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2014 National Ocean Dumping Site Monitoring Assessment Report



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Executive Summary

In the United States, dredged material is the primary material (in terms of volume) disposed into the ocean today. Dredged material is sediment excavated or otherwise removed in order to maintain safe navigation channels in the navigable waters of the United States. Other materials disposed in the ocean include fish wastes, vessels, and human remains for burial at sea.

Under the Marine Protection, Research, and Sanctuaries Act (MPRSA), U.S. Environmental Protection Agency (EPA) is responsible for designating and managing ocean disposal sites for the permitted disposal of materials. In Fiscal Year (FY) 2014, EPA managed 95 designated ocean disposal sites located off the U.S. Atlantic, Gulf of Mexico, and Pacific Coasts; and near Puerto Rico, Hawaii, Guam, and American Samoa. All but one of these sites is designated for the disposal of sediment (dredged material) removed from our nation's waterways to support a network of coastal ports and harbors for commercial, transportation, national defense, and recreational purposes. In FY 2013, marine transportation contributed more than \$59 billion and 420,000 jobs to the U.S. economy (National Ocean Economics Program, 2016).

EPA designates ocean disposal sites in areas that: 1) minimize the impact of ocean dumping on the local ecosystem and its resources, such as fisheries, coral reefs, and endangered species; 2) interfere as little as possible with other uses of the ocean, particularly navigation and fisheries; and 3) support the cost-effective maintenance of the ports and harbors vital to the nation's economy and security.

Once designated, management of ocean disposal sites ensures that disposal activities will not unreasonably degrade or endanger human health, welfare, the marine environment, or economic potentialities. Effective management of ocean disposal sites prevents physical obstructions, damage to tourist attractions like beaches and coral reefs, and degradation of areas surrounding the disposal site.

Monitoring is a key component of ocean disposal site management. EPA monitors the environment within and around each ocean site to verify that permitted disposal does not cause unanticipated or significant adverse effects and that all the terms of MPRSA permits are met. While EPA's pre-disposal testing procedures ensure dredged material meets the ocean dumping criteria, monitoring at ocean disposal sites verifies that the marine environment is reacting to and recovering from the impact of disposal activities as anticipated.

This national report reviews EPA's ocean dumping monitoring activities conducted in FY 2014.

As part of the FY 2014 surveys, EPA scientists employed a wide range of well-established monitoring techniques. These techniques included sediment grabs, video and still underwater images, sonar bathymetry, benthic trawls, crab pots, and water samplers. These are scientifically sound techniques widely accepted in the scientific community. Using these techniques, EPA assessed changes in biological community conditions, chemical concentrations in sediment and biota, water quality, and sediment grain size. At some sites, EPA evaluated fate and transport of material after disposal to determine if the material moved in unanticipated ways and had the potential to adversely impact other uses of the ocean.

In FY 2014, EPA conducted surveys at ten ocean disposal sites. This report summarizes each survey's objective(s), activities, conclusions, and recommended environmental management actions. The ocean disposal sites surveyed are as follows:

- Central Long Island Sound Dredged Material Site, Connecticut (Region 1);
- Norfolk, Virginia Ocean Dredged Material Disposal Site (Region 3);

- Savannah Harbor, Georgia Ocean Dredged Material Disposal Site (Region 4);
- Palm Beach Harbor, Florida Ocean Dredged Material Disposal Site (Region 4);
- Port Everglades Harbor, Florida Ocean Dredged Material Disposal Site (Region 4);
- Miami, Florida Ocean Dredged Material Disposal Site (Region 4);
- Galveston, Texas Ocean Dredged Material Disposal Site (Region 6);
- Humboldt Open Ocean Disposal Site, California (Region 9);
- Mouth of the Columbia River Deep Water Site, Oregon (Region 10); and
- Mouth of the Columbia River Shallow Water Site, Oregon (Region 10).

EPA found environmentally acceptable conditions at all ten sites surveyed. Based on results of FY 2014 ocean disposal site surveys, EPA has taken or plans to take the following site management actions:

- EPA determined that environmentally acceptable conditions had been met and permitted disposal of dredged material under the MPRSA could continue without any modifications to site usage at five ocean disposal sites (Central Long Island Sound, Norfolk, Palm Beach, MCR Deep Water Site, and MCR Shallow Water Site).
- EPA plans to modify two ocean disposal sites to continue with permitted disposal (Port Everglades and Humboldt). At Port Everglades, EPA plans to alter the release zone to prevent movement of dredged material out of the disposal site. At Humboldt, EPA plans to expand the site because the site's capacity will be reached sooner than anticipated.
- EPA plans to use information collected in the FY 2014 survey to inform the design of future monitoring surveys at two sites (Miami and Galveston). At Miami, the information collected during the 2014 survey will be used in the design of a 2016 survey. At Galveston, the Region plans to collect additional tissue samples during a future survey to establish background chemical concentration levels for use in dredged material evaluation.
- EPA plans to use the data collected at two sites (Savannah and Palm Beach) as a baseline to measure the impact of large disposal events planned in the near future. EPA expects large volumes of material at both sites from upcoming deepening projects at nearby ports. These deepening projects will allow the ports to accommodate the largest vessels that traverse the recently expanded Panama Canal. After the deepening projects are completed, the Region will visit the sites again to collect data and compare that data to the baseline.

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ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
EPA	United States Environmental Protection Agency
ERL	effects range-low
ERM	effects range-median
ft	feet
FY	fiscal year
MBES	multibeam echo sounder
MCR	Mouth of the Columbia River
MPRSA	Marine Protection, Research, and Sanctuaries Act
nm ²	square nautical mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
ODFW	Oregon Department of Fish and Wildlife
ODMDS	Ocean Dredged Material Disposal Site
OSI	organism sediment index
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
R/V	research vessel
SEF	sediment evaluation framework
SL	screening level
SMART	Site Monitoring Assessment Report
SMMP	site management and monitoring plan
SQG	sediment quality guideline
USACE	U.S. Army Corps of Engineers

1.0 Introduction

The Marine Protection, Research, and Sanctuaries Act (MPRSA), also referred to as the Ocean Dumping Act, regulates the dumping and transportation for the purpose of dumping of any material into ocean waters. Generally, ocean dumping cannot occur unless a federal permit is issued under the MPRSA.

Under the MPRSA, U.S. Environmental Protection Agency (EPA) established environmental criteria for the evaluation of all permit applications. EPA issues the ocean dumping permits for all materials other than dredged material. In the case of dredged material, U.S. Army Corps of Engineers (USACE) issues the ocean dumping permits (or, in the case of federal projects, authorizes ocean dumping of dredged material) using EPA's environmental criteria. All MPRSA permits and federal projects involving the ocean dumping of dredged material are subject to EPA review and concurrence. All dredged material proposed for ocean dumping is evaluated to determine whether it must be tested or whether it can be excluded from testing. Dredged material that is not exclusionary is tested using published testing guidance and must meet the environmental regulatory criteria.

EPA is responsible for designating ocean disposal sites under the MPRSA. To minimize the adverse impacts of ocean dumping on human health and the marine environment, EPA designates sites based on environmental studies of the proposed site, environmental studies of regions adjacent to the proposed site, and historical knowledge of the impact of disposal on areas having similar physical, chemical, and biological characteristics. EPA carefully considers specific criteria (published at 40 CFR 228.5 and 229.6) as part of a site designation evaluation to ensure that disposal activities at the site selected for designation will not likely cause significant adverse impacts to the marine environment. The Agency analyzes these impacts through environmental assessments or environmental impact statements. In general, EPA designates sites only in areas where ocean dumping will not have a significant impact on various amenities, such as fisheries, coral reefs, and endangered species.

EPA is also responsible for managing all ocean disposal sites designated under the MPRSA. EPA management helps ensure that disposal activities will not unreasonably degrade or endanger human health, welfare or amenities; or the marine environment, ecological systems or economic potentialities. Management of ocean disposal sites involves:

- regulating the times, quantity, and characteristics of the material dumped at the site;
- establishing disposal controls, conditions, and requirements to minimize potential impacts to the marine environment; and
- monitoring the site and surrounding environment to verify that unanticipated or significant adverse effects are not occurring from historical or continued use of the ocean disposal site and that the terms of the MPRSA permit are met.

All designated dredged material disposal sites are required to have a site management and monitoring plan (SMMP). EPA, in conjunction with USACE, develops an SMMP for each ocean disposal site. Each SMMP includes, but is not limited to:

- a baseline assessment of site conditions;
- a monitoring program for the site;
- special management conditions or practices to be implemented at the site that are necessary for protection of the environment;

- consideration of the quantity of disposed material, and the presence, nature, and bioavailability of the contaminants in the material;
- consideration of the anticipated long-term use of the site; and
- a schedule for review and revision of the SMMP.

A key component of the SMMP is the monitoring program. The monitoring program is designed to assess current environmental conditions within and around the disposal site. EPA uses this information to:

- ensure that the dumped material is being adequately tested and there are no unexpected adverse impacts;
- evaluate movement and deposition of the dumped material to determine whether or how to modify site use; and/or
- support SMMP development and updates.

EPA typically evaluates environmental impact at a site by comparing current conditions to the conditions at the time of designation (baseline conditions) along with any other historical survey data. Control sites, which are close to the disposal site but are not affected by disposed dredged materials, are also used to assess the impact from disposal. Guidelines for ocean disposal site baseline and trend assessment surveys are set forth in 40 CFR 228.13. EPA conducts these surveys using scientifically sound monitoring techniques widely accepted in the scientific community and rigorous data quality control/quality assurance.

