3	None	None	None	73%	96%	>100	None	>100	None	>100	None	None	None	None	None
DU4	Arsenic	None	None	78%	96%	>100	100[g]	>100	None	>100	None	None	None	None	None
DU5	Arsenic	Copper	1.6	79%	96%	>100	None	>100	None	>100	None	None	None	None	None
DU6	None	None	None	83%	92%	>100	None	>100	None	>100	100[h]	None	None	None	None
DU7	Arsenic	None	None	86%	92%	>100	None	>100	None	>100	100[h]	None	None	None	None
DU8	Arsenic	None	None	84%	100%	>100	None	>100	None	>100	100[h]	None	None	None	None
DU9	Arsenic	None	None	88%	92%	>100	100[g]	>100	None	>100	None	None	None	None	None
DU10	None	None	None	88%	92%	>100	None	>100	None	>100	100[h]	None	None	None	None

Notes:

Notes:

a. Source: Long et al. 1995. Environmental Management 19 (1)

b. Exceedances were of the ERL only; none of the constituents exceeded the ERM.

c. Source: USEPA 2016. National Recommended Water Quality Criteria. Accessed online: https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table.

d. Source: Mississippi Department of Environmental Quality, 2016. State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters. Office of Pollution Control

e. Dilution required is to ensure all constituents are below acute WQC, which must occur within 4 hours to meet LPC

f. None of the results for survival in test samples were statistically different from survival in the reference sample

g. Dilution required because survival in the 100 percent elutriate was significantly less than the control

h. Dilution required because normal development in the 100 percent elutriate was significantly less than the control

i. Standard elutriate and water colomn bioassay results are from the 2012 Turning Basin investigation. All other results are from the 2016 investigation

EC_{50}: mean effective concentration

ERL: effects range-low

ERM: effects range-median

hr: hour

LC_{50}: mean lethal concentration

LPC: limiting permissible concentration

NA: not applicable

NT: not tested

2016 sediment composite samples. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. Each of the tested constituents meet the LPC for water quality criteria for dredged material placement in the Pascagoula ODMDS.

Water Column Toxicity

The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of greater than 100 percent elutriate and the embryo development was normal (not significantly inhibited). The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. Therefore, no dilution is required for the sediment from DU1 from the Turning Basin Expansion to achieve the LPC for water column toxicity for dredged material placement in the Pascagoula ODMDS.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU1 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels. The bent-nose clam (*Macoma nasuta*) mean concentrations of 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) and 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD) statistically exceeded the pre-test (day 0) tissue concentrations, however, mean concentrations of both OCDD and 1,2,3,4,6,7,8-HpCDD did not statistically exceed the mean reference site tissue concentrations. The sand worm (*Nereis virens*) Total Dioxin toxicity equivalency quotient (TEQ) results, calculated using both the fish and mammal toxic equivalency factors (TEFs), statistically exceeded the pre-test (day 0) tissue concentrations, however, the Total Dioxin TEQ results for both fish and mammal did not statistically exceed the reference site Total Dioxin TEQ.

Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU1 and reference site sediment, it is anticipated that ocean placement of the dredged material from DU1 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU1 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU1 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

Turning Basin - Dredging Unit 2

The sediment collected from DU2 during the 2016 field investigation consisted primarily of sand (51 percent) and silt and clay (49 percent). The sediment collected during the 2012 field investigation consisted primarily of silt and clay (58 percent) and was 42 percent sand. All metals were detected in the 2016 composite sediment sample at concentrations similar to or less than the concentrations reported at the reference site, and none were detected at concentrations greater than the ERL. PAHs, SVOCs, PCB congeners, organotins, pesticides, TPH, and dioxin and furan congeners were either not detected or detected at very low concentrations in the 2012 and 2016 sediment composite samples. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. Each of the tested constituents meet the LPC for water quality criteria for dredged material placement in the Pascagoula ODMDS.

Water Column Toxicity

The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of greater than 100 percent elutriate and the embryo development was normal (not significantly inhibited). The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. Therefore, no dilution is required for the sediment from DU2 from the Turning Basin Expansion to achieve the LPC for water column toxicity for dredged material placement in the Pascagoula ODMDS.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU2 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses

performed on tissues exposed to sediment from DU2 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU2 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU2 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU2 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

Turning Basin - Dredging Unit 3

The sediment collected from DU3 during the 2016 field investigation consisted primarily of silt and clay (52 percent) and sand (48 percent). The sediment collected during the 2012 field investigation exhibited similar grain size composition, with 54 percent silt and clay and 46 percent sand. All metals were detected in the 2016 composite sediment sample at concentrations similar to or less than the concentrations reported at the reference site, and none were detected at concentrations greater than the ERL. PAHs, SVOCs, PCB congeners, pesticides, organotins, TPH, and dioxin and furan congeners were either not detected or detected at very low concentrations in the 2012 and 2016 sediment composite samples. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. Each of the tested constituents meet the LPC for water quality criteria for placement in the Pascagoula ODMDS.

Water Column Toxicity

The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of greater than 100 percent elutriate and the embryo development was normal (not significantly inhibited). The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. Therefore, no dilution is required for the sediment from DU3 from the Turning Basin Expansion to achieve the LPC for water column toxicity for ocean placement in the Pascagoula ODMDS.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU3 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU3 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU3 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU3 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU3 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged placement option.

Turning Basin - Dredging Unit 4

The sediment collected from DU4 during the 2016 field investigation consisted primarily of silt and clay (92 percent). The sediment collected during the 2012 field investigation exhibited similar grain size composition, with 94 percent silt and clay. All metals were detected in the 2016 composite sediment sample at concentrations similar to or less than the concentrations reported at the reference site. One metal, arsenic, was detected at a concentration between the ERL and ERM. PAHs, SVOCs, pesticides, organotins, and TPH were not detected in the 2012 and 2016 composite samples. PCB congeners and dioxin and furan congeners were either not detected or detected at very low concentrations in the 2012 and 2016 sediment composite samples. Detected concentrations for these chemicals were similar to concentrations in the reference site.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. Each of the tested constituents meet the LPC for water quality criteria for placement in the Pascagoula ODMDS.

Water Column Toxicity

The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of greater than 100 percent elutriate and the embryo development was normal (not significantly inhibited). The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate, however the survival was significantly different from the control in the inland silverside (*Menidia beryllina*) bioassay. Therefore, a 100-fold

dilution was required for the sediment from DU4 to achieve the LPC for water column toxicity for ocean placement in the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU4 met the LPC for water column toxicity by achieving the 100-fold dilution required to meet the LPC. Based on the STFATE modeling results, the dilution would be achieved; therefore, the standard elutriates from DU4 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU4 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU4 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU4 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU4 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU4 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

Turning Basin - Dredging Unit 5

The sediment collected from DU5 during the 2016 field investigation consisted primarily of silt and clay (94 percent). The sediment collected during the 2012 field investigation exhibited similar grain size composition, with 97 percent silt and clay. All metals were detected in the 2016 composite sediment sample at concentrations similar to or less than the concentrations reported at the reference site. One metal, arsenic, was detected at a concentration between the ERL and ERM. PAHs, SVOCs, pesticides, organotins, and TPH were not detected in the 2012 and 2016 composite samples. PCB congeners and dioxin and furan congeners were either not detected or detected at very low concentrations in the 2012 and 2016 sediment composite samples. Detected concentrations for these chemicals were similar to concentrations in the reference site.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life, with the exception of copper. Copper had a concentration 2.3 times greater than the USEPA saltwater acute quality criteria and required a dilute factor of 1.55. Results of the STFATE modeling indicated that within four hours of placement in the ODMDS, the dilution factor achieved would be sufficient to meet the required dilution to meet the acute WQC for copper. All constituents meet the LPC for water quality criteria for placement in the Pascagoula ODMDS.

