FINDING OF NO SIGNIFICANT IMPACT AND ENVIRONMENTAL ASSESSMENT

OPERATIONS AND MAINTENANCE

OPEN-LAKE PLACEMENT OF MATERIAL DREDGED FROM CLEVELAND HARBOR FEDERAL NAVIGATION CHANNELS IN THE UPPER CUYAHOGA RIVER

CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, NY 14207-3199

February 2014

PUBLIC REVIEW PERIOD ENDS: March 26, 2014

OPERATIONS AND MAINTENANCE

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FINDING OF NO SIGNIFICANT IMPACT

The U.S. Army Corps of Engineers (USACE) has assessed the environmental impacts of the above project in accordance with the National Environmental Policy Act (NEPA) of 1969, and has determined a Finding of No Significant Impact (FONSI). The Environmental Assessment (EA) accompanying this FONSI presents the results of the environmental analysis.

The primary purpose of the EA is to update previous environmental documentation prepared for dredging and dredged material placement activities at Cleveland Harbor. The quality of Cleveland Harbor sediments located in the Upper Cuyahoga River Channel has improved to the point that it now meets U.S. Environmental Protection Agency (USEPA)/USACE guidelines for open-lake placement. Consequently, this EA addresses a change in the placement method of this material.

Cleveland Harbor is a deep-draft commercial harbor located on Lake Erie in Cuyahoga County, Ohio. The harbor is situated on the southern shore of the lake at the mouth of the Cuyahoga River, approximately 110 miles east of Toledo, Ohio. The federal harbor project consists of a network of authorized navigation channels within a breakwater-encompassed Outer Harbor in Lake Erie, and an Inner Harbor along the Cuyahoga River. This FONSI addresses the management of material that would be dredged from federal navigation channels in the reach of the upper Cuyahoga River between Stations 799+00 (upstream channel limit) and 736+00 (Upper Turning Basin) and referred to as the "Upper Cuyahoga River Channel."

The proposed project would involve open lake placement of sediments routinely dredged from the Upper Cuyahoga River Channel. Although the environmental effects of the dredging operation were assessed in past NEPA documentation, it typically occurs annually in both Spring/Summer and Fall phases. The dredging would be accomplished by mechanical means with storage, transport and placement of the dredged material via scow. Shoals within the channel would be dredged to authorized depth, with an additional four feet of material removed to include one foot of overdepth and three feet of advanced maintenance, in an attempt to ensure sufficient water depths are achieved for the commercial navigation. The quantity of material dredged from the Upper Cuyahoga River Channel on a yearly basis would be about 180,000 cubic yards. Based on a comprehensive 2013 evaluation of 2012, 2010 and 2007 sediment test data, the dredged material has been determined to meet federal [U.S. Environmental Protection Agency (USEPA)/USACE] guidelines for open-lake placement. Therefore, the material would be placed at either of two designated, deep-water open-lake areas offshore of Cleveland in Lake Erie and referred to as CLA-1 and CLA-4. The CLA-1 location was formerly used for dredged material placement over 40 years ago. These areas are two-square miles in size and have water depths ranging from about 55 to 62 feet below LWD[1], however, dredged material placement in both areas would be limited to one-square-mile or less. Open-lake placement of dredged material would occur during the harbor's dredging operations which generally occur between May 1 and December 30 with the majority normally taking place over an approximately eight week period in May and June. The placement of this dredged material at the

open-lake areas in Lake Erie is appropriate because it would not have an unacceptable adverse impact on the aquatic ecosystem, either individually or in combination with known and/or probable impacts of other activities affecting the ecosystem.

Alternatives to the proposed plan were considered in this evaluation, but it was determined that no practicable alternative currently exists for material that is suitable for open-lake placement. The "No Action" alternative was considered but dismissed since it would not address the navigation needs of the harbor and a viable alternative was identified. Several beneficial use of dredged material studies are currently being evaluated and are in various phases of study through the USACE Regional Sediment Management (RSM) Program. However, at this time none of these studies have progressed to the point that they are ready for implementation. There is currently no placement area outside the aquatic ecosystem available to the USACE that is accessible, economically feasible, and can accommodate the quantity of dredged material necessary to maintain the federal navigation channels at Cleveland Harbor on an annual basis and at a reasonable federal cost.

Several concerns were expressed with respect to the open-lake placement of this dredged material. The Ohio Environmental Protection Agency (OEPA) provided detailed concerns regarding the suitability of this material for open-lake placement, largely due to polychlorinated biphenyl (PCB) contamination. The presence of PCBs in Lake Erie are a cause of impairment in fish tissue. The USACE prepared a comprehensive response to these concerns and re-affirmed that the dredged material does meet federal guidelines for open-lake placement. In that response, USACE concluded that bioaccumulation (biological uptake) of PCBs from the dredged material would be similar to what already occurs from Lake Erie background sediments, and that it would represent no appreciable increased risk to the aquatic ecosystem (including fish) or human health. Another concern expressed by OEPA was that the open-lakes areas used for comparisons to the dredged material were contaminated. The USACE responded by noting that testing showed that the lake sediments were not toxic and that contaminant concentrations were within the range of Lake Erie background contamination. The city of Cleveland expressed concerns that the open-lake placement of this dredged material would degrade the quality of water at existing potable water intakes (PWIs) in Lake Erie. However, conservative scenarios modeled by U.S. Army Engineer Research and Development Center (USAERDC) indicated that open-lake placement at CLA-1 and CLA-4 would result in no significant contribution of suspended solids, contaminants, total organic carbon (TOC), dissolved organic carbon (DOC) or ammonia to the water column at the PWIs and have no potential to violate water quality standards for the protection of human health.

Dredged material from federal harbors eventually being found to meet federal guidelines for open-lake placement is not uncommon and is an expected result over time. This is largely due to improved sediment quality in Lake Erie watersheds following decades of environmental regulation and remediation. Among federal harbors on Lake Erie, this material in Cleveland Harbor is the

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[1] Low Water Datum (LWD) for Lake Erie is 569.2 feet above mean sea level at Rimouski, Quebec, Canada (IGLD 1985).

most recent to become suitable for open-lake placement, and follows similar findings from the evaluation of material dredged from Huron, Toledo, Lorain and Erie Harbors.

A significant amount of material dredged from the Upper Cuyahoga River Channel has been previously placed into the open-lake. Between 1985 and 1993, about 25 percent of sandy material dredged from this channel was routinely placed at an authorized nearshore placement area offshore of Bratenahl as littoral nourishment. After 1993, this dredged material was found to be unsuitable for littoral nourishment by USACE because it no longer met federal guidelines for open-lake placement and contained an insufficient fraction of sand. Approximately ten years ago the OEPA and Ohio Department of Natural Resources (ODNR) requested that USACE reinvestigate the placement of this dredged material into the nearshore zone of Lake Erie. However, subsequent testing and evaluation according to newer (1998) federal guidelines showed that the material remained unsuitable for open-lake placement at that time.

This proposed routine harbor maintenance activity is limited in scope and analysis has shown that the project is not a major federal action which would result in significant adverse impacts on the quality of the human or natural environment. Public coordination to date has uncovered no areas of environmental controversy that have not been sufficiently addressed. Based on these factors, it has been determined that an Environmental Impact Statement will not be required. Those who may have new information that may alter this assessment should notify me within 30 days. If no comments that would alter this finding are received within the 30 day review period, or after such comments are sufficiently addressed, this finding will be signed and filed with project documentation.

Date: _____

Owen J. Beaudoin
Lieutenant Colonel, Corps of Engineers
District Commander

OPERATIONS AND MAINTENANCE

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CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

TABLE OF CONTENTS

SECTION	Page
SECTION 1 – INTRODUCTION	1
SECTION 2 – SELECTED PLAN AND ALTERNATIVE CONSIDERATIONS	5
SECTION 3 – AFFECTED ENVIRONMENT	9
SECTION 4 – ENVIRONMENTAL IMPACTS	16
SECTION 5 – COMPLIANCE WITH ENVIRONMENTAL PROTECTION REQUIREMENTS	40
SECTION 6 – PUBLIC/AGENCY COORDINATION	44
SECTION 7 – REFERENCES	47

ENVIRONMENTAL ASSESSMENT APPENDICES

A – TABLES AND FIGURES	52
B – CLEAN WATER ACT SECTION 404(b)(1) EVALUATION & EVALUATION OF UPPER CUYAHOGA RIVER CHANNEL DREDGED SEDIMENTS	62
C – COASTAL MANAGEMENT PROGRAM CONSISTENCY DETERMINATION	369
D – COMMENTS/RESPONSES ON NEPA SCOPING AND CLEAN WATER ACT SECTION 404(a) PUBLIC NOTICE	379

OPERATIONS AND MAINTENANCE

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ENVIRONMENTAL ASSESSMENT

SECTION 1 – INTRODUCTION

1.1 PURPOSE AND AUTHORITY

1.1.1 Purpose - The purpose of this Environmental Assessment (EA) is to provide sufficient information on the potential environmental impacts resulting from open-lake placement of material dredged from the Upper Cuyahoga River Channel of Cleveland Harbor, Ohio, as proposed by the U.S. Army Corps of Engineers (USACE). Analysis of the potential impacts of the proposed project will determine if the project is a major federal action significantly affecting the quality of the human environment. This EA facilitates compliance with the National Environmental Policy Act (NEPA) of 1969, and includes discussion of the need for the action, the affected environment, a description of the proposed action and alternatives, its environmental impacts, applicable analyses, environmental compliance, and a list of agencies, interested groups and individuals consulted.