In FY 2014, EPA Regions managed 95 ocean disposal sites off the U.S. Atlantic, Gulf of Mexico, and Pacific Coasts; and near Puerto Rico, Hawaii, Guam, and American Samoa. All but one of the 95 ocean disposal sites are designated for the disposal of dredged material permitted under the MPRSA. One EPA-designated ocean disposal site located near American Samoa is designated for fish processing wastes. Typically, ocean disposal sites are located offshore of major ports, harbors, and marinas.

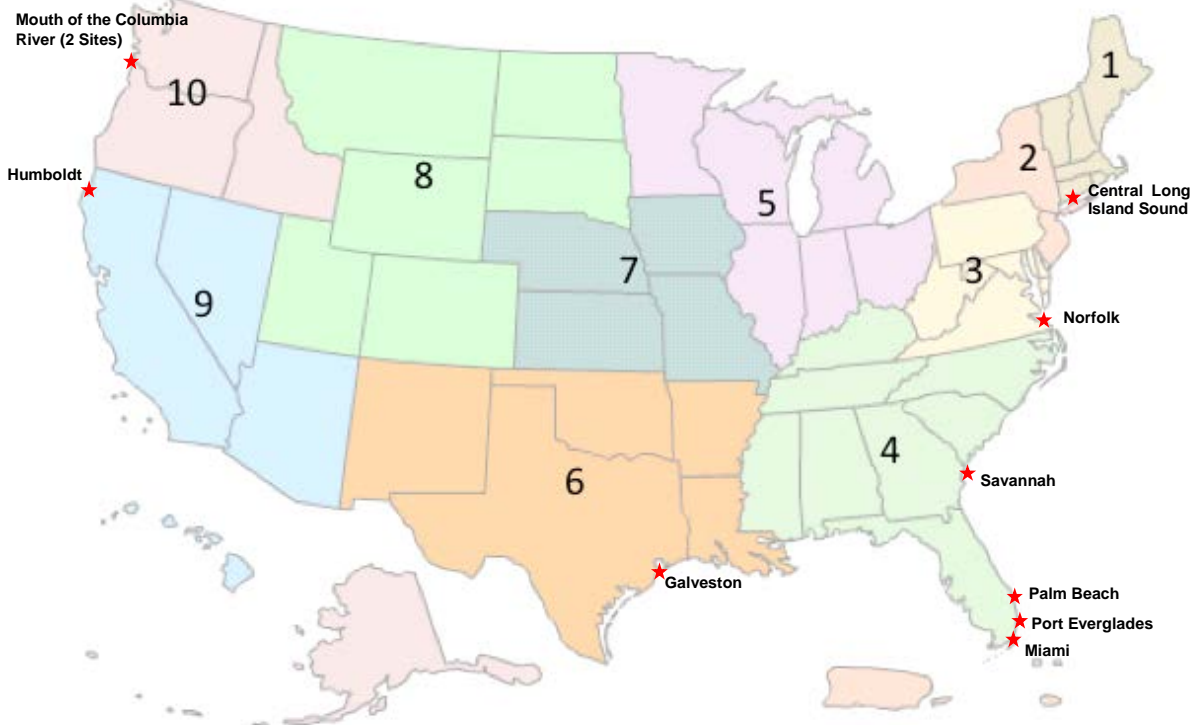
2.0 Report Objectives

This national report serves as a comprehensive summary of the ocean disposal site monitoring surveys funded by EPA in FY 2014. Specifically, the report summarizes the activities, findings, conclusions, and actions resulting from these EPA monitoring efforts as reported in the Site Monitoring Assessment Reports (SMARTs) prepared by EPA Regions.

EPA scientists conducted surveys at ten ocean disposal sites in FY 2014 (Table 1), located in six of the seven EPA coastal Regions (Figure 1). EPA conducted these monitoring surveys using vessels accessed through contracts and through interagency agreements with National Oceanic and Atmospheric Administration (NOAA) and USACE.

Table 1. Area and depth of ocean disposal sites surveyed in FY 2014.

Region	Disposal Site	Area (nm ²)	Depth (ft)
1	Central Long Island Sound	2.4	59-74
3	Norfolk	50.0	43-85
4	Savannah	4.3	28-42
4	Palm Beach	1.0	165-195
4	Port Everglades	1.0	195-215
4	Miami	1.0	415-770
6	Galveston	6.6	33-53
9	Humboldt	1.0	160-180
10	Mouth of Columbia River Deep Water Site	10.5	190-300
10	Mouth of Columbia River Shallow Water Site	1.4	45-75

**Figure 1. Locations of the ten ocean disposal sites surveyed in FY 2014.**

3.0 General Information on Ocean Disposal Site Monitoring

EPA designs and conducts ocean disposal site monitoring surveys using scientifically proven principles and methods. The following paragraphs provide background information on certain important aspects of survey design and data analysis.

The quantity and distribution of samples collected in each EPA monitoring survey vary considerably. A number of factors contribute to the differences in sampling design in the FY 2014 surveys. For example, if past surveys and historical data from a disposal site have shown

a high variance in the measurements taken at that site, EPA typically collects more samples per unit area to adequately characterize the site. If the data show the site to be consistently homogenous over many years, fewer samples may be collected. Sampling plans may also be influenced by other factors including, but not limited to, the specific objectives of the survey and the scope of the investigation. The protocols for sample collection are designed not only to be scientifically sound, but also logistically and financially practical.

EPA evaluates the health of the benthic community using sediment infaunal samples and sediment profile images. Benthic community health can be classified using defined successional stages, ranging from stage zero (recently disturbed) to stage 3 (mature). The parameters used to make this classification include, but are not limited to: sediment grain size, depth of oxygenated sediment, species diversity, and sediment penetrability (Rhoads and Germano, 1982). Species diversity is a measure that combines species richness (the number of different species) and evenness (the relative abundance of species). The Organism-Sediment Index (OSI) is another classification that provides a measure of general benthic habitat quality (Rhoads and Germano, 1986). OSI values between +7 and +11 are typical of natural, undisturbed, fine grained sediments. OSI values less than +6 can indicate a stressed or disturbed benthic environment, and values less than zero indicate degraded benthic habitat.

EPA commonly compares contaminant concentrations in site sediments to sediment quality guidelines (SQGs) to evaluate the potential for dredged material disposed to have an impact on the benthic communities at or near disposal sites. SQGs are informal benchmarks used to relate chemical concentrations in sediments to the potential toxicity to benthic or aquatic organisms. Using SQGs, EPA identifies areas and chemicals of concern and directs further investigations accordingly (Long and MacDonald, 1998). Different SQGs have been established by various entities at the national and regional levels. Many EPA Regions rely on effects range low (ERL) and effects range median (ERM) national SQGs developed by NOAA (NOAA, 1999) to assess conditions at ocean disposal sites. Chemical concentrations below the NOAA ERL are not likely to cause adverse effects, while chemical concentrations above the NOAA ERM are likely to cause adverse effects.

4.0 Summary of Monitoring Surveys

In FY 2014, EPA funded and conducted monitoring surveys to assess environmental conditions at ten ocean disposal sites (Table 1). These surveys employed a wide range of established techniques, including sediment grabs, sonar bathymetry, video and still underwater images, benthic trawls, crab pots, and water samplers. Using the data obtained from these surveys, EPA assessed the physical, chemical, and biological conditions in and around the disposal site to determine if disposal was causing unacceptable impacts. At some sites, EPA evaluated transport of material after disposal to determine if the material moved in unanticipated ways and had the potential to adversely impact other uses of the ocean.

A summary of FY 2014 survey objectives, activities, and results, as well as the environmental management decisions made following these surveys is presented below, by EPA Region.

4.1 Region 1 – Central Long Island Sound Dredged Material Site, Connecticut

Region 1 monitored the Central Long Island Sound disposal site, located offshore from East Haven, Connecticut. The Region conducted the survey in August 2014 aboard the R/V *Jamie Hanna* through an interagency agreement with the New England District of USACE. The objectives for this survey were: (1) to characterize the seafloor topography of the disposal site; (2) to evaluate the biological recovery of the benthic community following disposal activities; and (3) to define the physical characteristics of the surface sediments.

The Region collected sediment samples, sediment profile/plan view images, and multi-beam echo sounder (MBES) data. Sediment samples were collected at 9 stations within the disposal site and 3 stations at the control site. These samples were analyzed for total organic carbon, grain size, and benthic infaunal characteristics. Sediment profile/plan view images were collected at 60 stations within the disposal site and the control site. The Region used an MBES to characterize the physical structure of the surficial sediments over the entire site. The Region used preliminary MBES results during the survey to determine the optimal locations to collect sediment profile/plan view images.