Water Column Toxicity

The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of greater than 100 percent elutriate and the embryo development was normal (not significantly inhibited). The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. Therefore, no dilution is required for the sediment from DU5 from the Turning Basin Expansion to achieve the LPC for water column toxicity for ocean placement in the Pascagoula ODMDS.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU5 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU5 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU5 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU5 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU5 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

Turning Basin - Dredging Unit 6

The sediment collected from DU6 during the 2016 field investigation consisted primarily of silt and clay (88 percent). The sediment collected during the 2012 field investigation exhibited similar grain size composition, with 83 percent silt and clay. All metals were detected in the 2016 composite

sediment sample at concentrations similar to or less than the concentrations reported at the reference site and none of the metals were detected at concentrations exceeding the ERL. PAHs, SVOCs, pesticides, organotins, and TPH were not detected in the 2012 and 2016 composite samples. PCB congeners and dioxin and furan congeners were either not detected or detected at very low concentrations in the 2012 and 2016 sediment composite samples. Detected concentrations for these chemicals were similar to concentrations in the reference site.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. Each of the tested constituents meet the LPC for water quality criteria for placement in the Pascagoula ODMDS.

Water Column Toxicity

The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of greater than 100 percent elutriate, however, the normal development in the 100 percent elutriate test was statistically different from the control. The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. Therefore, a 100-fold dilution was required for the sediment from DU6 to achieve the LPC for water column toxicity for ocean placement in the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU6 met the LPC for water column toxicity by achieving the 100-fold dilution required to meet the LPC. Based on the STFATE modeling results, the dilution would be achieved; therefore, the standard elutriates from DU6 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU6 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU6 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU6 at the Pascagoula ODMDS is

not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU6 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU6 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

Turning Basin - Dredging Unit 7

The sediment collected from DU7 during the 2016 field investigation consisted primarily of silt and clay (92 percent). The sediment collected during the 2012 field investigation exhibited similar grain size composition, with 89 percent silt and clay. All metals were detected in the 2016 composite sediment sample at concentrations similar to or less than the concentrations reported at the reference site. One metal, arsenic, was detected at a concentration between the ERL and ERM. PAHs, SVOCs, pesticides, organotins, and TPH were not detected in the 2012 and 2016 composite samples. PCB congeners and dioxin and furan congeners were either not detected or detected at very low concentrations in the 2012 and 2016 sediment composite samples. Detected concentrations for these chemicals were similar to concentrations in the reference site.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. Each of the tested constituents meet the LPC for water quality criteria for placement in the Pascagoula ODMDS.

Water Column Toxicity

The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of greater than 100 percent elutriate, however, the normal development in the 100 percent elutriate test was statistically different from the control. The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. Therefore, a 100-fold dilution was required for the sediment from DU7 to achieve the LPC for water column toxicity for ocean placement in the Pascagoula ODMDS. STFATE modeling was conducted to determine if the standard elutriate from DU7 met the LPC for water column toxicity by achieving the 100-fold dilution required to meet the LPC.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU7 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU7 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU7 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU7 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU7 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

Turning Basin - Dredging Unit 8

The sediment collected from DU8 during the 2016 field investigation consisted primarily of silt and clay (82 percent) and sand (18 percent). The sediment collected during the 2012 field investigation consisted of 73 percent silt and clay and 27 percent sand. All metals were detected in the 2016 composite sediment sample at concentrations similar to or less than the concentrations reported at the reference site. One metal, arsenic, was detected at a concentration between the ERL and ERM. PAHs, SVOCs, pesticides, organotins, and TPH were not detected in the 2012 and 2016 composite samples. PCB congeners and dioxin and furan congeners were either not detected or detected at very low concentrations in the 2012 and 2016 sediment composite samples. Detected concentrations for these chemicals were similar to concentrations in the reference site.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. Each of the tested constituents meet the LPC for water quality criteria for placement in the Pascagoula ODMDS.

Water Column Toxicity

The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of greater than 100 percent elutriate, however, the normal development in the 100 percent elutriate test was statistically different from the control. The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. Therefore, a 100-fold dilution was required for the sediment from DU8 to achieve the LPC for water column toxicity for ocean placement in the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU8 met the LPC for water column toxicity by achieving the 100-fold dilution required to meet the LPC. Based on the STFATE modeling results, the dilution would be achieved; therefore, the standard elutriates from DU8 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU8 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU8 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU8 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU8 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU8 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

Turning Basin - Dredging Unit 9

The sediment collected from DU9 during the 2016 field investigation consisted primarily of silt and clay (86 percent) and sand (14 percent). The sediment collected during the 2012 field investigation exhibited similar grain size results and consisted of 89 percent silt and clay and 11 percent sand. All metals were detected in the 2016 composite sediment sample at concentrations similar to or less than the concentrations reported at the reference site. One metal, arsenic, was detected at a concentration between the ERL and ERM. PAHs, SVOCs, pesticides, organotins, and TPH were not detected in the 2012 and 2016 composite samples. PCB congeners and dioxin and furan congeners were either not detected or detected at very low concentrations in the 2012 and 2016 sediment composite samples. Detected concentrations for these chemicals were similar to concentrations in the reference site.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the

protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. Each of the tested constituents meet the LPC for water quality criteria for placement in the Pascagoula ODMDS.

Water Column Toxicity

The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of greater than 100 percent elutriate and the embryo development was normal (not significantly inhibited). The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate, however the survival was significantly different from the control in the inland silverside (*Menidia beryllina*) bioassay. Therefore, a 100-fold dilution was required for the sediment from DU9 to achieve the LPC for water column toxicity for ocean placement in the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU9 met the LPC for water column toxicity by achieving the 100-fold dilution required to meet the LPC. Based on the STFATE modeling results, the dilution would be achieved; therefore, the standard elutriates from DU9 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU9 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU9 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU9 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU9 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU9 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

Turning Basin - Dredging Unit 10

The sediment collected from DU10 during the 2016 field investigation consisted primarily of silt and clay (54 percent) and sand (46 percent). The sediment collected during the 2012 field investigation

consisted of 43 percent silt and clay and 57 percent sand. All metals were detected in the 2016 composite sediment sample at concentrations similar to or less than the concentrations reported at the reference site, and none of the metals were detected at concentrations exceeded in the ERL. PAHs, SVOCs, pesticides, organotins, and PCB congeners were not detected in the 2012 and 2016 composite samples. Diesel range organics and dioxin and furan congeners were detected at very low concentrations in the 2012 and 2016 sediment composite samples. Detected concentrations for these chemicals were similar to concentrations in the reference site.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. Each of the tested constituents meet the LPC for water quality criteria for placement in the Pascagoula ODMDS.