This EA does not pertain to the environmental impacts associated with dredging of the Upper Cuyahoga River Channel because various existing NEPA documentation already addresses this activity. The potential impacts from dredging the Cleveland Harbor federal navigation channel (including the Upper Cuyahoga River Channel) have been previously assessed in the documents noted below:

- Final Environmental Impact Statement (FEIS), Operation and Maintenance, Cleveland Harbor, Ohio, 1974
- Final Environmental Impact Statement, Diked Disposal Area, Site No. 12, 1974, clarification 1979;
- Final Environmental Impact Statement, Diked Disposal Facility, Site No. 14, 1975, clarification 1978;
- Final Environmental Statement, Cleveland Harbor Navigation Study, 1978, clarification 1979 & 1986;
- Cleveland Harbor, OH Dike Disposal Site 14, Supplemental Information Report and Section 404(b)(1) Evaluation, 1983;
- Final Environmental Impact Statement Confined Disposal Facility 10B, 1994;
- Finding of No Significant Impact and Environmental Assessment Cleveland Harbor (Re-use of CDF 12), 2004; and
- Draft Dredged Material Management Plan and Environmental Impact Statement, 2009.

Since dredging-related impacts have been assessed in these previous documents, the primary focus of this EA will be to assess the potential impacts associated with the placement of dredged material at the two designated, proposed open lake areas offshore of Cleveland, Ohio.

1.1.2 Authority - Maintenance dredging operations at the Cleveland Harbor federal navigation project and the preparation of this EA are accomplished under the USACE operation and maintenance (O&M) authority. The existing federal navigation project at Cleveland Harbor, Ohio, is authorized as a federal harbor through the Rivers and Harbors Act of 1875, as amended. Various modifications to the project were also authorized under the 1976 and 1986 Water Resource Development Acts (WRDA), the Supplemental Appropriations Act of 1987, and the Energy and Water Appropriations Act of 1988.

1.2 PROJECT LOCATION - Cleveland Harbor is a deep-draft commercial harbor located in north-central Ohio within Cuyahoga County situated on the south shore of Lake Erie at the mouth of the Cuyahoga River (Appendix A, Figure 1). The harbor contains 5.8 miles of federal navigation channel within the Cuyahoga River, approximately one mile within the Old River, and five miles in the Outer Harbor. Authorized project depths range from 25 to 29 feet below low water datum (LWD[1]) in the Outer Harbor Channel and 18 to 27 feet below LWD in the Cuyahoga River and Old River Channels. The key features of Cleveland Harbor are illustrated in Appendix A, Figure 2.

1.3 NEED FOR THE PROPOSED ACTION

1.3.1 Cleveland Harbor Maintenance Dredging Operations – Cleveland Harbor federal navigation channels are dredged on an annual basis, typically twice per year during Spring/Summer and again in the Fall. The need for dredging arises as recurrent shoals in these channels reduce the navigable depths for deep-draft commercial navigation. Dredging restores these channels to authorized project dimensions which facilitates safe commercial navigation and its associated benefits. Since 2006, maintenance dredging of the entire harbor has been accomplished by removing approximately 225,000 cubic yards (CY) annually from the Federal navigation channels. The majority of the annual dredging at Cleveland Harbor (about 80 percent or 180,000 CY) occurs in the Upper Cuyahoga River Channel (Appendix A**,** Figure 3) where most of the shoal material originates from the upstream reaches of the Cuyahoga River. Dredging of this or any area cannot be accomplished without identifying a suitable location to place the dredged material.

1.3.2 Historic Dredged Material Management of Upper Cuyahoga River Channel Dredged Material – Due primarily to numerous past and present industrial uses and activities in the Cleveland Harbor area, sediments historically dredged from the federal navigation channels in Cleveland have been contaminated to the degree that resulted in them being unsuitable for open-lake placement. As a result, and except for some of the material between 1985 and 1993, these sediments have been placed in a series of constructed confined disposal facilities (CDFs) along the Cleveland waterfront. Since the 1960's, five CDFs have been constructed and utilized at Cleveland Harbor, including CDFs 9, 10B, 12, 13 and 14 (Appendix A, Figure 2).

1.3.3 Sediment Quality Trend in the Upper Cuyahoga River Channel – The quality of sediments in the Upper Cuyahoga River Channel has changed over time which has affected its suitability for open-lake placement. Between 1985 and 1993, about 25 percent of sandy material dredged from

[1] Low Water Datum (LWD) for Lake Erie is 569.2 feet above mean sea level at Rimouski, Quebec, Canada (IGLD 1985).

the channel was routinely placed at an authorized nearshore placement area offshore of Bratenahl, Ohio as littoral nourishment. After 1993, this dredged material was found by the USACE to be unsuitable for littoral nourishment because it no longer met federal guidelines for open-lake placement and contained an insufficient fraction of sand. Approximately ten years ago, the Ohio Environmental Protection Agency (OEPA) and Ohio Department of Natural Resources (ODNR) requested that USACE reinvestigate the placement of this dredged material in the nearshore zone for littoral nourishment purposes. However, subsequent and more advanced testing and evaluation according to newer (1998) federal guidelines at the time showed that the material remained unsuitable for open-lake placement. In 2007, an evaluation of the dredged material concluded that the material remained unsuitable for open-lake placement (USACE 2007). However, a more comprehensive study in 2010 evidenced a significant improvement in a large portion of the Upper Cuyahoga River Channel material (Kreitinger *et al.* 2011). Finally, another comprehensive evaluation completed in 2013 showed a net improvement in sediment quality along the entire Upper River channel reach between 2007 and 2012 (USACE 2013a). This evaluation determined that material in the Upper Cuyahoga River Channel meets federal guidelines for open-lake placement.

Placement of relatively clean dredged material in a suitably designated open-water area is often the most economical management alternative relative to use of a CDF or upland placement. However, since most sediments from the harbor have historically been placed within CDFs for decades, there is currently no existing, authorized open-water placement area established for Cleveland Harbor dredged material. Thus, the primary purpose of this document is to assess the environmental impacts associated with the placement of material dredged from the Upper Cuyahoga River Channel within two designated open-lake placement areas offshore of Cleveland, Ohio.

1.4 FEDERAL STANDARD FOR DREDGED MATERIAL MANAGEMENT – For any USACE civil works O&M dredging project, federal regulations require USACE to select the least-cost, environmentally acceptable dredged material management alternative that is engineeringly feasible. This is commonly referred to as the "Federal Standard." "Environmentally acceptable" within this definition means compliance with NEPA and Clean Water Act Section 404(b)(1) Guidelines (if there is a discharge of dredged material into a water of the United States). One objective of the Federal Standard is to ensure that federal dredging funds across states are spent in an equitable manner and in a way that does not favor any particular state policy relating to dredged material management. The USACE is responsible for determining compliance with the Clean Water Act Section 404(b)(1) Guidelines and for complying with NEPA. While beneficial use of the dredged material is often the preferred and most popular option, the actual implementation of such alternatives usually requires non-federal sponsorship and significant non-federal cost-sharing. Typically, when the discharge of dredged material is determined to meet Clean Water Act Section 404(b)(1) Guidelines, which includes compliance with applicable state water quality standards (WQSs), open-lake placement is often the least costly alternative which meets the Federal Standard. State requirements beyond compliance with Clean Water Act Section 404(b)(1) Guidelines exceed the Federal Standard and, if costly, require non-federal sponsorship and cost-sharing for implementation.