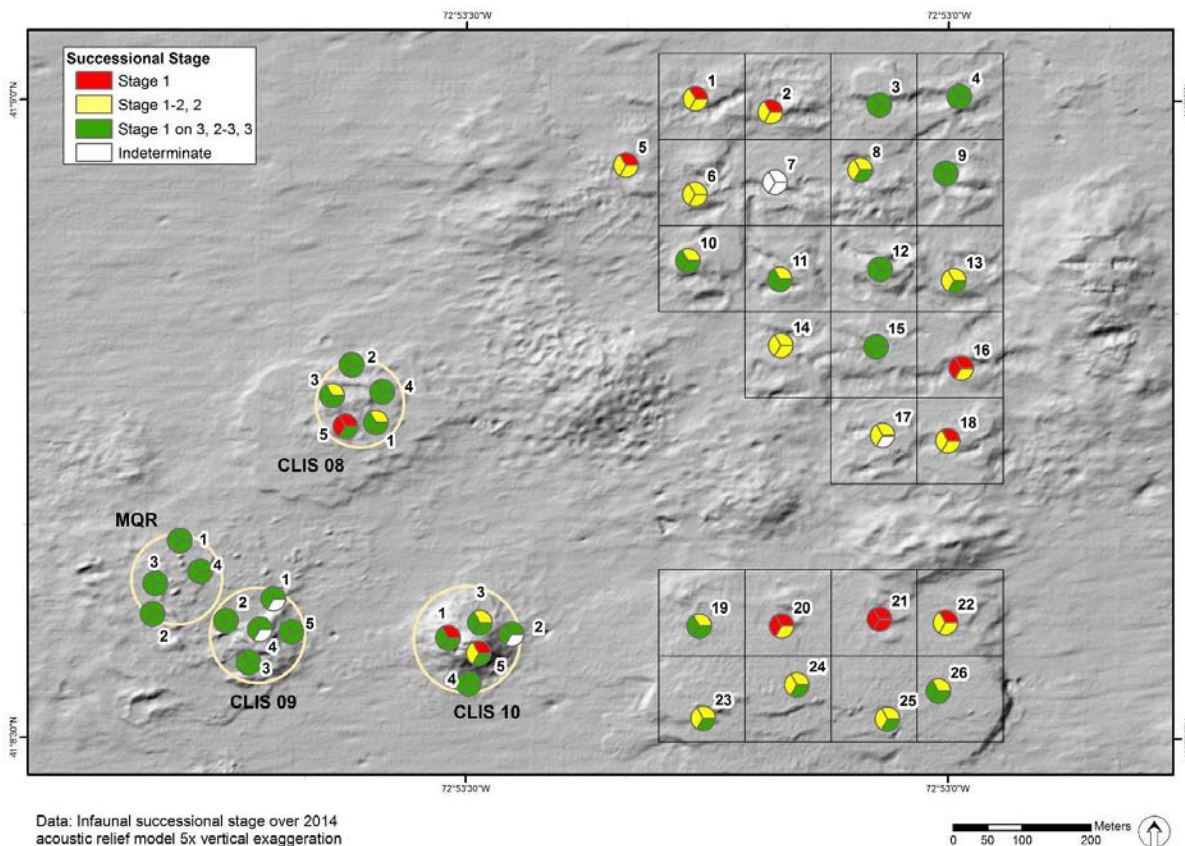


Figure 2. Study area within Central Long Island Sound Disposal Site showing benthic community successional stage at disposal site mounds MQR, CLIS-08, CLIS-09, CLIS-10, NHAV14-N (unlabeled), and NHAV14-S (unlabeled).

Dredged material at the Central Long Island Sound disposal site is disposed in mound formations. Four of the mounds (CLIS-08, CLIS-09, CLIS-10, and MQR) have been used in the last ten years, but not in the last five years. Sediment profile images of these mounds showed mature benthic communities that were approaching full recovery (Figure 2). Images at two other mounds, which have received material in the last four to six months (NHAV14-N and NHAV14-S), showed more variable and less advanced benthic community recovery than the communities at the control site.

Benthic community analysis of the sediment samples showed that there were no significant differences between samples collected at stations within the Central Long Island Sound disposal site and samples from the control site.

Sediment sample grain size analysis showed that all of the stations were dominated by silt, clay, and fine sand. Stations within the disposal site had similar grain size distributions as stations within the control site.

Bathymetry results confirmed that there were no changes to the physical conditions of the disposal mounds or to any other features at the site.

Based on the data collected in this survey, Region 1 confirmed that environmentally acceptable conditions are being met at the site. The Region updated the SMMP in 2016, and no changes were made based on conclusions from this survey.

4.2 Region 3 – Norfolk, Virginia Ocean Dredged Material Disposal Site

Region 3 monitored the Norfolk ocean disposal site, located off of Fisherman's Island, Virginia. The Region conducted this survey in May 2014 aboard the NOAA R/V *Nancy Foster*. The objective of the survey was to compare the physical, chemical, and biological conditions at the disposal site to those at the control site in order to assess whether dredged material disposal is adversely impacting the marine environment.

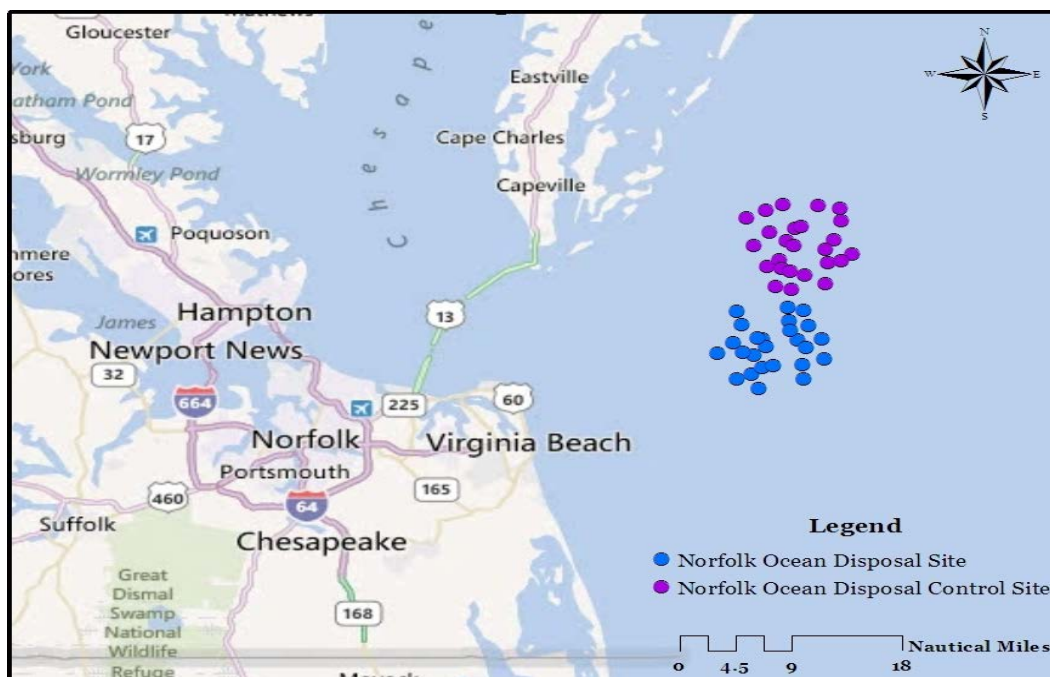


Figure 3. Norfolk ocean disposal site and Norfolk control site sampling stations.

The Region collected sediment samples at 50 stations, including 25 stations in the disposal site and 25 stations in the control site (Figure 3). Region 3 analyzed the samples for benthic community parameters, grain size, and metal concentrations.

Region 3 found statistically significant differences between the physical properties of the sediment samples collected at the disposal site and samples collected at the control site. While all sediment samples were composed predominantly of sand with a minor clay/silt constituent, the samples collected within the disposal site contained a significantly lower percentage of clay than those collected within the control site. Other grain size fractions were not significantly different between samples from the disposal site and samples from the control site.

Sediment metal concentrations were similar in samples collected from the disposal site and the control site. The Region analyzed the sediment samples for seven metals: cadmium, copper, lead, mercury, nickel, silver, and zinc (Table 1). Only nickel concentrations showed a statistically significant difference between the disposal site and the control site. However, sediment samples from the disposal site had lower nickel concentrations than those from the control site. Mercury and silver were not detected at any stations. All of the metal concentrations in samples collected on this survey were well below the NOAA ERL sediment quality guidelines.

Table 2. Mean sediment metal concentrations ($\mu\text{g/g}$) at the Norfolk disposal site and NOAA sediment quality guidelines.

Metal	Control Site	Disposal Site	NOAA Effects Range, Low (ERL)	NOAA Effects Range, Med (ERM)
Cadmium	0.005	0.000	1.2	9.6
Copper	1.041	0.736	34	270
Lead	1.973	1.671	46.7	218
Mercury	0.000	0.000	0.15	0.71
Nickel	3.364	2.489	20.9	51.6
Silver	0.000	0.000	1.0	3.7
Zinc	11.509	9.757	150	410

The benthic community analysis conducted by the Region did not show a significant difference between the disposal site and the control site. Benthic diversity, richness, and evenness were nearly identical in sediment samples from the two locations.

Based on the data collected in this survey, Region 3 confirmed that environmentally acceptable conditions are being met at the site. The Region does not recommend any changes to the SMMP at this time.

Region 3 used a portion of the 2014 Norfolk disposal site survey to collect water samples to support EPA coastal nutrient monitoring and ocean acidification efforts. EPA scientists typically include extra time in their survey plans to accommodate potential delays due to severe weather. Because weather conditions were favorable during the survey, Region 3 used the extra time to collect samples to support the Region's long-term monitoring of trends in nutrient concentrations along the Mid-Atlantic Bight. EPA used these samples to add to the baseline for future evaluation of ocean acidification, as they did during the FY 2013 survey at the Dam Neck disposal site.

Ocean acidification is a significant stressor for calcifying organisms because it affects the ability of these organisms to grow and maintain their aragonite-based structure (e.g., shells, reefs) when the aragonite saturation state is low. Ocean acidification evaluation is relevant to EPA's work because of the potential ecological and economic impacts caused by this phenomenon, as well as its use as an indicator of climate change.