Water Column Toxicity

The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of greater than 100 percent elutriate, however, the normal development in the 100 percent elutriate test was statistically different from the control. The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. A 100-fold dilution was required for the sediment from DU10 to achieve the LPC for water column toxicity for ocean placement in the Pascagoula ODMDS based on the results of the purple sea urchin (*Arbacia punctulata*) bioassay.

STFATE modeling was conducted to determine if the standard elutriate from DU10 met the LPC for water column toxicity by achieving the 100-fold dilution required to meet the LPC. Based on the STFATE modeling results, the dilution would be achieved; therefore, the standard elutriates from DU10 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU10 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU10 and pre-test tissue concentrations, it is

anticipated that ocean placement of the dredged material from DU10 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU10 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU10 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

Turning Basin Expansion Summary

For ocean placement to be a viable option for materials from the Turning Basin Expansion dredging footprint, the dredged material must comply with Section 103 of the MPRSA. Compliance with Section 103 of the MPRSA includes determining LPC compliance in four areas:

- WQC
- Water column toxicity
- Benthic toxicity
- Benthic bioaccumulation

Based on the results of the testing and analysis, each of the ten Turning Basin Expansion dredging units meet the LPC for ocean placement at the Pascagoula ODMDS. Because each of the ten Turning Basin Expansion DUs meet the LPC for ocean placement, beneficial use of the project material may be considered a viable option for placement because no ecologically significant effects on the benthic community are expected whether the material is placed in the open ocean or beneficially used at the Biloxi Marsh Complex.

Placing the dredged material at the Biloxi Marsh Complex Beneficial Use site is also potentially viable because the upper strata of the Turning Basin Expansion sediments are soft, silty sediments that may be used to re-establish or expand existing marsh, or may be placed within a marsh cell, where it will settle and consolidate until achieving the intertidal marsh elevation range. The deeper sediments within the proposed dredging footprint (from approximately -25 feet MLLW to the dredge depth) are a combination of stiff to very stiff marine clays and sands. The stiff to very stiff materials may also be used to enhance habitat diversity, creating a ridge or chenier within the Biloxi Marsh Complex Beneficial Use site to support avian habitat and possible nesting.

If dredged material placement in the Biloxi Marsh Complex Beneficial Use site or other beneficial use site is not a viable option because the site(s) is unavailable, then upland placement of the dredged material from the Turning Basin Expansion may be considered.

West Pier Terminal Expansion and Berthing Area

This section summarizes the sampling methods, results, and LPC compliance for the characterization of dredged material from the West Pier Terminal Expansion and Berthing Area.

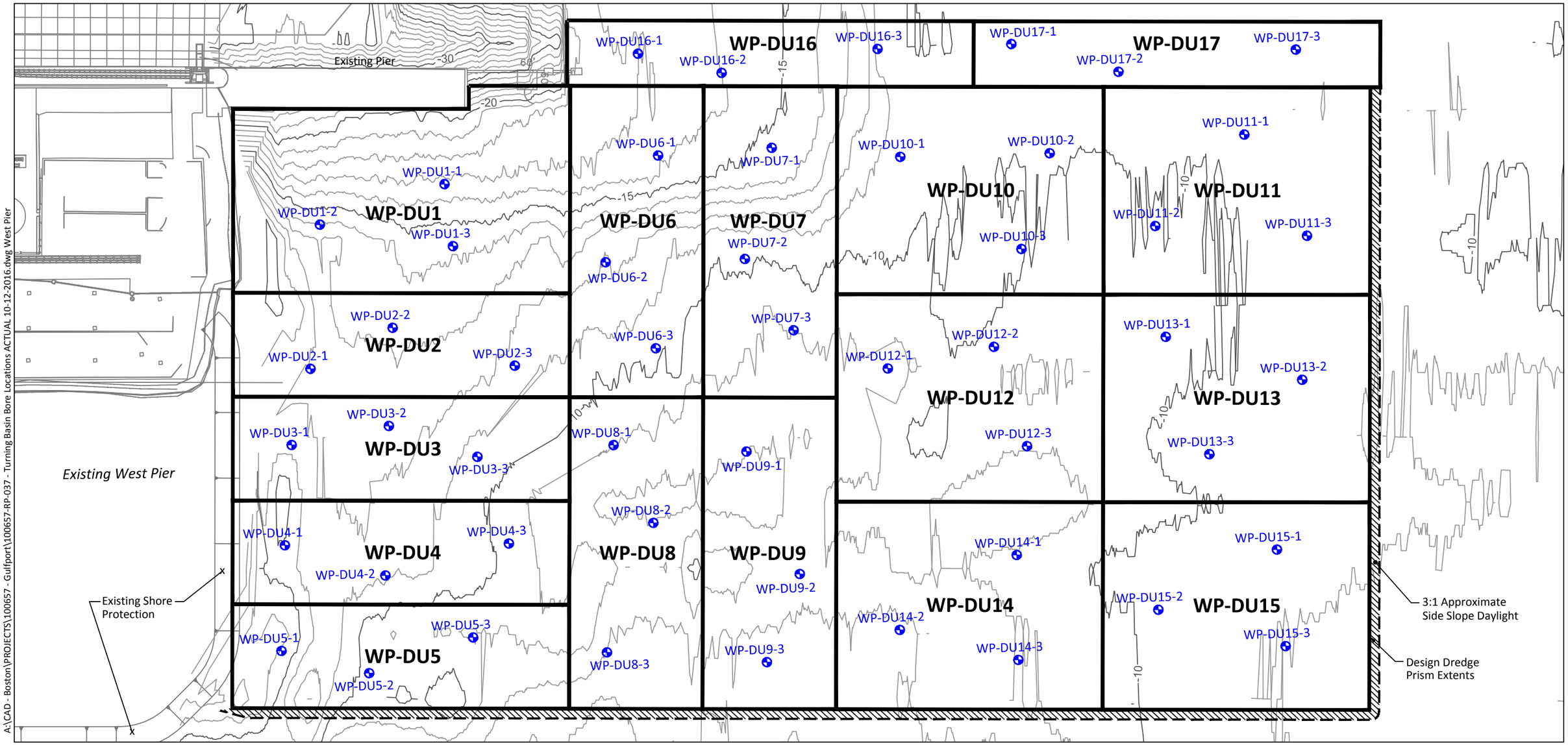
Sampling and Analysis Overview

The technical approach for the West Pier Terminal Expansion and Berthing Area dredge material characterization was designed to provide information regarding chemical and ecotoxicological data to assess potential impacts related to ocean placement at the Pascagoula ODMDS, and to document compliance with Section 103 of the MPRSA. This investigation consisted of collecting sediment cores and site water at specified locations within the West Pier Terminal Expansion and Berthing Area; sediment grab sampling at a Pascagoula Reference Site; conducting analytical testing of sediments, site water, standard elutriates, and aquatic organism tissue; conducting ecotoxicological testing (water column, whole sediment, and 28-day bioaccumulation bioassays); and evaluating test results. A detailed description of sampling methods and analyses is described in the *Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP): Evaluation of Dredged Material for Ocean Placement, Gulfport West Pier Terminal Expansion* (Anchor QEA 2016b).