1.4.1 Determining the Suitability of Dredged Material for Open-lake Placement Pursuant to Section 404 of the Clean Water Act – Section 404 of the Clean Water Act requires that the USACE determine whether the dredged material meets federal guidelines for open-lake placement, including compliance with applicable state WQSs. The Section 404(b)(1) Guidelines direct that contaminant determinations be made with respect to the proposed discharge of dredged material (40 CFR 230.11[d]). These determinations are based on formal federal guidance prescribed in the *Great Lakes*

Dredged Material Testing and Evaluation Manual (GLTM) (USEPA/USACE 1998a) and *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.—Testing Manual* (Inland Testing Manual [ITM]) (USEPA/USACE 1998b). The guidance emphasizes a biological effects-based approach to evaluating the suitability of dredged material for open-water placement, and the determination must evaluate whether the discharge of dredged material at a proposed disposal site would result in unacceptable, contaminant-related adverse impacts to the aquatic ecosystem and human health. The guidance prescribes a tiered approach be taken, with increasing levels of testing and evaluation intensity across four tiers. When evaluating the toxicity of the dredged material, a main point of comparison is the sediment at the open-water disposal site, which is typically represented by an open-water reference area(s). It is important to recognize that lake bottom sediments in the Great Lakes, like sediments in many such environments, are generally not uncontaminated. Therefore, open-lake reference areas with background contamination that reflects conditions over a large area and/or near large tributaries are acceptable for use in dredged material evaluations. The evaluation determining the suitability of Upper Cuyahoga River Channel dredged material for open-lake placement is provided in Appendix B of this EA along with the Section 404(b)(1) Evaluation and related correspondence (USACE 2013a).

1.5 Public and Inter-agency Coordination – Interagency and public coordination related to this proposal has taken place since 2011 when the USACE indicated that there was a strong possibility that sediments in the Upper Cuyahoga River Channel would soon be suitable for open lake placement. This outreach and coordination effort escalated in 2013 following completion of additional sediment sampling in 2012. A 2013 Dredged Material Sediment Evaluation concluded that this sediment was in fact suitable for open lake placement (Appendix B). An outline of outreach and coordination efforts that have taken place to date, or that are currently underway is presented below. The USACE has endeavored to address all applicable public and agency comments received to date within this draft EA and/or its associated appendices.

<u>National Environmental Policy Act</u>

- Public Scoping (August 2013)
- Draft EA/FONSI Coordination (February 2014)
- USACE-Hosted Webinar (scheduled March 4, 2014)

<u>Clean Water Act</u>

- Coordination with Cleveland Port Authority, OEPA & ODNR on 2012 Sediment Sampling Plan (March 2012)
- Meeting with OEPA on Draft Sediment Evaluation (November 2013)
- Water Quality Certification Application (November 2013)
- Section 404 Public Notice (December 2013)
- OEPA Public Hearing (March 2014)

<u>General Outreach & Coordination</u>

- Cleveland Task Force Public Meetings (early 2010 – early 2013)
- USACE Presentation at "State of the River Symposium" (September 2013)
- Meetings with Cleveland Water (October 2013 & January 2014)
- Meeting with Dike 14 Nature Preserve Committee staff (January 2014)
- Meeting with Ohio Environmental Council staff (February 2014)

SECTION 2 – SELECTED PLAN AND ALTERNATIVE CONSIDERATIONS

2.1 ALTERNATIVES CONSIDERED BUT NOT EVALUATED – The viability of the following alternative plans and their associated environmental impacts were considered in this EA, but were ultimately dismissed for the reasons described below:

2.1.1 Placement of Upper Cuyahoga River Channel Dredged Sediments in Existing Federal CDFs – Prior to the sediments in the Upper Cuyahoga River Channel being determined suitable for open-lake placement in 2013, they were placed into existing CDFs on the Cleveland lakefront. The only exception to this was that for a period of time between 1985 and 1993, a portion of these dredged sediments were coarse-grained (comprised of predominantly sands) and suitable for open-lake placement, and were therefore placed in the littoral zone of Lake Erie offshore of Bratenahl, Ohio. This CDF placement alternative is therefore practical from both an engineering and economic standpoint, but it is not policy compliant. The placement of dredged material that is determined suitable for open-lake placement into a federal CDF is inconsistent with USACE policy and Section 148 of Public Law 94-587, which requires the USACE to use best management practices to extend the useful life of CDFs and thereby minimize the need for the construction of new CDFs. Therefore, this alternative was removed from consideration for the management of sediments dredged from the Upper Cuyahoga River Channel. Note that material dredged from harbor channels downstream of the Upper Cuyahoga River Channel would continue to be placed in the existing CDFs in Cleveland Harbor (CDFs 9 and 10B) as these sediments have not yet been determined to be suitable for open-lake placement. Further comprehensive sediment sampling and analyses is likely to occur in Lower Cuyahoga River Channels in the future to re-evaluate their suitability for open-lake placement.

2.1.2 Beneficial Use of the Dredged Material – A beneficial use study for Cleveland Harbor is in progress through the USACE Regional Sediment Management (RSM) Program. Under Section 204 of the Water Resources Development Act (WRDA) of 1992, as amended, USACE is authorized to beneficially use dredged material for aquatic ecosystem restoration and storm damage reduction. In the vicinity of Cleveland Harbor, USACE is studying the feasibility of five locations for beneficially using suitable dredged material for aquatic ecosystem restoration. These sites include Edgewater Park West and East, Whiskey Island, Cleveland Lakefront State Park, and Dike 14 (southwest corner) (Appendix A, Figure 4). The preliminary range in volume of dredged material that might be used at each location is from approximately 61,000 cubic yards at Dike 14 (southwest corner) to over 627,000 cubic yards at Edgewater Park East. However, the project size of the selected location may need to be adjusted so that construction costs do not exceed the federal cost-share limit of $5M (not including any non-federal cost-share). Thus, a 627,000 cubic yard project is not likely realistic under this authority due to high construction costs. Also, since approximately 180,000 cubic yards of sediment would be dredged from the Upper Cuyahoga River Channel on an annual basis, it is not expected that a Section 204 project would account for a substantial amount of the dredged material removed from the harbor. This study is not expected to be completed during fiscal year (FY) 2014 and is likely to take several more years to complete, pending availability of federal funds. Typically, only material that is suitable for open-lake placement is considered suitable for aquatic beneficial uses. This Section 204 study is being evaluated through a separate authority and a separate NEPA document will be prepared at a future time.

If and when a beneficial use project is implemented, it will likely remain necessary to continue open-lake and/or CDF placement activities (as appropriate based on sediment testing results) to

ensure the continued navigability of Cleveland Harbor. Although the USACE strongly supports efforts to reduce sediment from entering the watershed, the federal navigation channel, and eventually Lake Erie (e.g., riparian buffers, wetland restoration), leading such efforts are currently outside any USACE study authority. Some non-aquatic beneficial uses have also been considered as part of the on-going Cleveland Harbor Short-Term Dredged Material Management Plan (see Section 2.3.2).

2.2 ALTERNATIVES EVALUATED – Since there currently are no established, authorized deep water areas in Lake Erie for the placement of Cleveland Harbor dredged material, the USACE initiated an effort to identify suitable open-lake placement areas in the vicinity of Cleveland Harbor. Four candidate areas, CLA-1 through CLA-4, were preliminarily identified by USACE as potential open-lake placement areas (Appendix A, Figure 5). Location CLA-1 is the open-lake area formerly used by the USACE for the placement of Cleveland Harbor dredged material over 45 years ago (per 1941 USACE drawing). These potential open lake placement areas were coordinated with applicable local, state and federal agencies, and sponsors in an effort to identify any resources or other interests that may be affected by use of the areas. Through this coordination, USACE initially determined that CLA-3 and CLA-4 were the preferred locations for open-lake placement. However, once sampling efforts commenced it was discovered that the predominant substrate present within CLA-3 was primarily bedrock, coarse sands, and gravels. If selected for open lake placement, these substrates would have been covered over with dredged material consisting of predominantly fine sands, silt, and clay, resulting in a substrate change to a type with less value for Lake Erie aquatic biota. Therefore, it was determined that CLA-3 would not be a suitable placement area. Since available evidence suggested that CLA-2 shared similar habitat characteristics, both areas were eliminated from further consideration. The focus of the sampling effort and modeling analyses associated with the proposed open-lake placement of Upper Cuyahoga River Channel dredged material has therefore been on CLA-1 and CLA-4 (Appendix A, Figure 6).

The viability of the following alternative plans and their associated environmental impacts has been evaluated in this EA:

2.2.1 No Action - The No Action alternative (Without Project Conditions) serves as the baseline against which to compare the potential effects of the other project alternatives. Under this alternative, open-lake placement of sediment dredged from the Upper Cuyahoga River Channel would not be conducted. However, this sediment could also not be placed into existing federal CDFs (see Section 2.1.1) which would likely result in an adverse impact to commercial navigation in Cleveland Harbor.