Region 3 deployed a water sampling device, equipped with a conductivity, temperature, and depth probe, to obtain seawater samples for the measurement of total alkalinity and dissolved inorganic carbon. These parameters provide insight on a marine system's buffer intensity, which is a measure of the ability of seawater to resist appreciable pH changes. Due to the inter-relationship of carbonate parameters, measurement of total alkalinity and dissolved inorganic

carbon allows the calculation of the partial pressure of dissolved carbon dioxide and aragonite saturation state.

4.3 Region 4 – Savannah Harbor, Georgia Ocean Dredged Material Disposal Site

Region 4 monitored the Savannah Harbor disposal site, located off the Atlantic coast of Georgia (Figure 4). The Region conducted this survey in April 2014 aboard the NOAA R/V *Nancy Foster*. The objective of this survey was to collect baseline data as part of a study to detect potential adverse impacts resulting from future disposal associated with the Savannah Harbor Expansion Project. This project will enable the port to accommodate larger “Post-Panamax” vessels that transit through the recently expanded Panama Canal. The project is projected to result in the disposal of an additional 5.8 million cubic yards of dredged material at the site. Average annual disposal at this site is approximately 1.1 million cubic yards. By comparing pre-disposal and post-disposal monitoring data, the study is designed to track movement of material beyond disposal site boundaries and to evaluate changes in benthic habitat. EPA also intends to use the data to confirm the results of a site capacity study conducted by USACE. The USACE study was designed to determine the long-term viability of the site for regular annual disposal of dredged material.



Figure 4. Savannah Harbor and ocean disposal site study area.

Region 4 collected sediment profile images at 38 stations. These stations were evenly distributed within and around the disposal site. To minimize analysis costs, the Region analyzed 20 of the 38 images collected (4 within the disposal site, 12 on the perimeter, and 4 outside the site). The Region is evaluating whether analysis of the other 18 images will be necessary in order to characterize the site after completion of disposal of material from the Savannah Harbor Expansion Project.

The Region analyzed the sediment profile images to determine the physical features of the sediment, including surface boundary roughness, grain size, and dredged material layer thickness. Sand ripples observed at the sediment surface indicated a physically dynamic

environment. Grain size generally ranged from very fine sand to fine sand. However, coarser sands were observed at stations in shallower areas of the site, which likely was due to grain size sorting by wave activity and tidal currents. Dredged material was detected on the sediment surface at three stations (two within the site and one on the eastern boundary) but was not detected outside of the ocean disposal site.

The Region also used sediment profile images to evaluate benthic infaunal community characteristics. All stations exhibited stage 1 benthic infaunal community succession. However, because the dynamic physical nature of the disposal site may have hindered benthic community development, the Region was unable to determine whether the observed low successional stage was due to recent or historical dredged material disposal. Stage 1 succession is characterized by either a lack of biological indicators or a small number of polychaete tubes. Stage 1 infauna are the first organisms to colonize the sediment surface following a disturbance. The OSI values for the stations within the disposal site ranged from +4 to +7, indicating that the benthic habitat at most stations was not adversely affected by disturbance.

Based on the data collected in this survey, Region 4 determined baseline physical and biological conditions at the disposal site. Determining baseline conditions should enable meaningful comparison to conditions evaluated after the disposal of dredged material from the Savannah Harbor Expansion Project is completed in 2018 or 2019. From this comparison, the Region would evaluate the impact of disposal from the harbor expansion project on the marine environment and the capacity of the site for ongoing annual disposal of dredged material associated with maintenance of navigation channels.

4.4 Region 4 – Palm Beach Harbor, Florida Ocean Dredged Material Disposal Site

Region 4 monitored the Palm Beach Harbor disposal site, located off the Atlantic coast of Florida. The Region conducted this survey in September 2014, aboard the NOAA R/V *Nancy Foster*. The objectives for the survey were: (1) to compare conditions at the disposal site to those outside the site and to conditions during previous sampling surveys and (2) to collect baseline data prior to a large disposal event. Disposal of over one million cubic yards of dredged material is anticipated from the planned Port of Palm Beach deepening project. This site is not used for annual dredged material disposal associated with maintenance of navigation channels.

The Region collected sediment samples, sediment profile/plan view images, water samples, and multi-beam bathymetry. Sediment samples were collected at 12 stations, 6 within and 6 outside the disposal site. The samples were analyzed for grain size, chemistry, and benthic community parameters (Figure 5). The Region collected sediment profile/plan view images at 23 stations, 12 within and 11 outside the disposal site. The images were analyzed for sediment grain size, dredged material thickness, and benthic community parameters such as successional stage and OSI. Water samples were collected at three stations, one located within the disposal site, a second up-current from the site, and a third down-current from the site. These samples were analyzed for physical and chemical parameters. Multi-beam bathymetry was collected across the entire site.

1999 study supporting the designation of the Palm Beach ocean disposal site. In the FY 2014 survey, the Region also found that the number of taxa and density were significantly greater outside of the disposal site compared to inside the site. However, due to the relatively low amount of material disposed in the ocean disposal site to date, the Region concluded that it is unlikely that these differences would be related to dredged material disposal.

Water quality was similar across the disposal site. All stations sampled were nearly identical in temperature, salinity, dissolved oxygen, and chlorophyll fluorescence. The Region found no significant differences in chemical concentrations between the three stations sampled and no chemical concentration exceeded EPA's marine water quality criteria.

Analyses of sediment profile/plan view images indicate similar physical sediment characteristics to those found in sediment samples. The images from all but one station showed a successional stage of 2 or 3, which is representative of mature benthic communities. Good habitat quality was found at all stations (OSI ranged from +7 to +10).

Bathymetric data indicated that water depths at the disposal site ranged from 165 to 195 meters. No hard bottom habitat was detected in the area. However, a possible shipwreck was identified to the northeast of the disposal site.

Based on the data collected in this survey, Region 4 confirmed that environmentally acceptable conditions are being maintained at the ocean disposal site. The Region does not recommend any changes to the SMMP at this time. The Region intends to use the baseline data from the FY 2014 survey to assess impacts at and around the ocean disposal site due to the projected increase in the quantity of dredged material to be disposed from the planned Port of Palm Beach deepening project.

4.5 Region 4 – Port Everglades Harbor, Florida Ocean Dredged Material Disposal Site

Region 4 monitored the Port Everglades Harbor disposal site, located off the Atlantic coast of Florida. The Region conducted this survey in September 2014, aboard the NOAA R/V *Nancy Foster*. The objectives for the survey were: (1) to determine the effectiveness of the release zone at containing dredged material within disposal site boundaries; and (2) to document trends in physical, chemical, and biological conditions within and surrounding the disposal site. Release zones are areas within the disposal site where the release of dredged material is least likely to result in deposition outside of the site. EPA revised the release zone in 2008 in response to disposal site surveys where EPA determined that the dredged material disposed of at the site had moved outside of site boundaries.

The Region collected sediment samples, sediment profile/plan view images, and water samples. Sediment samples were collected at 12 stations, 6 within and 6 outside the disposal site. Sediment samples were analyzed for physical (grain size), chemical (PCBs, pesticides, PAHs, metals, total organic carbon, total solids, and tributyltins), and benthic community parameters. The Region collected sediment profile/plan view images at 52 stations (12 stations around the perimeter, 12 stations coinciding with sediment sampling stations, and 28 stations from a 2006 sediment survey). The images were used to analyze sediment grain size, dredge material thickness, and characteristics of the benthic community such as successional stage and OSI. Water samples were collected at 3 stations: one station located within the disposal site; a second station "up current" from the site; and a third station "down current" from the site. These samples were analyzed for physical and chemical parameters.

The Region made several conclusions about disposal and post-disposal movement of dredged material based on observations of the physical qualities of the sediment. First, carbonate rock

rubble was observed in plan view images at ten stations in or near the release zone established in 2008. This observed dredged material is not native and its presence is due to the disposal of rocky material within the release zone. Second, sediment profile images showed that a dredged material layer was present at all stations within the release zone and that this layer extended both north and south of the site boundary (Figure 6). The Region observed a thin layer of dredged material extending past the northern boundary of the site and a thicker, potentially more harmful layer of dredged material extending past the southern boundary. This trend was also seen in the data collected in 2006.

Sediment chemical analyses showed differences between stations within and outside the disposal site. Sediment samples from inside the disposal site showed significantly higher concentrations of the metals arsenic, copper, lead, and zinc, as well as PAHs and organotins. Copper concentrations at stations within the disposal site exceeded the NOAA ERL (NOAA, 1999), but not the NOAA ERM, and were higher than concentrations measured in samples previously collected at the disposal site. Sediment chemical concentrations above the NOAA ERL but below the NOAA ERM are not likely to be harmful to benthic organisms, but consideration of such concentrations is sometimes helpful to identify a source of toxicity if impacts on benthic communities are observed.