Sediments from the West Pier Terminal Expansion and Berthing Area were sampled and tested based on a DU approach. The dredging footprint was divided into a total of 17 DUs (15 DUs in the West Pier Terminal Expansion and two DUs in the Berthing Area) based on the total quantity of dredged material that will be removed from each DU (Figure 3). The DUs and expected dredged material quantities are summarized in Table 3. Sediment cores were collected from three locations within each DU and composited together to create one composite sample per DU (Figure 3). Site and reference sediments were submitted for physical, chemical, and ecotoxicological testing. Site water was collected from one location within the dredge prism and analyzed for chemical constituents and ecotoxicological testing and used for standard elutriate preparation.

The composite sediment samples and the reference site sample were submitted for physical and chemical analysis, standard elutriate testing, water column bioassays, whole sediment bioassays, and bioaccumulation testing. The physical composition of the sediment was described by grain size, specific gravity, TS, and Atterberg limits determinations. Chemical concentrations of metals, PAHs, pentachlorophenol, PCB congeners, chlorinated pesticides, ammonia, butyltins, dioxin and furan congeners, and TOC were measured in the sediment samples.

The composite samples and the reference sample were also submitted for ecotoxicological testing, including whole sediment and 28-day bioaccumulation bioassays. The whole sediment bioassays evaluated the effects of exposure to the sediment samples on survival of test organisms and were conducted with the polychaete (*Neanthes arenaceodentata*) and the amphipod (*Leptocheirus plumulosus*). The bioaccumulation tests evaluated the potential for chemical uptake as a result of



A:\CAD - Boston\PROJECTS\100657 - Gulfport\100657-RP-037 - Turning Basin Bore Locations ACTUAL 10-12-2016.dwg West Pier

Oct 13, 2016 11:19am psciaba

SOURCE: Bathymetry from DIMCO, Inc. (June 27, 2016)
HORIZONTAL DATUM: Mississippi State Plane East, NAD83, U.S. Survey Feet
VERTICAL DATUM: Mean Lower Low Water (MLLW)

LEGEND:

WP-DU#-## Actual Sediment Core Locations Bathymetry

-15 Contour (1 ft)

0 300
Scale in Feet

ANCHOR QEA

Figure 3
West Pier Terminal Expansion and Berthing Area Sediment Core Locations
Gulfport Turning Basin and West Pier Terminal Expansion Dredged Material Evaluation
Mississippi State Port Authority - Port of Gulfport

Table 3

Approximate Dredging Volumes for Each West Pier Terminal Expansion and Berthing Area Dredging Unit

Dredging Unit	Project Depth		Total Volume (cy)	Project Depth (feet MLLW)
	Design Depth Cut Volume (cy)	0.5 Foot Tolerance Overdepth (cy)		
West Pier Terminal Expansion				
WP-DU1	102,800	11,200	114,000	-20
WP-DU2	94,000	6,100	100,100	-20
WP-DU3	104,200	6,100	110,300	-20
WP-DU4	115,800	6,100	121,900	-20
WP-DU5	131,700	6,100	137,800	-20
WP-DU6	95,100	7,200	102,300	-20
WP-DU7	118,900	7,200	126,100	-20
WP-DU8	167,400	7,200	174,600	-20
WP-DU9	171,200	7,200	178,400	-20
WP-DU10	179,900	9,600	189,500	-20
WP-DU11	184,400	9,600	194,000	-20
WP-DU12	204,200	9,600	213,800	-20
WP-DU13	189,800	9,600	199,400	-20
WP-DU14	236,100	9,600	245,700	-20
WP-DU15	187,700	9,600	197,300	-20
Total	2,283,200	122,000	2,405,200	
West Pier Berthing Area[1]				
WP-DU16	217,600	9,000	226,600	-38
WP-DU17	217,600	9,000	226,600	-38
Total	435,200	18,000	543,200	

Notes:

1: The dredging allowable overdepth for the West Pier Berthing Area is 1 foot

Based on a bathymetric survey completed in June 2016.

cy: cubic yards

MLLW: mean lower low water

exposure to the sediment samples and were conducted with the bent-nose clam (*Macoma nasuta*) and sand worm (*Nereis virens*). At the completion of the 28-day bioaccumulation exposure, organism tissue was submitted for the following analyses (discussions with USEPA Region 4 determined the level of tissue testing):

- Metals analysis on samples from DUs 1 through 17, reference site, and pre-test tissues
- PAH analysis on samples from DUs 4, 5, and 8, reference site, and pre-test tissues
- PCB congener analysis on samples from DUs 1 through 5 and DU16, reference site, and pre-test tissues
- Dioxin and furan congener analysis on samples from DUs 3 through 9 and DU16, reference site, and pre-test tissues

The site water was submitted for chemical analysis, standard elutriate preparation, and water column bioassay testing. Receiving water from the Pascagoula ODMDS was also collected for chemical analysis. Chemical analyses for the site water, receiving water, and standard elutriate samples included metals, PAHs, pentachlorophenol, PCB congeners, chlorinated pesticides, tributyltin (TBT), ammonia, cyanide, and TOC. The water column bioassay testing program consisted of 96-hour water column bioassays with mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) and 48-hour water column bioassays with purple sea urchin (*Arbacia punctulata*).

Sampling Results and LPC Compliance

This section presents a summary of the sediment, standard elutriate, and ecotoxicological testing for the West Pier Terminal Expansion and Berthing Area. A summary is also provided in Table 4.

West Pier Expansion - Dredging Unit 1

Results of the grain size analysis indicated that sediment from DU1 consisted primarily of silt and clay (87.3 percent). The remainder of the sample was made up of sand (12.7 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. None of the metal concentrations exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL. The concentration of total PCB congeners slightly exceeded its ERL, but was substantially less than the ERM.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. Only one metal, copper, was detected at a concentration that exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Copper concentrations indicated that a 2.5-fold dilution within four hours after placement of sediment at the Pascagoula ODMDS would be required

Table 4
Summary of Results for West Pier Terminal Expansion and Berthing Area Sediment, Standard Elutriate, Toxicity, and Bioaccumulation Testing