2.1.2 Selected Plan (Open-lake Placement of Dredged Material at CLA-1 and CLA-4 – The proposed project would involve open-lake placement of sediment dredged during routine maintenance dredging operations in the Upper Cuyahoga River Channel between Stations 799+00 (upstream channel limit) and 736+00 (Upper Turning Basin). The suitability of dredged material for open lake placement is based on a determination of which sediments meet federal guidelines for open lake suitability and comply with applicable promulgated state water quality standards. The dredged material from the Upper Cuyahoga River Channel would be placed at either of two designated, deep water open-lake areas offshore of Cleveland in Lake Erie, referred to as CLA-1 and CLA-4 (reference Section 3.2). Each area is two-square miles in size and has depths ranging from 55 to 62 feet below LWD. Dredged material placement in both areas would be limited to one-square-mile or less. Open-lake placement of dredged material would occur during the harbor's annual dredging operations which generally can occur between May 1 and December 30, with the

majority normally taking place over an approximately eight week period in May and June.

Open-lake placement associated with dredging of the Upper Cuyahoga River Channel would occur annually, and would typically be completed in both Spring/Summer and Fall phases. Maintenance dredging operations would be performed by a contractor of the federal government. The dredging would be accomplished by mechanical means with storage, transport and placement of the dredged material via scow. After arrival at the placement area, the scow would slow down, its bottom gates would be opened, and the dredged material would settle to the lake bottom. Dredged material placement would not be performed during Lake Erie storm events and measures would be incorporated to avoid transfer spillage. Shoals within the channel would be dredged to authorized depth, with an additional four feet of material removed to include one foot of over-depth and three feet of advanced maintenance dredging in an attempt to ensure sufficient water depths for commercial navigation. The quantity of material dredged from the Upper Cuyahoga River Channel on a yearly basis would be approximately 180,000 cubic yards, although this quantity will vary from year to year based on shoaling rates and available maintenance dredging funds.

2.3 OTHER ONGOING MANAGEMENT MEASURES - In addition to the above project alternatives, the USACE is aware of, or is continuing to work with, other harbor interests toward the development of other measures that may influence harbor dredged material management. These other initiatives include:

2.3.1 Cuyahoga River Bed Load Interception Studies – The Cleveland Port Authority (CPA) and partners are currently in the process of evaluating the use of sediment bed load interceptor technologies in the Cuyahoga River upstream of the federal navigation channel in an effort to reduce the amount of sediment that is carried down the river and ultimately deposited in the federal navigation channel. Work to date has included the installation of a small bed load collector near Harvard Road operated periodically over a 10-day period as a proof-of-concept study. Work has also included collection of sediment samples from various locations in the river for chemistry analyses to determine its suitability for upland uses. To date, samples have consistently been deemed suitable for upland uses. Based on the results produced thus far, the CPA believes bed load interception could be a cost effective tool for reducing overall dredging requirements. Refined modeling results are expected to reasonably differentiate between suspended and bed load sediments, and to predict the quantity of bed load sediments that would be most susceptible to interception and harvesting. Pending the outcome of this modeling, the next step reported by the CPA would be to plan and execute a large scale, multi-year pilot evaluation. The CPA has reserved funds in their 2014 budget to support engineering for this endeavor.

2.3.2 Other Dredged Material Management Investigations – Prior to 2010, the USACE worked closely with the CPA and other harbor interests on a Cleveland Harbor Dredged Material Management Plan which at the time involved several alternative sites for construction of a new CDF on the Cleveland waterfront. A Draft Environmental Impact Statement (DEIS) for that study was released in August 2009. Following receipt of public and agency comments on the DEIS, a letter dated June 23, 2010 was sent by the CPA to the USACE stating that they were “unable to provide the required ‘Self-Certification of Financial Capability’ necessary to move the DMMP process forward” and they were therefore not able to fulfill their non-federal sponsor cost-share obligation. Therefore, the USACE effectively terminated that study and withdrew its application for water quality certification with OEPA in July 2010. Subsequent efforts focused on characterizing sediment quality and assessing cost-effective alternatives to constructing a new CDF,

including potential beneficial uses. These efforts ultimately led to the draft of a Short-Term Dredged Material Management Plan for Cleveland Harbor. The objective of the short-term plan was to identify a preferred method(s) of confining sediments. This would also allow time to further evaluate the potential suitability of navigation channel sediments for open lake placement as the next routine sediment sampling and evaluation was not scheduled until 2012/2013.

A draft of the USACE Short-Term Decision Document which is currently under internal review evaluates various measures that would provide approximately one million cubic yards of new confinement capacity for material that is unsuitable for open lake placemnt. Measures focus on expanding capacities at the existing CDFs and upland beneficial uses. The measures for CDF expansion include a shift from hydraulic to mechanical placement into the disposal facilities to reduce the amount of water needing to be managed, allow for faster drying and to facilitate grading necessary to stack sediment higher within existing footprints. Various design options were looked at for mounding sediment higher at existing CDFs 9, 10B, and/or 12, as well as the potential for beneficial use of dredged material at three upland sites (i.e., CVIC, Brook Park Landfill, and Silver Oak Landfill). Also considered as part of this decision document is an alternative whereby the CPA proposes to take over disposal operations by designing and implementing a similar mounding approach at only CDF 12. Based on this plan the CPA would recover much of its investment through a tipping fee to be paid by USACE and others for placement of dredged material into CDF 12. Section 217 of WRDA 1996, as amended, authorizes the USACE to enter into an agreement to use a dredged material disposal facility designed, constructed, managed, owned, or operated by a non-federal interest, a private entity, or both. This plan may be pursued through a Section 217 agreement with the CPA, who would assume any risks associated with its costs and technical feasibility. Such an agreement would also depend on approval by the Assistant Secretary of the Army for Civil Works.

The proposal for open-lake placement does not preclude nor delay completion of this decision document and the selection of a plan to provide new confinement capacity. The USACE sees these potential interim measures at the existing CDFs, in combination with open-lake placement, as having a high probability for providing suitable dredged material management capacity in Cleveland Harbor for the next 20 years.

2.3.3 Gorge Dam – The USACE and OEPA, in close coordination with USEPA, are negotiating a partnership agreement to complete a Sediment Management Plan at the Gorge Dam on the Cuyahoga River, in Cuyahoga Falls, Ohio. The Sediment Management Plan would entail a feasibility-level evaluation of an alternative to remove the Gorge Dam and the sediment deposited behind it, along with a 35 percent level of design. This study will also include an evaluation of what effect removal of this dam might have on sediment loading in the Cuyahoga River which may or may not influence shoaling in the federal navigation channel far downstream.

SECTION 3 – AFFECTED ENVIRONMENT

3.1 LOCATION AND PHYSICAL DESCRIPTION – Sites CLA-1 and CLA-4 are located offshore approximately five to nine miles out in Lake Erie between Rocky River and Cleveland, Ohio, in depths ranging from 55 to 62 feet below LWD. This area of Lake Erie is influenced by nearby urban activities in the form of urban point and non-point source discharges.

3.1.1 *CLA-1* – This area was historically used by USACE for dredged material placement prior to implementation of the Clean Water Act in 1972. However, following the Clean Water Act it was no longer used due to non-compliance with Section 404 of the Clean Water Act. This site is two square miles (two miles in length and one mile in width) in size, the center of which is located approximately 9.43 miles north of the West Breakwater Light (Main Entrance Light) at a bearing of N3.1635°W (azimuth 357°). The average depth in the area is approximately 62 feet below LWD. Currents and velocities at this area are principally driven by meteorological conditions (wind and atmospheric pressure changes). Velocities are unstratified, and are predominantly in an easterly or east-northeasterly direction running parallel to the shoreline (U.S. Army Engineer Research and Development Center [USAERDC] 2013a).

3.1.2 *CLA-4* – This proposed open-lake placement area for Cleveland Harbor dredged material has not been previously used. It is two square miles (two miles in length and one mile in width) in size, the center of which is located approximately 6.24 miles northwest of the West Breakwater Light at a bearing of N61.1994°W (azimuth 299°). It is directly north of the existing, authorized Rocky River Harbor open-lake placement area. Average depth in the area is approximately 55 feet below LWD. As with CLA-1, currents and velocities at this area are principally driven by meteorological conditions, and velocities are unstratified and are predominantly in an easterly or east-northeasterly direction running parallel to the shoreline (USAERDC 2013a).

3.2 FISH AND WILDLIFE RESOURCES

3.2.1 Habitat – Habitat in the open lake environment at CLA-1 and CLA-4 consists of a deep, warm water aquatic ecosystem with a mud-bottom substrate. The substrate at these areas consists mainly of silts and clays (USACE 2013a). This habitat supports biological communities in the benthic zone, water column and near the water surface.