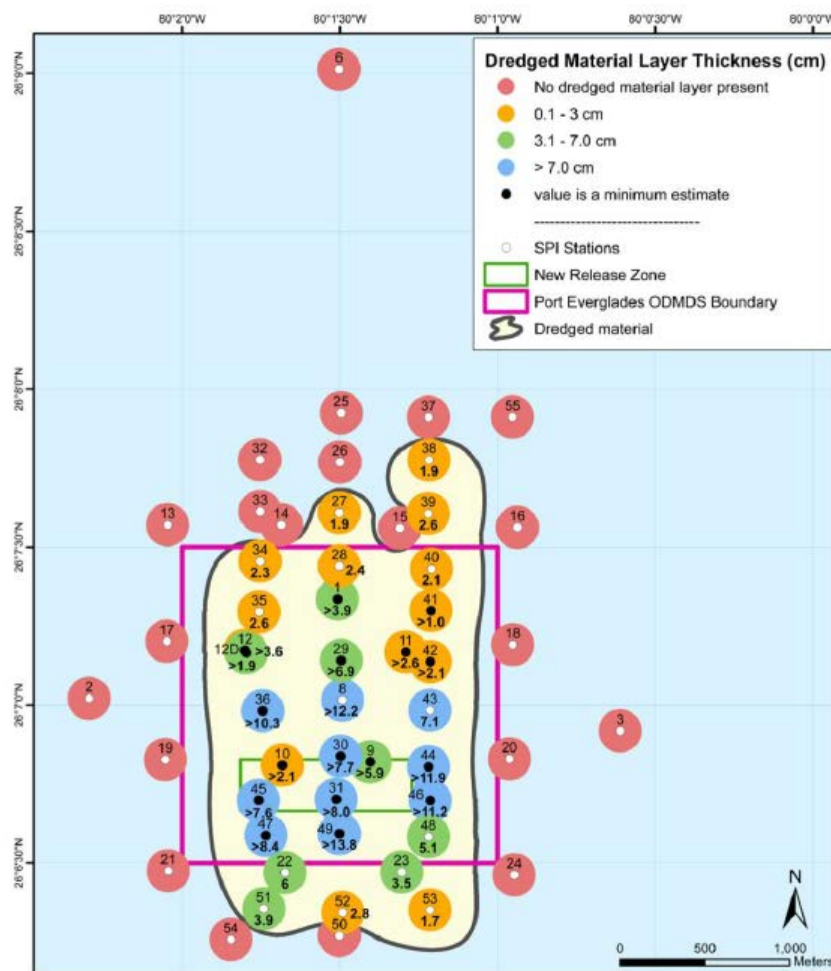


Figure 6. Dredged material layer thickness estimated from sediment profile images at Port Everglades disposal site.

Benthic community characteristics observed in sediment samples and sediment profile images differed between stations inside and outside the disposal site. Due to a relatively high variance within the observations, however, these differences were not statistically significant. The mean number of individuals and taxa density was lower in samples collected inside the disposal site than outside. In general, stations closest to the release zone exhibited the lowest number of individuals and taxa. Sediment profile images confirmed well-established, mature benthic communities at all stations within and outside the disposal site (OSI stage 2 to 3). While the benthic community was dominated by arthropods and annelids at the time the disposal site was designated in 1998, the community is now dominated by annelids at all stations sampled.

All three stations where water samples were collected were nearly identical in temperature, salinity, dissolved oxygen, and chlorophyll fluorescence. Metal concentrations were found to be above the minimum reporting limits, which is the lowest level at which a laboratory can consistently detect an analyte. Zinc concentrations were higher in water samples from the down-current station, but no chemical concentrations exceeded EPA's marine water quality criteria.

Based on the data collected in this survey, Region 4 plans to modify the SMMP to change the release zone for ocean disposal of dredged material within the disposal site. The release zone will be moved approximately 50 meters to the north to ensure that most of the dredged material is distributed and contained within the southern boundary of the disposal site. The 2014 survey showed that the benthic community within and around the site is healthy despite elevated chemical concentrations in the sediment and the presence of a layer of dredged material.

4.6 Region 4 – Miami, Florida Ocean Dredged Material Disposal Site

During the 2014 Port Everglades-Palm Beach survey, Region 4 also briefly visited the Miami ocean disposal site offshore of Miami, Florida (Figure 7). This survey provides preliminary information in advance of a survey planned for 2016 with the following objectives: (1) to investigate elevated PCB and copper concentrations in sediments that were observed in a 2009 EPA survey and (2) to determine if dredged material from the Miami Port Deepening project is moving outside of the disposal site.

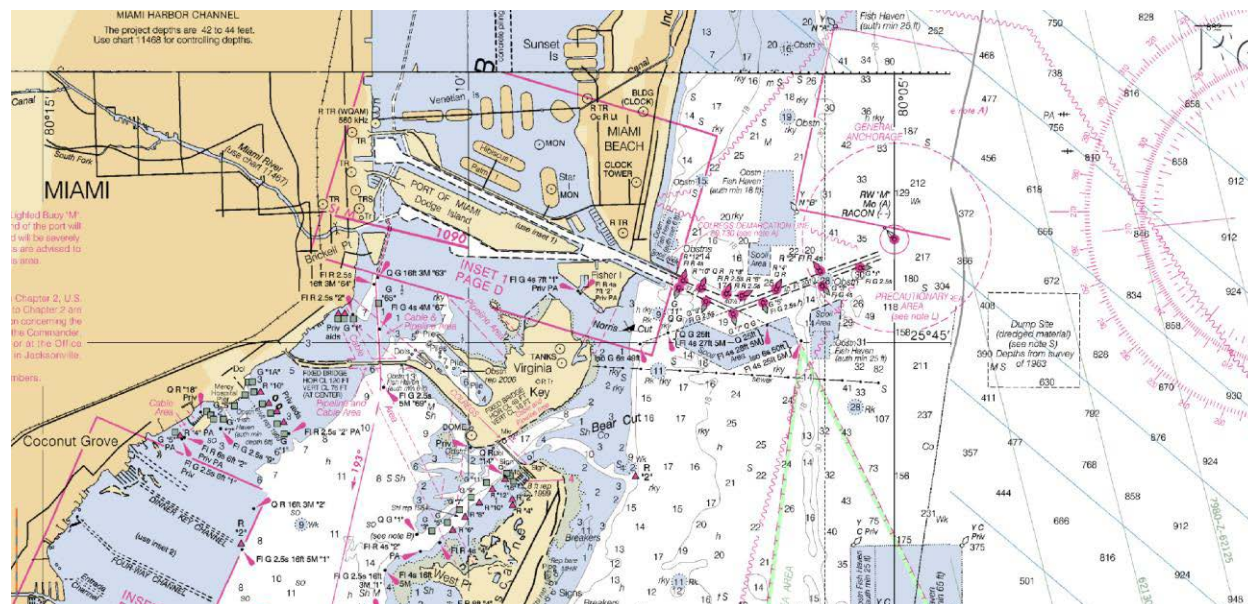


Figure 7. Port of Miami and ocean disposal site study area.

Sediment samples were collected at 3 stations and analyzed for metals and PCB congeners. EPA is preparing to report the results of this analysis when it reports the results of the 2016 survey at the Miami disposal site. The Region also collected sediment profile/plan view images at 5 stations around the perimeter of the disposal site. The perimeter images did not indicate that any dredged material had moved outside of the disposal site or that disposal at the site had created any hard bottom habitat.

4.7 Region 6 – Galveston, Texas Ocean Dredged Material Disposal Site

Region 6 monitored the Galveston reference site and adjacent areas, located in the Gulf of Mexico, offshore of Galveston, Texas. The Region conducted this survey in October 2014 aboard Louisiana University Marine Consortium's R/V *Pelican*. The survey had two primary objectives. The first objective was to obtain background chemical concentration levels in polychaete and bivalve tissues in the western Gulf of Mexico. The results of bioaccumulation studies conducted on dredged material would be compared to these "screening concentrations" to evaluate the material's suitability for ocean disposal. The second objective was to assess the historic reference site and adjacent areas. Region 6 has noted a concern that the reference site may be adversely affected by contaminated sediments, possibly migrating out of the Houston Ship Channel system.

A reference site is an area where the sediment is substantially free of contaminants and where the sediments are as similar as practical in grain size to the dredged material and the sediment at the disposal site, in order to reflect conditions that would exist in the vicinity of the disposal site had no dredged material disposal ever taken place, but is exposed to the full range of other influences on sediment condition as the disposal site. The suitability of dredged material for ocean disposal is determined using studies that compare bioaccumulation in organisms grown on dredged material proposed for disposal at the disposal site to organisms grown on material collected at the reference site.

The Region collected polychaete and bivalve tissue samples from trawls conducted at 3 sites near the disposal site (Figure 8): Site A (20 miles east and up-current of the Galveston Entrance Channel), Site B (adjacent to the Galveston Entrance Channel), and Site C (10 miles west and down-current of the Galveston Entrance Channel). Tissue samples were analyzed for metal and organic chemical concentration levels. The Region also collected sediment samples from 18 stations (3 stations within the reference site and 15 stations within four miles north and east of the reference site). Sediment samples were analyzed for physical properties and chemical properties, including concentrations of metals, PAHs, dioxins and furans. Concentrations of all dioxins and furans were expressed in toxic equivalency (TEQ), which provides a single measure based on a weighted toxicity analysis.

Polychaete tissue sample analysis demonstrated differences in chemical concentrations at Sites A, B, and C. Samples collected at Sites B and C generally indicated higher concentrations of metals, dioxins, and furans than those from Site A.

Bivalve tissue biomass collected from Sites A, B, and C was combined into a single sample for analysis because the volume from each site was insufficient for independent analyses. Given the increasing trend in the polychaete tissue TEQs and metals from Sites A and C, the Region concluded that the bivalve tissue sample was unlikely to be representative of background chemical concentrations.