	SEDIMENT	STANDARD ELUTRIATE		BIOASSAY TESTS								STFATE MODEL RESULTS[g]		BIOACCUMULATION TESTS			
				WHOLE SEDIMENT		WATER COLUMN								*Macoma nasuta*		*Nereis virens*	
	Comparison to Regional SQGs[a]			*10-Day Mean Percent Survival*[f]		*Menidia Beryllina*		*Americamysis bahia*		*Arbacia punctulata*							
Dredging Unit (DU)	ERL < Concentration > ERM[b]	Comparison to Water Quality Criteria (Acute)[c,d]	Maximum Dilution Required for all Exceeding Constituents to meet LPC[e]	*Leptocheirus plumulosus*	*Neanthes arenaceodentata*	96-hour LC_{50} (% elutriate)	Dilution Required to Comply with 0.01 LC_{50} within 4-hr	96-hour LC_{50} (% elutriate)	Dilution Required to Comply with 0.01 LC_{50} within 4-hr	48-hour EC_{50} (% elutriate)	Dilution Required to Comply with 0.01 EC_{50} within 4-hr	Dilution Achieved	Modeled Volume (cy) Per Placement Event	Project Area Mean Statistically > Day Zero Mean (p<0.05)	Project Area Mean Statistically > Reference Mean (p<0.05)	Project Area Mean Statistically > Day Zero Mean (p<0.05)	Project Area Mean Statistically > Reference Mean (p<0.05)
West Pier Terminal Expansion																	
Reference Site (RS-PAS-C)	None	NT	NT	87%	88%	NT	NT	NT	NT	NT	NT	NT	NT	NA	NA	NA	NA
DU1	Total PCBs	Copper	2.5	99%	100%	>100	None	>100	None	20.9	479	591	4,000	None	None	None	None
DU2	Dieldrin	Copper	1.7	96%	84%	>100	None	>100	None	20.0	501	689	4,000	Cadmium	None	None	None
DU3	None	Copper	1.6	93%	68%	>100	None	>100	None	21.9	458	713	4,000	Cadmium	None	1,2,3,4,6,7,8-HpCDD	None
DU4	Arsenic, Total PCBs	Copper	1.2	90%	96%	>100	None	>100	None	20.8	480	698	4,000	Cadmium	None	None	None
DU5	None	Copper	1.1	81%	92%	>100	None	>100	None	17.2	583	900	4,000	None	None	None	None
DU6	None	None	--	87%	92%	>100	None	>100	None	>100	None	757	4,000	Cadmium	None	None	None
DU7	None	None	--	97%	92%	>100	None	>100	None	6.76	1,479	1,700	1,250	None	None	None	None
DU8	None	Copper	1.1	87%	88%	>100	None	>100	None	10.4	960	1,016	3,500	None	None	None	None
DU9	None	None	--	92%	96%	>100	None	>100	None	8.69	1,151	1,159	2,500	Arsenic	None	None	None
DU10	Arsenic	None	--	93%	96%	>100	None	>100	None	12.2	818	861	2,750	None	None	None	None
DU11	None	None	--	89%	84%	>100	None	>100	None	0.97	10,309	11,764	150	None	None	None	None
DU12	None	None	--	94%	92%	>100	None	>100	None	3.83	2,611	2,761	750	None	None	None	None
DU13	Arsenic	Copper	1.8	100%	100%	>100	None	>100	None	19.6	510	624	4,000	None	None	None	None
DU14	Arsenic	None	--	96%	96%	>100	None	>100	None	23.7	423	653	4,000	None	None	None	None
DU15	Arsenic	None	--	94%	96%	>100	None	>100	None	21.9	456	601	4,000	None	None	None	None
West Pier Berthing Area																	
DU16	Arsenic	Ammonia	1.1	94%	96%	>100	None	>100	None	29.2	343	670	4,000	None	None	None	None
DU17	Arsenic	None	--	82%	100%	>100	None	>100	None	21.6	462	636	4,000	None	None	None	None

Notes:

a. Source: Long et al. 1995. Environmental Management 19 (1)

b. Exceedances were of the ERL only, none of the constituents exceeded the ERM

c. Source: USEPA 2016. National Recommended Water Quality Criteria. Accessed online: https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table.

d. Source: Mississippi Department of Environmental Quality 2016. State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters. Office of Pollution Control

e. Dilution required is to ensure all constituents are below acute WQC, which must occur within 4 hours to meet LPC

f. None of the results for survival in test samples were statistically different from survival in the reference sample

g. STFATE modeling conducted based on water column bioassay with the lowest EC_{50} or LC_{50}

Orange shaded cells show survival was less than reference sample survival (88%) by more than 10 percent; however, the results were not statistically different from the reference sample

DUs highlighted in yellow will require best management practices and/or limited dredged material placement quantities to meet the requirements for placement at the Pascagoula ODMDS

cy = cubic yard
EC_{50} = mean effective concentration
ERL = effects range low
ERM = effects range median
HpCDD = Heptachlorodibenzo-p-dioxin
hr = hour
LC_{50} = mean lethal concentration
LPC = limiting permissible concentration
NA = not applicable
NT = not tested
SQG = sediment quality guideline
STFATE = short-term fate

to meet the LPC. STFATE modeling indicated that a 591-fold dilution would be achieved upon placement in Zone B of the Pascagoula ODMDS. Therefore, all constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 20.9 percent elutriate. Therefore, a 479-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU1 met the LPC for water column toxicity by achieving the 479-fold dilution required and to verify that the sediment plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that placement of 4,000 cy of sediment at Zone B of the Pascagoula ODMDS will result in a 591-fold dilution. Therefore, the standard elutriates from DU1 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU1 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU1 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU1 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU1 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU1 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

West Pier Expansion - Dredging Unit 2

Results of the grain size analysis indicated that sediment from DU2 consisted primarily of silt and clay (63.8 percent) and sand (36.2 percent). All metals were detected at concentrations similar to the

concentrations reported at the reference site. None of the metal concentrations exceeded ERLs. Butlytins, PAHs, pentachlorophenol, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL. One pesticide, dieldrin, was detected at a concentration that slightly exceeded its ERL, but was substantially less than the ERM.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. Only one metal, copper, was detected at a concentration that exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Copper concentrations indicated that a 1.7-fold dilution within four hours after placement of sediment at the Pascagoula ODMDS would be required to meet the LPC. STFATE modeling indicated that a 689-fold dilution would be achieved upon placement in Zone B of the Pascagoula ODMDS. Therefore, all constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 20.0 percent elutriate. Therefore, a 501-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU2 met the LPC for water column toxicity by achieving the 501-fold dilution required and to verify that the sediment plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that placement of 4,000 cy of sediment at Zone B of the Pascagoula ODMDS will result in a 689-fold dilution. Therefore, the standard elutriates from DU2 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU2 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels. The bent-nose clam (*Macoma nasuta*) mean concentration of cadmium statistically exceeded the pre-test (day 0) tissue concentrations, however, did not statistically exceed the mean reference site tissue concentrations.

None of the tested analytes in the sand worm (*Nereis virens*) samples statistically exceeded the pre-test (day 0) tissue concentrations.

Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU2 and reference site sediment, it is anticipated that ocean placement of the dredged material from DU2 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU2 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU2 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

West Pier Expansion - Dredging Unit 3

Results of the grain size analysis indicated that sediment from DU3 consisted primarily of silt and clay (80.9 percent). The remainder of the sample was made up of sand (19.1 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. None of the metal concentrations exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. Only one metal, copper, was detected at a concentration that exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Copper concentrations indicated that a 1.6-fold dilution within four hours after placement of sediment at the Pascagoula ODMDS would be required to meet the LPC. STFATE modeling indicated that a 713-fold dilution would be achieved upon placement in Zone B of the Pascagoula ODMDS. Therefore, all constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 21.9 percent elutriate. Therefore, a 458-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU3 met the LPC for water column toxicity by achieving the 458-fold dilution required and to verify that the sediment

plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that placement of 4,000 cy of sediment at Zone B of the Pascagoula ODMDS will result in a 713-fold dilution. Therefore, the standard elutriates from DU3 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the polychaete (*Neanthes arenaceodentata*) whole sediment bioassay samples was less than the reference sample survival by more than ten percent. However, survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). The dredged material from DU3 meets the benthic toxicity LPC for amphipods, but did not meet the benthic toxicity LPC for polychaetes. The potential for ocean placement of the dredged material from DU3 will be coordinated with EPA Region 4.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels. The bent-nose clam (*Macoma nasuta*) mean concentration of cadmium statistically exceeded the pre-test (day 0) tissue concentrations, however, did not statistically exceed the mean reference site tissue concentrations. The sand worm (*Nereis virens*) mean concentration of 1,2,3,4,6,7,8-HpCDD statistically exceeded the pre-test (day 0) tissue concentrations, however, did not statistically exceed the mean reference site tissue concentrations.

Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU3 and reference site sediment, it is anticipated that ocean placement of the dredged material from DU3 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU3 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU3 meet the criteria for the LPC for WQC, water column toxicity, and benthic bioaccumulation. The dredged material from DU3 meets the benthic toxicity LPC for amphipods, but did not meet the benthic toxicity LPC for polychaetes. For polychaetes, the survival was lower than the reference site, and although this result was not statistically different from the reference, the polychaete results do not meet the LPC for ocean placement. However, the total testing program for the dredged material from this dredging unit indicated that sediment concentrations were low, there is no potential for remobilization of chemicals into the water column, there was no toxicity to water column species, and there was no potential for bioaccumulation. The potential for ocean placement of the dredged material from DU3 will be coordinated with EPA Region 4. But, based on all a comprehensive evaluation of all the testing results from DU3 and because the dredged material from

DU3 meets the LPC for benthic toxicity for amphipods, placement of the material from DU3 in the Biloxi Marsh Complex is likely the most viable placement alternative.

West Pier Expansion - Dredging Unit 4

Results of the grain size analysis indicated that sediment from DU4 consisted primarily of silt and clay (71.3 percent). The remainder of the sample was made up of sand (28.7 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. One metal, arsenic, was detected at a concentration between the ERL and ERM; all other metal concentrations were less than ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL. The concentration of total PCB congeners slightly exceeded its ERL, but was substantially less than the ERM.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. Only one metal, copper, was detected at a concentration that exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Copper concentrations indicated that a 1.2-fold dilution within four hours after placement of sediment at the Pascagoula ODMDS would be required to meet the LPC. STFATE modeling indicated that a 698-fold dilution would be achieved upon placement in Zone B of the Pascagoula ODMDS. Therefore, all constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 20.8 percent elutriate. Therefore, a 480-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU4 met the LPC for water column toxicity by achieving the 480-fold dilution required and to verify that the sediment plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that placement of 4,000 cy of sediment at Zone B of the Pascagoula ODMDS will result in a 698-fold dilution. Therefore, the standard elutriates from DU4 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU4 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels. The bent-nose clam (*Macoma nasuta*) mean concentration of cadmium statistically exceeded the pre-test (day 0) tissue concentrations, however, did not statistically exceed the mean reference site tissue concentrations. None of the tested analytes in the sand worm (*Nereis virens*) samples statistically exceeded the pre-test (day 0) tissue concentrations.

Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU4 and reference site sediment, it is anticipated that ocean placement of the dredged material from DU4 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU4 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU4 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

West Pier Expansion - Dredging Unit 5

Results of the grain size analysis indicated that sediment from DU5 consisted primarily of silt and clay (62.9 percent) and sand (37.1 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. None of the metal concentrations exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. Only one metal, copper, was detected at a concentration that exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Copper concentrations indicated that a 1.1-fold dilution within four hours after placement of sediment at the Pascagoula ODMDS would be required to meet the LPC. STFATE modeling indicated that a 900-fold dilution would be achieved upon placement in Zone B of the Pascagoula ODMDS. Therefore, all constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 17.2 percent elutriate. Therefore, a 583-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU5 met the LPC for water column toxicity by achieving the 583-fold dilution required and to verify that the sediment plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that placement of 4,000 cy of sediment at Zone B of the Pascagoula ODMDS will result in a 900-fold dilution. Therefore, the standard elutriates from DU5 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU5 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU5 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU5 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU5 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU5 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

West Pier Expansion - Dredging Unit 6

Results of the grain size analysis indicated that sediment from DU6 consisted primarily of silt and clay (77.2 percent). The remainder of the sample was made up of sand (22.8 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. None of the metal concentrations exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in

the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. All constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of greater than 100 percent elutriate and the embryo development was normal (not significantly inhibited). The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. Therefore, no dilution is required for the sediment from DU6 to achieve the LPC for water column toxicity for ocean placement in Zone B of the Pascagoula ODMDS.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU6 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels. The bent-nose clam (*Macoma nasuta*) mean concentration of cadmium statistically exceeded the pre-test (day 0) tissue concentrations, however, did not statistically exceed the mean reference site tissue concentrations. None of the tested analytes in the sand worm (*Nereis virens*) samples statistically exceeded the pre-test (day 0) tissue concentrations.

Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU6 and reference site sediment, it is anticipated that ocean placement of the dredged material from DU6 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU6 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU6 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

West Pier Expansion - Dredging Unit 7

Results of the grain size analysis indicated that sediment from DU7 consisted primarily of silt and clay (77 percent). The remainder of the sample was made up of sand (23 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. None of the metal concentrations exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals, ammonia, and heptachlor were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. All constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 6.76 percent elutriate. Therefore, a 1,479-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU7 met the LPC for water column toxicity by achieving the 1,479-fold dilution required and to verify that the sediment plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that a maximum placement volume of 1,250 cy of sediment at Zone B of the Pascagoula ODMDS will result in a 1,700-fold dilution and meet the dilution required. Therefore, the standard elutriates from DU7 meet the LPC requirements for water column toxicity, with limited placement volume.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU7 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses

performed on tissues exposed to sediment from DU7 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU7 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU7 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU7 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option, with the limitation of a maximum placement volume of 1,250 cy per placement event.