3.2.2 Benthic Community – A detailed description and assessment of the benthic macroinvertebrate communities in the vicinity of CLA-1 and CLA-4 is contained in Kennedy *et al.* (2014). Four sediment grab samples were collected from both CLA-1 and CLA-4 to characterize their benthic communities. The most abundant phylum identified was the segmented annelid worms, which consisted of three genera from the oligochaete family (Tubificidae) and one specimen from the leech family (Glossiphoniidae). The second most abundant phylum was Arthropoda (e.g., insects, crustaceans), which was represented only by the insect family Chironomidae (midges). Mollusks were the third most abundant phylum, consisting of sphaeriid clams and dreissenid (zebra/quagga) mussels. Finally, the phylum Nematoda (segment-less worms) was represented by only four individual specimens (<2 percent of total). Benthic communities at CLA-1 and CLA-4 were comparable in terms of abundance and total species richness. Taxonomic composition of the areas was fairly similar, with slight dissimilarity occurring due to presence/absence of leeches (one specimen in one sample), dreissenid mussels (present in one sample), and Nematode worms (present in two samples). Differences in diversity and similarity between the two areas were caused by the greater diversity of tubificid worm genera at CLA-1 and

the greater diversity of chironomid genera at CLA-4. Overall, the benthic macroinvertebrate communities at the areas were similar, with slightly greater diversity at CLA-4. The communities in both areas had a relatively low density and low taxonomic richness, and the majority of the organisms are considered pollution tolerant.

3.2.3 Water Column Community – The water column community at CLA-1 and CLA-4 is typical of deep-water Lake Erie environs and consists of native and non-native planktonic (phytoplankton and zooplankton) and nektonic (fish and other free-swimming organisms) species. An overview of the aquatic community of Lake Erie has been prepared by the National Oceanic and Atmospheric Administration (NOAA) and is available at the following website (NOAA, 2014a): http://www.glerl.noaa.gov/pubs/brochures/foodweb/LEfoodweb.pdf

3.2.4 Plankton

The phytoplankton composition and abundance in Lake Erie is largely driven by season and cultural eutrophication. The lake's planktonic community has historically been tolerant of eutrophic conditions, which infers a naturally productive environment. In general, it is dominated by diatoms and green algae in the Spring and can become substantially influenced by blue-green algae in the Summer. The zooplankton community is typically dominated by various water flea, copepod and rotifer species.

3.2.5 Fisheries

a. Community. Fish species using the open-lake areas largely depends upon season, but some of the more common forage species include rainbow smelt (*Osmerus mordax*), emerald shiner (*Notropis atherinoides*), lake whitefish (*Coregonus clupeaformis*), yellow perch (*Perca flavescens*), alewife (*Alosa pseudoharengus*), gizzard shad (*Dorosoma cepedianum*), freshwater drum (*Aplodinotus grunniens*) and round goby (*Neogobius melanostomus*). Common predatory species may include species such as walleye (*Sander vitreus*) and white bass (*Morone chrysops)* (NOAA, 2014).

In a letter dated January 17, 2014 the ODNR indicated that the open lake locations identified are eligible for Statewide In-Water Work Restrictions associated with Percids (e.g., walleye). The ODNR Division of Wildlife recommended that no in-water work take place between March 15 and June 30 to reduce impacts to indigenous aquatic species and their habitat. They concluded that "if specific Best Management Practices (BMPs) to reduce the impacts of sediment resuspension are incorporated into the proposed project, the project may qualify for a waiver of a portion or all of the In-Water Work Restrictions."

b. Polychlorinated Biphenyl (PCB) Contamination in Fish Tissue. Total PCB fish tissue concentrations in Lake Erie fish often exceed several thresholds:

1) **23 µg/kg** – OEPA Clean Water Act 303[d] human health beneficial use impairment (BUI) threshold for the Lake Erie Basin.
2) **50 µg/kg** – OEPA fish consumption advisory (FCA) threshold for "eat no more than one meal per week" advisories.
3) **100 µg/kg** – Great Lakes Water Quality Agreement (GLWQA) threshold for the protection of avian and wildlife consumers of fish.
4) **160 µg/kg** – USEPA wildlife protection value (OEPA 2013; USACE 2013b).

While sediment PCB contamination is a well-recognized pathway with respect to bioaccumulation by fish, weight-of-the-evidence suggests that these impaired tissue residues are substantially influenced by existing Lake Erie background concentrations of PCBs in the water column (USACE 2013b). For example, measured total PCB concentrations in Lake Erie water exceed existing OEPA chronic WQSs that are protective of fish tissue (i.e., 0.12 ng/L for the protection of wildlife; 0.026 ng/L for the protection of human health) (USACE 2010, USACE 2011). Major sources of PCB contamination to the Great Lakes are air deposition and the larger tributaries. Offenberg *et al.* (2005) found that urban influenced air-water exchange fluxes dominate PCB lake water budgets.

3.2.6 Aquatic Birds – The location of CLA-1 and CLA-4 is at the intersection of principal routes of the Atlantic Flyway, which are major migration routes for at least 22 species of waterfowl. Ten of these species are seasonally common within and around Cleveland and may periodically be found further out in Lake Erie, especially in the winter months prior to the lake freezing over. In the winter months many such species could also be located closer to shore near warm water discharge points which prevent or delay surface freezing. Notable waterfowl may include mallard (*Anas platyrhynchos*), redhead (*Aythya americana*), canvasback (*Aythya valisineria*), greater scaup (*Aythya marila*), lesser scaup (*Aythya affinis*), common goldeneye (*Bucephala clangula*), bufflehead (*Bucephala albeola*), ruddy duck (*Oxyura jamaicensis*), common merganser (*Mergus merganser*) and red-breasted merganser (*Mergus serrator*). Other aquatic birds that may be found in the area include Canada geese (*Branta canadensis*), horned grebe (*Podiceps auritus*), pied-bill grebe (*Podilymbus podiceps*), American coot (*Fulica americana*), herring gull (*Larus argentatus*), ring-billed gull (*Larus delawarensis*), common tern (*Sterna hirundo*) and Caspian tern (*Sterna caspia*).

3.3 THREATENED AND ENDANGERED SPECIES – In a letter dated September 12, 2013, the U.S. Fish and Wildlife Service (USFWS) indicated that the project lies within the range of the Indiana bat (*Myotis sodalis*), Kirtland's warbler (*Setophaga kirtlandii*), and piping plover (*Charadrius melodus*), federally listed endangered species. The letter further indicated that the project lies within the range of the bald eagle (*Haliaeetus leucocephalus*), a species protected under the Bald and Golden Eagle Protection Act (16 USC 668-668d) and the Migratory Bird Treaty Act (16 USC 703-712). These species are not present at either of the proposed open lake placement areas, except perhaps as passerines.

In correspondence dated January 17, 2014, ODNR noted a number of federal and potential state-listed rare and endangered species in the vicinity of Cleveland Harbor, including Peregrine falcon (*Falco peregrinus*), Canada darner (*Aeshna canadensis*), black bear (*Ursus americanus*) and king rail (*Rallus elegans*). In addition, they noted that the state-threatened Richardson's Pondweed (*Potamogeton richardsonii*) has been documented to occur in Cleveland Harbor. However, according to information stored in the ODNR Division of Wildlife's Natural Heritage Database, the occurrence of this species was last documented in 1991. Based on data stored within the Natural Heritage Database, it may no longer qualify for state-threatened status and could be de-listed to potentially threatened in 2014. None of the above-listed species are known to occur at either of the proposed open lake placement areas. The ODNR Natural Heritage Database has no other records for rare or endangered species at this project site, and are unaware of any unique ecological sites, geologic features, animal assemblages, scenic rivers, state wildlife areas, nature preserves, parks or forests, national wildlife refuges or other protected natural areas within the project area. However, a lack of records for any particular area is not a statement that rare species or unique features are absent from that area.

3.4 SEDIMENT QUALITY

3.4.1 Sampling and Analyses of Upper Cuyahoga River Channel and Cleveland Open-lake Vicinity Sediments – A large scale sampling and testing effort was completed on the Upper Cuyahoga River Channel and at open water sites CLA-1 and CLA-4 in 2012. The following is a brief summary of the results from this effort (USACE 2013a):

• Discrete surface sediment samples using a Peterson grab were collected from the Upper Cuyahoga River Channel across three dredged material management units (DMMUs) designated as DMMU-1, DMMU-2a and DMMU-2b (Appendix A, Figure X). In addition, discrete surface grab samples were collected from CLA-1 and CLA-4 (Appendix A, Figure X). Discrete samples were combined for composite samples of the DMMU and open-lake area sediments.