The Region found no significant differences in sediment grain size between samples from stations within and outside the reference site. Clay/silt sized sediments dominated all of the sampling stations.

Dioxin TEQs calculated from sediment samples were variable across the area, gradually decreasing eastward away from the reference area. Further investigation indicated that the historic reference area may act as a “sink” for dioxin because it is situated in the sediment fan resulting from the discharge of water and sediment through Galveston Bay and into the Gulf of Mexico. PAH and metal concentrations in sediment samples were found to be below the NOAA ERL at all stations.

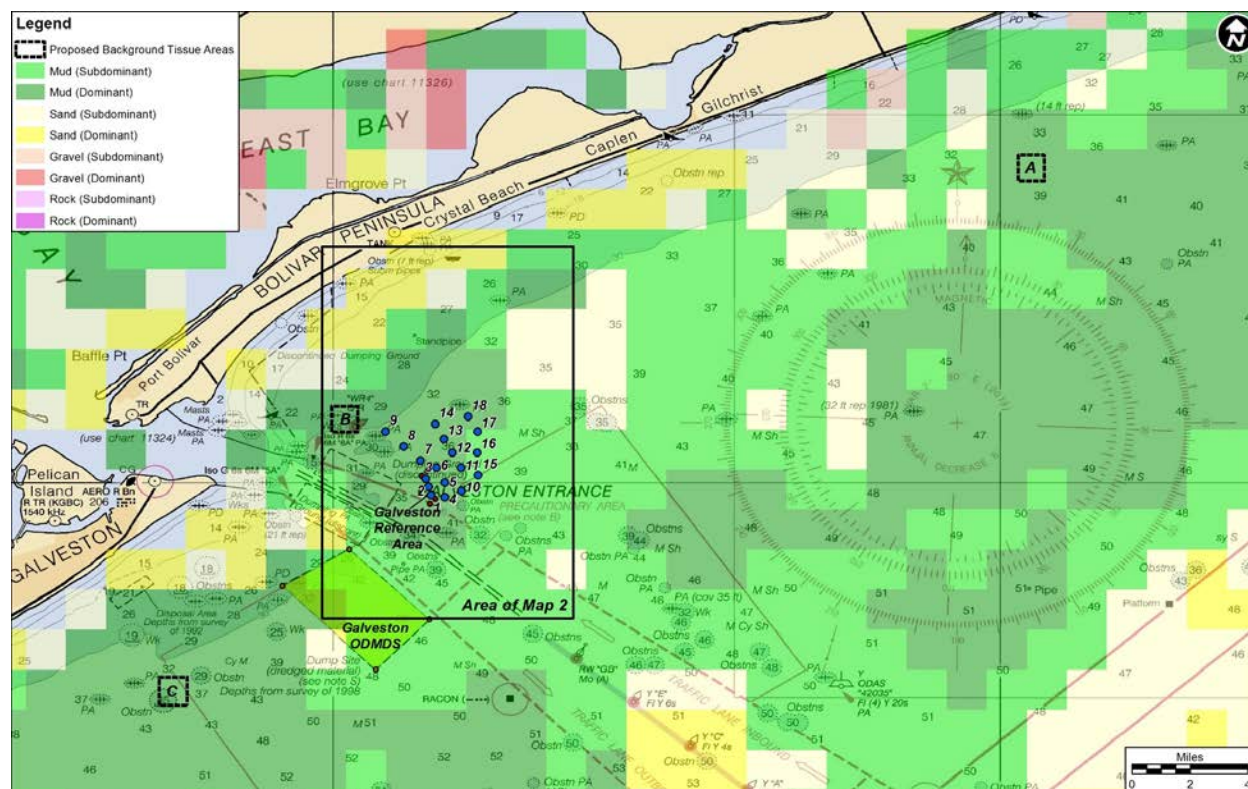


Figure 8. Background tissue sampling areas (A, B, and C), Galveston disposal site, Galveston reference site, and sediment sampling locations.

The Region also used the sediment chemical analysis data collected from the October 2014 Galveston survey to evaluate impacts of the Texas City “Y” oil spill in Galveston Bay on the reference site. In March 2014, a barge collided with a ship at the intersection of the Texas City Channel and the Houston Ship Channel and approximately 4,000 barrels of fuel oil spilled into Galveston Bay and dispersed into the Gulf of Mexico. The Region compared PAH concentrations in sediments samples collected before the spill in 1995, just after the spill in March 2014, and during the current study in October 2014. The comparison showed an increase in PAH concentrations in all areas downstream from the site of the spill to the ocean disposal site and the reference site. This provides additional evidence that the reference area sediment may be under the influence of sediment deposition from the Houston Ship Channel. Sediment samples from the October 2014 study showed that PAH concentrations returned to background levels within six months of the spill.

Based on the data collected in this survey, Region 6 plans to return to the Galveston area of the Gulf of Mexico to collect additional bivalve tissue samples for the Regional tissue database. The Region also plans to collect sediment samples outside of the influence of the sediment fan to further characterize background concentrations of metals and dioxin and other organic compounds. This information may be used to identify locations that are more suitable for use as a reference site.

4.8 Region 9 – Humboldt Open Ocean Disposal Site, California

Region 9 monitored the Humboldt Open Ocean Disposal Site, located off Eureka, California. The Region conducted this survey in September 2014 aboard Humboldt State University's R/V *Coral Sea*. The objectives of the survey were: (1) to determine the horizontal extent of the dredged material footprint relative to the disposal site boundaries; (2) to assess the overall impact of disposal operations on the marine environment; and (3) to collect data to support potential expansion of the site. Each year, this site, with an area of one square nautical mile, receives an average of one million cubic yards of sand dredged by USACE from the Humboldt Harbor entrance channel. In recent years, the average water depth of the disposal site has decreased significantly and the site is now very near its capacity. The Region plans to expand the current site to avoid the risk of a navigation hazard caused by the effect of decreased depth on wave dynamics.

Before the EPA-led survey, the Region collected bathymetric information across the disposal site in August 2014. This information (Figure 9) was used to identify bottom features of interest and confirm the selection of sampling stations for the September 2014 survey.

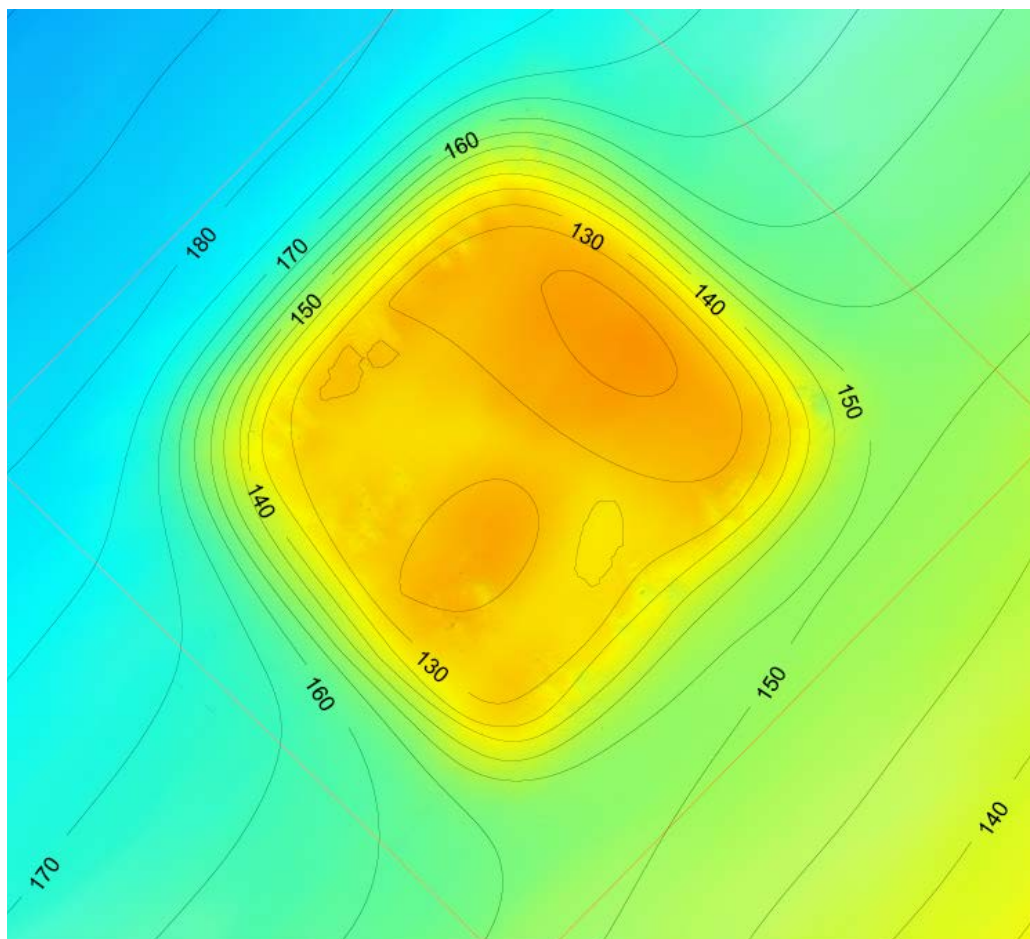


Figure 9. Bathymetry of the dredged material mound at Humboldt Open Ocean Disposal Site collected in August 2014.