West Pier Expansion - Dredging Unit 8

Results of the grain size analysis indicated that sediment from DU8 consisted primarily of silt and clay (62 percent) and sand (37.9 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. None of the metal concentrations exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals, ammonia, and PAHs were the only constituents that were detected in the standard elutriate sample. Only one metal, copper, was detected at a concentration that exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Copper concentrations indicated that a 1.1-fold dilution within four hours after placement of sediment at the Pascagoula ODMDS would be required to meet the LPC. STFATE modeling indicated that this dilution would be achieved upon placement in Zone B of the Pascagoula ODMDS. Therefore, all constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 10.4 percent elutriate. Therefore, a 960-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU8 met the LPC for water column toxicity by achieving the 960-fold dilution required and to verify that the sediment plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that a maximum placement volume of 3,500 cy of sediment at

Zone B of the Pascagoula ODMDS will result in a 1,016-fold dilution and meet the dilution required. Therefore, the standard elutriates from DU8 meet the LPC requirements for water column toxicity, with limited placement volume.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU8 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU8 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU8 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU8 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU8 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option, with the limitation of a maximum placement volume of 3,500 cy per placement event.

West Pier Expansion - Dredging Unit 9

Results of the grain size analysis indicated that sediment from DU9 consisted primarily of silt and clay (53 percent) and sand (47 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. None of the metal concentrations exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. All constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 8.69 percent elutriate. Therefore, a 1,151-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU9 met the LPC for water column toxicity by achieving the 1,151-fold dilution required and to verify that the sediment plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that a maximum placement volume of 2,500 cy of sediment at Zone B of the Pascagoula ODMDS will result in a 1,159-fold dilution and meet the dilution required. Therefore, the standard elutriates from DU9 meet the LPC requirements for water column toxicity, with limited placement volume.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU9 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels. The bent-nose clam (*Macoma nasuta*) mean concentration of arsenic statistically exceeded the pre-test (day 0) tissue concentrations, however, did not statistically exceed the mean reference site tissue concentrations. None of the tested analytes in the sand worm (*Nereis virens*) samples statistically exceeded the pre-test (day 0) tissue concentrations.

Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU9 and reference site sediment, it is anticipated that ocean placement of the dredged material from DU9 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU9 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU9 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option, with the limitation of a maximum placement volume of 2,500 cy per placement event.

West Pier Expansion - Dredging Unit 10

Results of the grain size analysis indicated that sediment from DU10 consisted primarily of silt and clay (89.7 percent). The remainder of the sample was made up of sand (10.3 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. One metal, arsenic, was detected at a concentration between the ERL and ERM; all other metals were not detected at concentrations that exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. All constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 12.2 percent elutriate. Therefore, an 818-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU10 met the LPC for water column toxicity by achieving the 818-fold dilution required and to verify that the sediment plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that a maximum placement volume of 2,750 cy of sediment at Zone B of the Pascagoula ODMDS will result in an 861-fold dilution and meet the dilution required. Therefore, the standard elutriates from DU10 meet the LPC requirements for water column toxicity, with limited placement volume.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU10 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU10 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU10 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU10 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU10 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option, with the limitation of a maximum placement volume of 2,750 cy per placement event.

West Pier Expansion - Dredging Unit 11

Results of the grain size analysis indicated that sediment from DU11 consisted primarily of silt and clay (80.4 percent). The remainder of the sample was made up of sand (19.6 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. None of the metal concentrations exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. All constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 0.97 percent elutriate. Therefore, a 10,309-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU11 met the LPC for water column toxicity by achieving the 10,309-fold dilution required and to verify that the sediment

plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that a maximum placement volume of 150 cy of sediment at Zone B of the Pascagoula ODMDS will result in a 11,764-fold dilution and meet the dilution required. Therefore, the standard elutriates from DU11 meet the LPC requirements for water column toxicity, with limited placement volume.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU11 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU11 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU11 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU11 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU11 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option, with the limitation of a maximum placement volume of 150 cy per placement event.

West Pier Expansion - Dredging Unit 12

Results of the grain size analysis indicated that sediment from DU12 consisted primarily of silt and clay (71.5 percent). The remainder of the sample was made up of sand (28.5 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. None of the metal concentrations exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC

following open water placement. All constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 3.83 percent elutriate. Therefore, a 2,611-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU12 met the LPC for water column toxicity by achieving the 2,611-fold dilution required and to verify that the sediment plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that a maximum placement volume of 750 cy of sediment at Zone B of the Pascagoula ODMDS will result in a 2,761-fold dilution and meet the dilution required. Therefore, the standard elutriates from DU12 meet the LPC requirements for water column toxicity, with limited placement volume.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU12 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU12 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU12 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU12 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU12 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option, with the limitation of a maximum placement volume of 750 cy per placement event.

West Pier Expansion - Dredging Unit 13

Results of the grain size analysis indicated that sediment from DU13 consisted primarily of silt and clay (92.5 percent). The remainder of the sample was made up of sand (7.5 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. One metal, arsenic, was detected at a concentration between the ERL and ERM; all other metals were not detected at concentrations that exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. Only one metal, copper, was detected at a concentration that exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Copper concentrations indicated that a 1.8-fold dilution within four hours after placement of sediment at the Pascagoula ODMDS would be required to meet the LPC. STFATE modeling indicated that a 624-fold dilution would be achieved upon placement in Zone B of the Pascagoula ODMDS. Therefore, all constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 19.6 percent elutriate. Therefore, a 510-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU13 met the LPC for water column toxicity by achieving the 510-fold dilution required and to verify that the sediment plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that placement of 4,000 cy of sediment at Zone B of the Pascagoula ODMDS will result in a 624-fold dilution. Therefore, the standard elutriates from DU13 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU13 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU13 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU13 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU13 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU13 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

West Pier Expansion - Dredging Unit 14

Results of the grain size analysis indicated that sediment from DU14 consisted primarily of silt and clay (86.2 percent). The remainder of the sample was made up of sand (13.8 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. One metal, arsenic, was detected at a concentration between the ERL and ERM; all other metals were not detected at concentrations that exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals, ammonia, and heptachlor were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. All constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 23.7 percent elutriate. Therefore, a 423-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU14 met the LPC for water column toxicity by achieving the 423-fold dilution required and to verify that the sediment plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that placement of 4,000 cy of sediment at Zone B of the Pascagoula ODMDS will result in a 653-fold dilution. Therefore, the standard elutriates from DU14 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU14 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU14 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU14 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU14 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU14 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

West Pier Expansion - Dredging Unit 15

Results of the grain size analysis indicated that sediment from DU15 consisted primarily of silt and clay (98.2 percent). The remainder of the sample was made up of sand (1.8 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. One metal, arsenic, was detected at a concentration between the ERL and ERM; all other metals were not detected at concentrations that exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the

protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. All constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 22.0 percent elutriate. Therefore, a 456-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU15 met the LPC for water column toxicity by achieving the 456-fold dilution required and to verify that the sediment plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that placement of 4,000 cy of sediment at Zone B of the Pascagoula ODMDS will result in a 601-fold dilution. Therefore, the standard elutriates from DU15 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU15 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU15 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU15 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU15 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU15 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