• Discrete sediment sample testing generally included: (1) bulk grain size (sieve and hydrometer) and percent moisture; (2) target analyte list (TAL) metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, thallium, vanadium and zinc); (3) inorganics total cyanide (CN), ammonia-nitrogen (ammonia-N or NH_3), total phosphorus (TP), total Kjedlahl nitrogen (TKN), total organic carbon (TOC), percent organic matter (POM); (4) organics PCBs (as Aroclors), pesticides and polycyclic aromatic hydrocarbons (PAHs) (16 USEPA priority pollutants and methylnaphthalenes); and (5) miscellaneous, including simultaneously extracted metals/acid volatile sulfides (SEM/AVS), benzene-toluene-ethylbenzene-xylenes (BTEX), solid-phase microextraction (SPME) fiber burdens and total extractable hydrocarbons.

• Composite sediment sample testing generally included: (1) bulk grain size (sieve and hydrometer) and percent moisture; (2) TAL metals; (3) inorganic CN, NH_3, TP, TKN, POC and TOC; (4) organics, PCBs (as Aroclors and congeners), pesticides and PAHs (16 USEPA priority pollutants and methylnaphthalenes); (5) miscellaneous, including SEM/AVS, SPME fiber burdens and total extractible hydrocarbons; (6) analysis of sediment pore water for 34 PAHs including many of the most common parent PAH compounds and many alkylated PAH compounds frequently found in PAH mixtures; (7) standard10-day solid phase *Hyalella azteca* (amphipod) and *Chironomus dilutus* (midge fly) toxicity tests (bioassays) with survival, and survival and growth, as biological measurement endpoints, respectively; (8) standard 28-day *Lumbriculus variegatus* sediment bioaccumulation tests for PCB congeners and the pesticides dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethylene (DDE) and dichlorodiphenyldichloroethane (DDD), including analysis of lipid content; (9) standard 48-hour *Ceriodaphnia dubia* (water flea) and 96-hour *Pimephales promelas* (fathead minnow) water column bioassays with survival as the biological measurement endpoint (if required, toxicity reduction evaluations [TRE] were performed for these water column bioassays); and (10) elutriate testing including a standard elutriate test (SET) and modified elutriate test (MET) on DMMU and select discrete samples for TAL metals, CN, NH_3, TP, TKN, TOC, water hardness (usually), total suspended solids (TSS), turbidity, PCBs (as Aroclors), pesticides and PAHs (16 USEPA priority pollutants and methylnaphthalenes). In addition, a lake water sample was analyzed for TAL metals, CN, NH_3, TP, ortho-phosphate, TKN, TOC, TSS, water hardness, turbidity, PCBs (as Aroclors), pesticides and PAHs (16 USEPA priority pollutants and methylnaphthalenes).

Data generated under the above effort are presented, described and evaluated in USACE (2013a).

3.4.1.1 CLA-1 and CLA-4 Sediments

a. Bulk Contaminant Concentrations. USACE (2013a, 2013b) discusses bulk sediment contaminant concentrations at CLA-1 and CLA-4 in detail. Sediment contamination at these open-lake areas is typical and within the range of what exists in the deep-water Lake Erie environs (USACE 2013b). For example, average total PCB (Aroclor sum) concentrations ranged from 120 to 132 µg/kg, and average total PAH concentrations ranged from 1.77 to 4.9 mg/kg (9.68 mg/kg when including an outlier; see USACE 2013a). While these concentrations are higher than those measured at a previous Cleveland Harbor open-lake reference area referred to as CLA-R07 (USACE 2007) as expressed by OEPA (2013-)], average CLA-1/CLA-4 organic carbon (OC)-normalized total PCB (5161 µg/kg-OC) and PAH (143 mg/kg-OC) concentrations are still comparable to the respective averages of 4682 µg/kg-OC and 199 mg/kg-OC across open-lake reference areas offshore of Rocky River, Fairport and Ashtabula (USACE 2013b).

Although CLA-1 was used for dredged material placement more than 45 years ago, more than a foot of sediment deposition would be expected to have buried any past dredged material over time below the depth of the 2012 sampling. A comparison of historic bulk sediment data on this area to recent data shows that contamination in surficial sediments has declined over time (e.g., Sweeney, et al 1975 vs. USACE 2013a). For example, average bulk sediment concentrations of cadmium, chromium and mercury in surficial sediment samples show a net decline between 1973 (7.9, 94 and 0.66 mg/kg, respectively) and 2013 (3.2, 56.2 and 0.18 mg/kg, respectively).

b. Biological Toxicity. USACE (2013a, 2013b) discusses the results of bioassays applied to CLA-1 and CLA-4 sediment in detail. Standard bioassay data using *H. azteca* and *C. dilutus* as benthic test species showed no significant acute toxicity associated with bottom sediments at CLA-1 and CLA-4 as they yielded high survivals (*H. azteca* range 84±15 to 92±11%; *C. dilutus* range 88±5 to 90±10%) and growth (*C. dilutus* range 1.69±0.14 to 1.72±0.16 mg) (USACE 2013a and 2013b). Note that the application of these two bioassays on CLA-R07 sediments yielded similar results (*H. azteca* survival 88±13%; *C. dilutus* survival 94±13 and growth 1.01±0.16 mg) (USACE 2013b), thus demonstrating that the toxicity of sediments across CLA-1, CLA-4 and CLA-R07 is unremarkable and inconsequential.

3.4.1.2 Upper Cuyahoga River Channel Sediments

a. Bulk Contaminant Concentrations. USACE (2013a, 2013b) discusses bulk sediment contaminant concentrations in DMMU-1, DMMU-2a and DMMU-2b sediments in detail. Contamination in these management unit sediments is typical of what would be expected in a present day industrial harbor in the Great Lakes. For example, nickel was measured at one discrete site in DMMU-1 at a concentration of 139 mg/kg, which is about double that of CLA-1/CLA-4 (up to 59.1 mg/kg). Average total PCB (Aroclor sum) concentrations ranged from 92.8 to 125 µg/kg, which were similar to the average concentrations observed at CLA-1 (132 µg/kg) and CLA-4 (120 µg/kg) (USACE 2013b). Average total PAH concentrations ranged from 8.28 mg/kg (DMMU-1) to 12.8 mg/kg (DMMU-2a). These concentrations were higher than the average concentrations at CLA-1 (4.9 mg/kg) and CLA-4 (1.77 mg/kg; 9.68 mg/kg when including an outlier; see USACE 2013a). Toluene concentrations in the management unit sediments were quite variable and higher at

values ranging from 0.23 to 14,500 µg/kg. These concentrations were well over those observed at CLA-1 and CLA-4 (<0.092 to <92.7 µg/kg) (USACE 2013a).

b. Biological Toxicity. USACE (2013a, 2013b) discusses the results of bioassays applied to DMMU-1, DMMU-2a and DMMU-2b sediments in detail. The standard benthic *H. azteca* and *C. dilutus* bioassays showed no significant acute toxicity associated with these management unit sediments as they yielded high survivals (*H. azteca* range 82±25 to 94±6%; *C. dilutus* range 80±7 to 90±10%) and growth (*C. dilutus* range 2.17±0.30 to 3.51±0.12 mg) (USACE 2013a and 2013b). These data demonstrate that these management unit sediments are not acutely toxic and that the concentrations of PAHs (and toluene) are not of significant toxicological concern. Discussions pertaining to the potential chronic toxicity of these sediments are included in Section 4.2.3 and are addressed in detail in USACE (2013b).

3.5 WATER QUALITY – Water quality at CLA-1 and CLA-4 is typical of what normally exists in the deep-water Lake Erie environs. USACE (2013a) contains analytical data on samples collected from the water column offshore of Cleveland. Except for PCBs (Section 3.2.5 and USACE 2013b), such data typically indicate that all measured water quality parameters (e.g., metals, nutrients, PAHs, PCBs, pesticides), are undetectable and/or below Ohio WQSs for the protection of aquatic life. Standard laboratory water column bioassays using *C. dubia* and *P. promelas* as test species show no significant acute toxicity associated with lake water as they yielded high survivals (i.e., *C. dubia* 80%; *P. promelas* 100%) (USACE 2013a).

3.6 AIR QUALITY – The potential project area lies within the Ohio Air Quality Control Region (AQCR) referred to as Cleveland number 174. Boundaries for each region were set by consideration of air pollution levels, population density, geography, and common meteorological conditions. As indicated in the Ohio Air Quality Report, the following criteria pollutants were monitored: particulate matter smaller than or equal to 10 micrometers (µm) (PM10), particulate matter smaller than or equal to 2.5 (µm) (PM 2.5), sulfur dioxide (SO2), nitrogen dioxide (NO2), carbon monoxide (CO), ozone (03), and lead (Pb) (OEPA 2010a). In 2010, Cuyahoga County was designated a nonattainment area for ozone (eight-hour) and PM 2.5 (particulate matter under 2.5 micrometers).