During the September 2014 survey, the Region collected sediment profile/plan view images and sediment samples. The Region collected sediment profile/plan view images at 50 stations (39

within and 11 outside the disposal site) and analyzed the images for the dredged material layer thickness and benthic community parameters (Figure 10). The Region collected sediment samples at 26 stations (5 within and 21 outside the disposal site) and analyzed the samples for physical, chemical, and benthic community parameters.

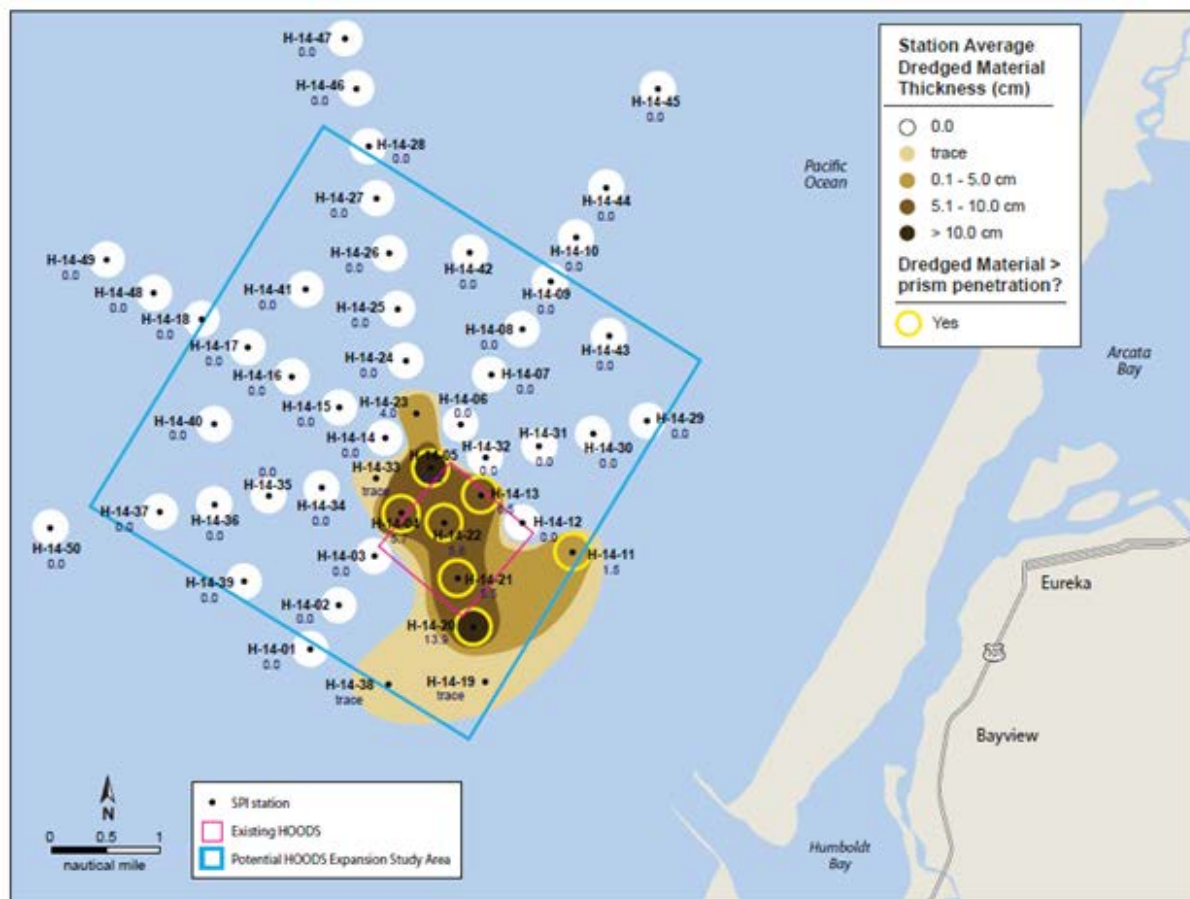


Figure 10. Dredged material layer thickness at the Humboldt disposal site mapped using sediment profile images.

Region 9 used the sediment profile images to identify the area of the site affected by disposal (Figure 9). The geometric shape of the disposal footprint within the site shows that current disposal practices effectively contain the impact of dredged material within site boundaries. However, the images showed dredged material deposition present outside the eastern boundary of the site in the direction of the harbor entrance. The Region attributes this to “short dumping” of dredged material by barge operators before reaching the disposal site, which likely occurred before current compliance monitoring practices were implemented.

The Region observed physical differences between sediment samples collected at stations within and outside the disposal site that could be attributed to dredged material disposal operations. Sediments outside of the disposal site appeared to be predominantly fine grained (silt and clay) in character, consistent with the native sediments of the local offshore area. Sediments inside of the disposal site were predominantly coarse grained (sandy) in character, consistent with the disposal of sandy sediments dredged from the Humboldt Bay entrance channel.

The chemical concentrations measured in sediment samples from the disposal site and across the study area were comparable and do not present a risk to the marine environment. There were no significant differences in benthic communities observed in sediment samples or sediment profile images from within and outside the disposal site, except for the top of the active disposal mound itself. Mature (stage 3) successional assemblages were present at 47 of the 50 stations, indicating that dredged material disposal does not have a lasting impact on the benthic community at the site. Benthic infaunal analysis indicates that the benthic communities in areas affected by dredged material disposal and areas not affected by dredged material disposal are generally similar in mean species abundance, density, and richness.

Based on the data collected in the survey, Region 9 confirmed that environmentally acceptable conditions are being met at the site and does not recommend any changes to the SMMP at this time. The Region will address the risk to navigation caused by decreased depths by expanding the existing site into the areas surveyed outside of the existing site to the west and north. Region 9 has begun the process to modify the location and size of the site.

4.9 Region 10 – Mouth of the Columbia River Deep Water Site and Shallow Water Site, Oregon

Region 10 monitored two Mouth of the Columbia River (MCR) ocean dredged material disposal sites: the MCR Deep Water Site and the MCR Shallow Water Site located off Astoria, Oregon (Figure 11). The Region conducted surveys in June/July 2014 and in October 2014 aboard Oregon State University's R/V *Pacific Storm*. The objectives of the EPA-led surveys were: (1) to assess the physical, chemical, and biological conditions of the benthic environment within previous and current dredged material release zones at the Deep Water Site; and (2) to assess habitat at both sites for Dungeness crab, a commercially important species.

In addition, Region 10 supported a collaborative survey of the MCR Deep Water Site in August/September 2014. NOAA National Marine Fisheries Service (NMFS) led this 2014 survey in conjunction with USACE, Oregon Department of Fish and Wildlife (ODFW), and Oregon State University. The objectives of the NMFS-led survey were: (1) to evaluate macrofauna distribution and density on the seafloor and (2) to assess impacts of dredged material disposal on Dungeness crab and other macroinfauna.

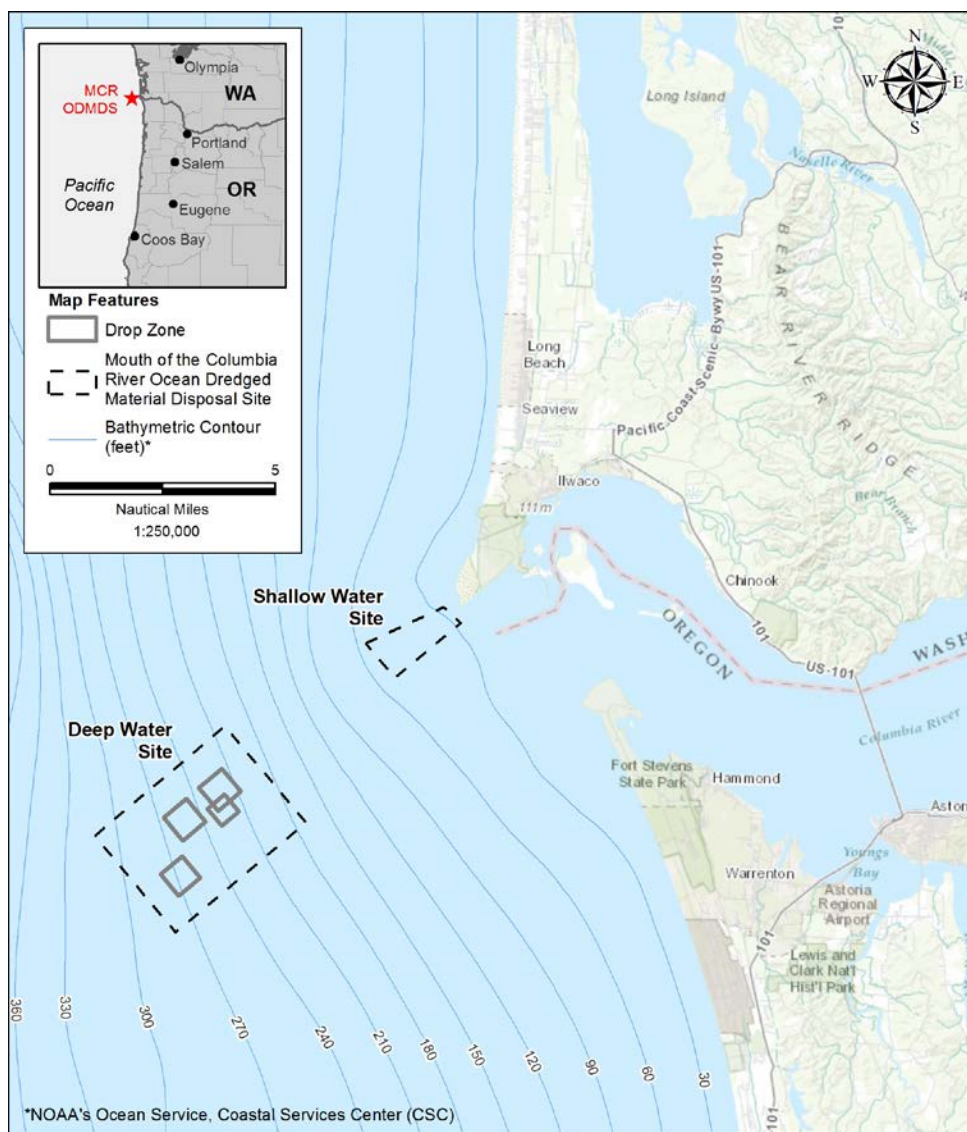


Figure 11. Mouth of the Columbia River Deep Water Site and Shallow Water Site. Release zones are shown within the Deep Water Site.