West Pier Expansion - Dredging Unit 16

Results of the grain size analysis indicated that sediment from DU16 consisted primarily of silt and clay (68.7 percent) and sand (31.2 percent). All metals were detected at concentrations similar to the

concentrations reported at the reference site. One metal, arsenic, was detected at a concentration between the ERL and ERM; all other metals were not detected at concentrations that exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals, ammonia, and heptachlor epoxide were the only constituents that were detected in the standard elutriate sample. Only ammonia was detected at a concentration that exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. The ammonia concentration indicated that a 1.1-fold dilution within four hours after placement of sediment at the Pascagoula ODMDS would be required to meet the LPC. STFATE modeling indicated that a 670-fold dilution would be achieved upon placement in Zone B of the Pascagoula ODMDS. Therefore, all constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 29.2 percent elutriate. Therefore, a 343-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU16 met the LPC for water column toxicity by achieving the 343-fold dilution required and to verify that the sediment plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that placement of 4,000 cy of sediment at Zone B of the Pascagoula ODMDS will result in a 670-fold dilution. Therefore, the standard elutriates from DU16 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU16 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU16 and pre-test tissue concentrations, it is

anticipated that ocean placement of the dredged material from DU16 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU16 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU16 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

West Pier Expansion - Dredging Unit 17

Results of the grain size analysis indicated that sediment from DU17 consisted primarily of silt and clay (94.9 percent). The remainder of the sample was made up of sand (5.1 percent). All metals were detected at concentrations similar to the concentrations reported at the reference site. One metal, arsenic, was detected at a concentration between the ERL and ERM; all other metals were not detected at concentrations that exceeded ERLs. Butlytins, PAHs, pentachlorophenol, pesticides, PCB congeners, and dioxin and furan congeners were either not detected or detected at very low concentrations in the sediment sample. Detected concentrations for all these chemicals were similar to concentrations in the reference site and none were detected at concentrations greater than the ERL.

Water Quality Criteria

Metals and ammonia were the only constituents that were detected in the standard elutriate sample. However, none of the concentrations exceeded the USEPA or Mississippi State Acute WQC for the protection of aquatic life. Therefore, none of the constituents required dilution to achieve WQC following open water placement. All constituents meet the LPC for water quality criteria for placement in Zone B of the Pascagoula ODMDS.

Water Column Toxicity

The LC_{50} for the mysid shrimp (*Americamysis bahia*) and inland silverside (*Menidia beryllina*) were both greater than 100 percent elutriate. The water column bioassay for the purple sea urchin (*Arbacia punctulata*) had an EC_{50} value of 21.6 percent elutriate. Therefore, a 462-fold dilution is required for the sediment to achieve the LPC for water column toxicity for ocean placement at the Pascagoula ODMDS.

STFATE modeling was conducted to determine if the standard elutriate from DU17 met the LPC for water column toxicity by achieving the 462-fold dilution required and to verify that the sediment plume would stay within the site boundary within the first four hours following placement. The STFATE modeling results indicate that placement of 4,000 cy of sediment at Zone B of the Pascagoula ODMDS will result in a 636-fold dilution. Therefore, the standard elutriates from DU17 meet the LPC requirements for water column toxicity.

Benthic Toxicity

Survival in the whole sediment bioassays was not statistically different from the reference site for either the polychaete (*Neanthes arenaceodentata*) or amphipod (*Leptocheirus plumulosus*). Therefore, sediment from DU17 meets the LPC requirement for benthic toxicity.

Benthic Bioaccumulation

None of the tested analytes in tissue samples from bent-nose clams (*Macoma nasuta*) and sand worms (*Nereis virens*) exceeded the USFDA Action/Guidance/Tolerance Levels or statistically exceeded the pre-test tissue concentrations. Based on the assessment of chemical analyses performed on tissues exposed to sediment from DU17 and pre-test tissue concentrations, it is anticipated that ocean placement of the dredged material from DU17 at the Pascagoula ODMDS is not expected to result in ecologically significant bioaccumulation of contaminants. Therefore, the dredged material from DU17 meets the LPC for benthic bioaccumulation.

LPC Compliance

Sediments from DU17 meet the criteria for the LPC for WQC, water column toxicity, benthic toxicity, and benthic bioaccumulation, indicating that ocean placement is a potential dredged material placement option.

West Pier Terminal Expansion and Berthing Area

For ocean placement to be a viable option for materials from the West Pier Terminal Expansion and Berthing Area dredging footprint, the dredged material must comply with Section 103 of the MPRSA. Compliance with Section 103 of the MPRSA includes determining LPC compliance in four areas:

- WQC
- Water column toxicity
- Benthic toxicity
- Benthic bioaccumulation

Based on the results of the testing and analysis, 16 of the 17 West Pier Terminal Expansion and Berthing Area dredging units meet the LPC for ocean placement at the Pascagoula ODMDS without restriction. Based on the results of this testing program, dredged material placement in the Biloxi Marsh Complex is a viable alternative for each of the 17 DUs.

It is important to note that the testing program indicated that none of the dredged material would result in significant ecological effects on aquatic organisms and the benthic community and that there is low potential for uptake (bioaccumulation) of tested analytes. However, for several of the DUs best management practices will need to be implemented to manage dredged material placement.

- For DU7, DU8, DU9, DU10, DU11, and DU12, the STFATE modeling indicated that dredged material placement volumes at the Pascagoula ODMDS would be limited to volumes less than full barge loads. Although this dredged material meets the LPC for water column toxicity, the viability of ocean placement of this material will be evaluated on DU-by-DU basis. Ocean placement of material from these DUs may not be the most efficient alternative once transportation costs and dredging operational efficiency are considered. Placement of this material in the Biloxi Marsh Complex is likely the most viable dredged material placement option for material from these DUs. Upland placement of the dredged material may also be considered as a placement option if the Biloxi Marsh Complex is not available.

- For DU3, the dredged material met the LPC for benthic toxicity for one of the two species tested (*Leptocheirus plumulosus*). For the second species (*Neanthes arenaceodentata*) the survival was lower than the reference site, and although this result was not statistically different from the reference, the *N. arenaceodentata* results do not meet the LPC for ocean placement. However, the total testing program for the dredged material from this dredging unit indicated that sediment concentrations were low, there is no potential for remobilization of chemicals into the water column, there was no toxicity to water column species, and there was no potential for bioaccumulation. The potential for ocean placement of the dredged material from DU3 will be coordinated with EPA Region 4. However, based on a comprehensive evaluation of all the testing results from DU3 and because the dredged material from DU3 meets the LPC for benthic toxicity for amphipods, placement of the material from DU3 in the Biloxi Marsh Complex is likely the most viable placement alternative. Upland placement of the dredged material may also be considered as a placement option if the Biloxi Marsh Complex is not available.

Placing the dredged material at the Biloxi Marsh Complex Beneficial Use site is also a viable alternative because the West Pier Terminal Expansion and Berthing Area dredged materials are primarily soft to very soft silts and clays that may be used to re-establish or expand existing marsh, or may be placed within a marsh cell, where it will settle and consolidate until achieving the intertidal marsh elevation range.

If dredged material placement in the Biloxi Marsh Complex Beneficial Use site or other beneficial use site is not a viable option because the site(s) is unavailable, then upland placement of the dredged material from the West Pier Terminal Expansion and Berthing Area may be considered.

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