3.7 TRANSPORTATION – Cleveland Harbor is a major receiving and shipping port on the Great Lakes and is a Critical Harbor of Refuge. The harbor is the 50th leading U.S. port based on 2011 data and is ranked 6th among Great Lakes Harbors based on five-year (2006 – 2010) average tonnage, with a five year average of 11.1 million (M) tons of material shipped and received. Bulk commodities that pass through the harbor generate $1.7 billion (B) annually in direct revenue while supporting 15,003 direct, indirect and induced jobs that produce over $1B per year in personal income (USACE 2013c). Major commodities shipped or received include iron ore, limestone, sand and gravel, salt, cement and concrete, general cargo and liquid bulk. The harbor contains a major iron ore transshipment facility located in the Outer Harbor. This facility provides iron ore to inland steel mills at lower delivery costs when compared to truck or rail delivery. The Burke Lakefront Airport (BKL) is also located along the shoreline of Lake Erie in Cleveland adjacent to the existing federal CDFs. The majority of this airport's air traffic is privately owned and charter aircraft along with flight training, leisure flying, and military operations among others (Burke Airport, 2014). The proposed open lake placement areas in Lake Erie are greater than five miles away from this airport. See Section 4.3.6 of this EA for additional information with respect to BKL.

3.8 PUBLIC SERVICES AND FACILITIES - Four potable water intakes (PWIs) for public water supplies are located in the lake just offshore of Cleveland, including the Crown, Morgan, Baldwin and Nottingham structures (Appendix A, Figure 7). Depths at these intakes range from about 45 to 50 feet below LWD, and water is typically drawn at depths ranging from 34 to 45 feet below LWD or about 10 feet above the sediment bed. Background TSS in the water column averages about 5 mg/L (USAERDC 2013a). The center of CLA-4 is located approximately 3.8 miles from the Crown PWI, 3 miles from the Morgan PWI, 3.7 miles from the Baldwin PWI and 11.5 miles from the Nottingham PWI. The center of CLA-1 is located approximately 11.8 miles from the Crown PWI, 6.9 miles from the Morgan PWI, 6.7 miles from the Baldwin PWI and 5.8 miles from the Nottingham PWI.

3.9 WETLANDS – The proposed open lake placement areas at CLA-1 and CLA-4 are both deep water environments and do not contain any wetland areas.

3.10 TERRESTRIAL VEGETATION – The proposed open lake placement areas at CLA-1 and CLA-4 are both aquatic environments and do not contain any terrestrial vegetation.

3.11 CULTURAL RESOURCES – Site CLA-1 has historically been used for the placement of dredged material. Material was placed in this area during dredging operations from the time the harbor was constructed until the late 1960's and prior to the implementation of the Clean Water Act. This particular area has therefore experienced significant past ground disturbance, and therefore is unlikely to contain any submerged resources that have not been previously impacted (i.e. covered). Site CLA-4 has not been used in the past as a dredged material placement area. Therefore, in accordance with 36 CFR 800.4(b)(1), a reasonable and good faith effort was conducted by USACE to identify any possible significant submerged resources located within or adjacent to CLA-4. An extensive search of literature and databases was conducted to discern areas where shipwrecks have occurred throughout Lake Erie, and more specifically in the vicinity of CLA-4. This effort included the review of appropriate literature and databases regarding Great Lakes shipwrecks, and consultation with appropriate agencies/organizations. Primary resources referenced during the literature search included *Erie Wrecks East* (Wachter, 2003) and *Erie Wrecks West* (Wachter, 2001). No records of shipwrecks were identified by these references in the vicinity of CLA-4. Also referenced during this effort was *The Great Lakes Shipwreck File: Total Losses of Great Lakes Ships 1679 – 2001* (Swayze 2011). This large, comprehensive database identifies and describes several thousand shipwrecks of historical significance documented in the Great Lakes. No documented shipwrecks were identified in the vicinity of CLA-4 as a result of this database search. The closest identified wreck was the "H.G. Cleveland" which is roughly 1.5 miles south of CLA-4.

In an effort to further identify any potential submerged resources in the vicinity of CLA-4, the USACE conducted a hydrographic survey of the area. This survey utilized both multi-beam soundings and side-scan sonar in an effort to identify any resources of concern that have not been previously documented. A total of 55 transects were run through the site to cover the entirety of the area of potential effect. No potential resources were identified as a result of these efforts. Coordination with the Ohio State Historic Preservation Office (SHPO) was conducted through the NEPA scoping and the Clean Water Act Section 404 public notice processes, although no comments were received from the SHPO as a result of this coordination. In addition, a Section 106 Project Summary Form and Effects Determination was submitted to the SHPO on February 19, 2014.

SECTION 4 – ENVIRONMENTAL IMPACTS

4.1 SITE CONCEPTUAL MODEL

This site conceptual model is intended to facilitate a focus on potential impacts that could occur as a result of the placement of the dredged material at CLA-1 and CLA-4. Both areas are two square miles in size and have water depths between 55 and 62 feet below LWD. Aquatic habitats at these two open-lake placement areas are similar and consist primarily of warmwater, mud or finer-grain-bottom benthic substrate with overlying water column. Site CLA-1 has been previously used for the placement of material dredged from Cleveland Harbor over 45 years ago; however, the formerly placed dredged material is covered by an estimated at least one foot of fine-grain sediment. Bottom sediments at these areas are colonized by a community of benthic invertebrates that are relatively low in species diversity and dominated by oligochaetes and chironomids. The water column at these areas is used by most plankton and nekton (including fish) on a transient basis as required for foraging and movement. Aquatic birds use the water surface and water column on a transient basis for resting and foraging. Examples of key biological receptors at these open-lake areas include pelagic and/or demersal fish species such as walleye, yellow perch and rainbow smelt.

Material from the Upper Cuyahoga River Channel would be dredged using mechanical equipment (clamshell bucket), then placed in a scow for transport and placement at CLA-1 and/or CLA-4. Dredged material placement operations would typically occur between May 1 and December 30, with the majority normally taking place over an approximately eight week period in May and June. The dredged material to be discharged is composed of a sands, silts, clays and water with residual bulk concentrations of contaminants and organic matter, and is similar in composition to the substrates at CLA-1 and CLA-4. During placement, dredged material would be released from the scow and rapidly descend through the water column and entrain water as it approaches the lake bottom, and strip clouds of fluidized material. The material would hit the bottom substrate, then collapse, entrain more water and spread out, come to rest on the lake bottom and release more fluidized material. The combined release of fluidized material in the decent and collapse of the material generates a short-term turbidity plume composed mainly of suspended solids and water. Contaminant-related impacts can occur in the water column, benthic and pelagic environs, and are assessed mainly through toxicity and bioaccumulation endpoints relative to biological receptors. Typical exposure pathways between the dredged material and receptors would include uptake through absorption (bioconcentration) and absorption/ingestion (bioaccumulation), and trophic transfer through bioaccumulation. With respect to contaminant-related impacts in the water column, effects require exposure to biota and include the release of dissolved contaminants from the dredged material and turbidity, both of which are short-term events. With respect to contaminant-related benthic impacts associated with the placed dredged material, effects require exposure to biota and include toxicity and bioaccumulation. Regarding dredged material movement on the lake bottom, the placed sediment would behave in a manner similar to the adjacent and surrounding lake bottom sediments; deep depths of the open-lake placement areas would serve to allay the potential for sediment erosion, resuspension and movement.

This section presents the environmental impact assessment of the proposed project. The project is evaluated for engineering and economic feasibility, environmental and social acceptability, and for best meeting project planning objectives to maintain unrestricted commercial navigation in Cleveland Harbor.

4.2 PHYSICAL/NATURAL ENVIRONMENT IMPACTS

4.2.1 Air Quality

No Action (Without Project Conditions) - Since this alternative may involve no dredging or dredged material management, air quality in the vicinity of the harbor would continue to be similar to existing conditions. There would be no project-related exhaust emissions from construction equipment that could contribute to the degradation of air quality.

In the event the harbor was not dredged due to lack of a suitable dredged material disposal location, its viability for commercial navigation would diminish over time especially in the Upper Cuyahoga River Channel. Associated commodities would therefore need to be moved by alternative modes of transportation, such as rail or truck. Truck and rail transport is much less efficient than that of a Great Lakes carrier. A Great Lakes carrier travels 607 miles on one gallon of fuel per ton of cargo, compared to 202 miles for a freight train and 59 miles for a truck. In one delivery, a Great Lakes carrier supplies 70,000 tons of cargo, which would require nearly 3,000 semi-truck loads. This vastly reduces fuel consumption. More importantly, a cargo of 1,000 tons transported by a Great Lakes carrier produces 90 percent less carbon dioxide as compared to the same cargo transported by truck and 70 percent less than the same cargo transported by rail (USACE 2009b). Therefore, the reduction in navigable depth and eventual closing of the harbor would likely increase annual emissions rates by up to 207,000 tons of harmful particulate matter (PM-10) (USACE 2013c).