During the EPA-led surveys, the Region collected sediment samples, fish and invertebrate samples, and video imagery. At the Deep Water Site, EPA collected sediment samples in June/July and again in October at 40 stations within the disposal site, both within and outside of the targeted release zones. The sediment samples were analyzed for physical and biological parameters in order to assess the effect of disposal events that occurred at the site between sampling periods (June/July and October). The Region collected sediment samples in October at 30 stations both within and outside of the release zones at the Deep Water Site for chemical analysis. Region 10 compared the sediment chemistry results to marine screening levels (SLs) established in the May 2009 Sediment Evaluation Framework (SEF) for the Pacific Northwest (USACE et al., 2009). Concentrations below the SEF SLs are not toxic to benthic organisms. The Region collected fish and invertebrate samples. The Region conducted 12 benthic trawls across the release zones at the Deep Water Site during both the June/July and October surveys. The Region also deployed crab pots in June/July at 24 stations in the release zones at the Deep Water Site and at 12 stations uniformly distributed across the Shallow Water Site.

The NMFS-led survey collected two types of video imagery from the Deep Water Site. One method was led by staff from ODFW, who towed a neutrally-buoyant video sled across transects within and outside the Deep Water Site. The videos were compared to the trawl data from the EPA-led survey to determine the effectiveness of assessing fish and invertebrate communities on the seafloor using video versus counting animals from trawls. NMFS deployed a second video imagery method by dropping a baited video lander (termed “CamPod”) on the seafloor just before a dredge dumped dredged material at the site. The CamPod captured the response of benthic organisms to the sediment plume resulting from the dredged material disposal.

Physical analysis showed that sediment samples collected in the Deep Water Site during the EPA-led survey were primarily composed of sand (70 to 99%). Samples collected within release zones where dredged material has been dumped had a slightly higher percentage of sand compared to sediments from outside the release zones.

Chemical analysis of sediment samples collected at the Deep Water Site during the EPA-led survey showed metal concentrations below the SEF SLs. There were no detectable levels of tributyltin, total petroleum hydrocarbons (including diesel and motor oil), or pesticides in any of the sediment samples. For the organic compounds measured in the samples, including chlorinated hydrocarbons, miscellaneous extractables, phthalates, phenols, and PAHs, only a few were detected in the sediments collected at the Deep Water Sites and none were above the SEF SLs. PCBs were detected in one sample from the Deep Water Site, but at a concentration well below the SEF SL.

Benthic infaunal analysis of sediment samples collected during the EPA-led survey showed that the benthic community has not been significantly affected by disposal over the long-term. Generally, species density and number of species at all stations increased from June/July to October, while species richness and diversity did not change. As expected, species density, richness, and diversity was found to decrease from June/July to October at the release zone that had been used for disposal during that time period. On the other hand, species density, richness, and diversity at a release zone that was last used in 2006 was significantly lower than at a similar nearby release zone that was last used in 2009. This result was not expected and indicates that there are some not yet fully understood benthic infaunal community dynamics.

Analysis of benthic trawl data by EPA showed that fish and invertebrate populations at the Deep Water Site are generally healthy. Taxa, abundance, and densities were similar to trawl data collected during previous surveys. Generally, greater fish and invertebrate densities were observed during June/July. The seasonal trend may be due to a number of factors including predator-prey relationships, size-class response to trawling, and/or physical oceanographic conditions.

This study did not demonstrate any impact of dredged material disposal on crab communities. The abundance, sex ratio, and size of Dungeness crabs caught during the EPA-led surveys was similar to baseline data collected during the 2005 survey.

The benthic sled video collected during the NMFS-led survey provided clear, qualitative information on the benthic habitats and the short-term impacts of dredged material disposal at the Deep Water Site. Prior to disposal at the Deep Water Site, the invertebrate community at the control and impacted sites were dominated by Dungeness crab and sand stars (Figure 12). After disposal commenced, the video observed a large number of spoon worms, which had not been observed before. The spoon worms were mainly observed on the sediment surface, which is unusual for a burrowing worm. This behavior may have been related to the anomalous ocean

conditions, such as the giant “blob” of warm water off the West Coast in the northeast Pacific Ocean first observed in fall of 2013 and winter of 2014.

The CamPod deployed by NMFS at the Deep Water Site captured a disposal plume arriving at the seafloor (at a depth of approximately 220 feet). At this depth, the sediment appears to sprinkle onto the seafloor with little to no disturbance of flatfish observed in the video. These video approaches shed light on the presence and response of motile biota to dredged material disposal in deep water.

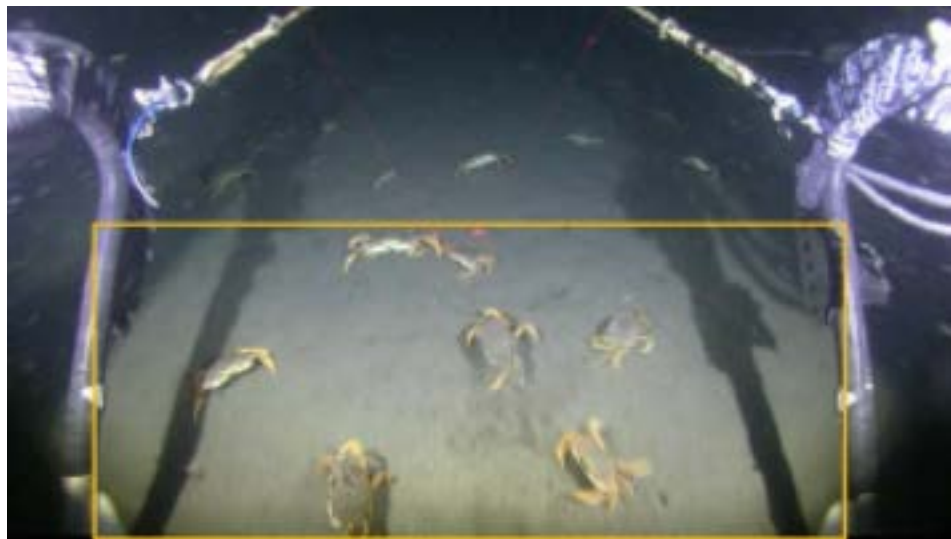


Figure 12. Benthic sled video screen shot showing Dungeness crab at the Deep Water Site.

Based on the data collected in this survey, Region 10 confirmed that environmentally acceptable conditions are being met at both sites and does not recommend any changes to the SMMP at this time. The Region plans to continue the use of the Shallow Water Site and Deep Water Site and to continue the required monitoring at both sites. In future monitoring surveys, Region 10 plans to measure water quality parameters (conductivity, temperature, and dissolved oxygen). Region 10 intends to produce a final report in 2017 comparing the 2014 NOAA-NMFS video survey data to the 2014 trawl data. Based on the results of this comparison, the Region would assess the utility of benthic video versus benthic trawls to determine the appropriate use of such a tool.

5.0 Conclusion

Based on results of the FY 2014 ocean disposal site surveys, EPA has taken or plans to take the following site management actions:

- EPA determined that environmentally acceptable conditions had been met and permitted disposal of dredged material under the MPRSA to continue without any modifications to site usage at five ocean disposal sites (Central Long Island Sound, Norfolk, Palm Beach, MCR Deep Water Site, and MCR Shallow Water Site).
- EPA plans to modify two ocean disposal sites to continue with permitted disposal (Port Everglades and Humboldt). At Port Everglades, EPA plans to alter the release zone to prevent movement of dredged material out of the disposal site. At Humboldt, EPA plans to expand the site because the site’s capacity will be reached sooner than anticipated.

- EPA plans to use information collected in the FY 2014 survey to inform the design of future monitoring surveys at two sites (Miami and Galveston). At Miami, the information collected during the 2014 survey will be used in the design of a 2016 survey. At Galveston, the Region plans to collect additional tissue samples during a future survey to establish background chemical concentration levels for use in dredged material evaluation.
- EPA plans to use the data collected at two sites (Savannah and Palm Beach) as a baseline to measure the impact of large disposal events planned in the near future. EPA expects large volumes of material at both sites from upcoming deepening projects at nearby ports. The deepening projects are intended to enable the ports to accommodate the largest vessels that traverse the recently expanded Panama Canal. After the disposal projects are completed, the Region intends to visit the sites again to collect data and compare that data to the baseline.

5.0 Acknowledgements

This report is based on the monitoring surveys conducted, analyses performed, and conclusions drawn by EPA Regional offices 1, 3, 4, 6, 9, and 10 during FY 2014. This report was developed with the support of Ocean Dumping staff from EPA Headquarters and all coastal Regional offices.

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