Selected Plan - The operation of dredging equipment (i.e., one tugboat, generators on scows) associated with open lake placement operations would result in only a minor, short-term (8-12 weeks/year), localized increase of air emissions into the local atmosphere (i.e., suspended particulates, nitrogen dioxide, carbon monoxide, etc.). This increased output is not expected to result in any violations or interfere with the ability of the AQCR to attain State air quality standards, including for ozone (eight-hour) or PM 2.5 for which it is currently in nonattainment. The need for a conformity determination on this proposed activity is likely not applicable (pending USEPA concurrence) since the proposed action is considered part of routine maintenance dredging of a federal harbor where no new depths are required and disposal will be at an approved location pending completion of this EA/FONSI and applicable state approvals (40 CFR Part 93.153). Additionally, the amount of emissions associated with open lake placement will be substantially less than what would be generated through CDF placement on an annual basis, which involves additional equipment (e.g., trucks, dozers) to mechanically off-load scows and move material around within the CDFs.

4.2.2 ***Water Quality***

No Action (Without Project Conditions) – Since this alternative may involve no dredging or dredged material management, there would be no potential for any adverse impacts relating to water quality.

Selected Plan – Open-lake placement of this dredged material would result in no significant water quality-related adverse impacts. All adverse impacts in this regard would be minor, very localized, and short-term. In general, impacts would include a temporary generation of turbidity, minor releases of sediment contaminants and variations of dissolved oxygen levels in the water column over a relatively small portion of the open-lake placement areas. The following sections address several specific water-quality related impacts associated with the selected plan.

4.2.2.1 Turbidity and Dredged Material Migration

Open-lake placement of dredged material would result in the generation of localized and temporary turbidity in the water column. The instantaneous discharge of mechanically dredged sediment from a scow creates a plume of suspended particles composed of clouds of stripped material during descent, dispersed and spreading of the material on the lake bottom. The dredged material is composed of cohesive clumps, sands, gravels, coarse organic matter, aggregates of silts/clays, and disaggregated silt and clay particles and fine organic matter. The turbidity plume is formed from disaggregated silt/clay particles and fine organic matter, while all of the other components in the material settle and deposit rapidly on the lake bottom. Based on Short-Term Fate (STFATE) simulation modeling, TSS concentrations in the plume suspended above the collapsed dredged material would initially be about 1,500 mg/L. The particles in suspension are predicted to settle and disperse rapidly. Under both typical low as well as stormy high velocity conditions, TSS concentrations would decline from 35 mg/L to 0.77 mg/L above background (about 15 percent above background water column TSS) at 6,500 and 16,000 feet from the placement site, respectively. The initial plume diameter would be about 330 feet and would increase to about 1,650 feet as it is transported three miles from the point of discharge. Depending on velocity, the plume would take 20 to 60 minutes to pass by a point that is three miles from the point of discharge (e.g., the nearest PWI). At this distance the plume would be close to decaying to a background TSS of 5 mg/L. In a letter dated September 9, 2013, the University of Akron expressed a concern that the dredged material placed at CLA-1 and CLA-4 had the potential to become remobilized and move, particularly during large storms and when considering some difference in sediment grain size (Appendix B). Movement of the dredged material and any associated turbidity (i.e., from resuspended dredged sediments) following active open-lake placement would not occur because the bottom shear stress at both CLA-1 and CLA-4 are too small to erode the deposited material, even under severe storm conditions (USAERDC 2014b). This is attributable to the deep depths of these areas, which are too great to be influenced by surface waves and where circulation velocities are low.

4.2.2.2 Aquatic Life

a. Short-term impacts—Open-lake placement of this dredged material would result in negligible to minor, short-term water quality-related adverse impacts to aquatic life. Open-lake placement via scow at CLA-1 and CLA-4 is an acute (a matter of minutes to hours) and discontinuous (intermittent) discharge event that would result in short-term releases of contaminants from the dredged material to the water column through a contaminant plume. These discrete discharges are repeated about every six hours throughout the duration of the dredging project (up to about eight weeks in Spring, two weeks in Fall). These contaminant releases were conservatively predicted through a standard elutriate test (SET), and were further evaluated through two standard elutriate bioassays in the laboratory using a water flea and fathead minnow as test species. All contaminant concentrations measured through the SET complied with applicable Ohio WQSs for the protection of aquatic life without the need for dilution (see Tables 5 – 8 of the Section 404[b][1] Evaluation [Appendix B]), except ammonia and toluene. In a letter dated September 9, 2013, the University of Akron pointed out that ammonia (in the NH_3 form) can be toxic to aquatic organisms. Upon consideration of the mixing available within the boundaries of the placement areas, the concentrations of both ammonia and toluene were predicted to be rapidly diluted in the water column mixing zone such that they would not result in any significant toxicity to aquatic life (USACE 2013a). They were also predicted to comply with all applicable Ohio WQSs for the

protection of aquatic life well before the plumes reach the boundaries of the placement areas. The results of the two standard elutriate bioassays indicated that open-lake placement of the dredged material would not result in any significant adverse, short-term impacts to aquatic life and that the initial toxicity was attributable to ammonia (USACE 2013a).

b. Long-Term Impacts—No significant long-term impacts on water quality would occur through the placement of this dredged material at CLA-1 and CLA-4. The dredged material quality is comparable to existing sediment quality at the open-lake areas in grain size distribution and overall degree of contamination. While some bulk concentrations of contaminants (e.g., PAHs) are somewhat higher in the dredged material in comparison to sediment at the open-lake areas, they are well within the range of other offshore sediments in the open-lake vicinity (USACE 2013a, 2013b). When placed at the open-lake areas, modeling showed that the dredged material is not predicted to erode or resuspend, and it therefore would not release contaminants or nutrients (USAERDC 2014b). The assimilative capacity of the water column is sufficient to accommodate the diffusion of the constituents in the dredged material without impacting water quality at the placement areas.

4.2.2.3 Human Health

a. Open-Lake Areas—Open-lake placement of this dredged material would result in no significant water quality-related adverse impacts with respect to human health. A comparison of the sediment SET data to applicable Ohio WQSs for the protection of human health is provided in Tables 5 – 8 of the Section 404[b][1] Evaluation (Appendix B). In a letter dated November 4, 2013, OEPA suggested that open-lake placement would potentially violate the Ohio PCB WQS for the protection of human health (Appendix B). The USACE responded by indicating that open-lake placement would comply with all Ohio WQSs for PCBs (USACE 2013b). PCBs tend to be tightly adsorbed to sediment (and TOC), and do not easily release to and dissolve in the water column (i.e., they are very hydrophobic and insoluble). The SET results consistently showed that PCBs were non-detectable (below Ohio's practical quantitation limit of 0.5 µg/L) in all dredged material composite samples. The non-detectable concentrations of PCBs yielded in the SET would be expected based on the low concentrations of PCBs in the dredged material. In addition, open-lake placement would result in acute, discrete, non-continuous contaminant releases and are inappropriately evaluated by comparisons to chronic PCB WQSs such as that for human health. These discharges would dilute rapidly and approach background water column concentrations of PCBs within a few hours.

b. PWIs – All referenced correspondence in this section may be found in Appendix D to this EA. In an e-mail dated August 15, 2013, the Northeast Ohio Regional Sewer District (NEORSD) expressed concern that open-lake placement of this dredged material could affect the quality of water at the Crown PWI due to its proximity to CLA-4. In an e-mail dated September 12, 2013, the city of Cleveland (Cleveland Water) noted that storm conditions could result in the migration of material from the open-lake placement areas and requested the opportunity to review the modeling . They further requested that the modeling include the Crown PWI, and noted an opposition to the use of any open-lake placement area that could impact the quality of the city's raw water. In a letter dated September 14, 2013, USEPA recommended that any open-lake placement alternative evaluate any impacts on safe and reliable functioning of public drinking water supplies. Further, they recommended that modeling should consider the potential for placement activities to generate plumes under different weather conditions affecting winds and lake currents, including reasonable foreseeable worst-case conditions. The OEPA made a similar recommendation in a letter dated September 13, 2013. Finally, the University of Akron on September 9, 2013, recommended that CLA-4 not be considered for dredged material placement due to the potential for wind-driven

currents in the lake to drive fine sediment particles toward PWIs located to the east.

The water depths of CLA-1 and CLA-4 are sufficiently deep that the sediment on the lake bed will not be strongly affected by wave action (USAERDC 2013a). Further, water velocities are generally too low to generate sufficient bottom sheer stress to resuspend bedded sediments or keep dredged material discharge plumes in suspension. To address concerns relating to the potential impacts of open-lake placement of dredged material on the quality of water at PWIs, USAERDC completed modeling to evaluate the potential associated transport of total suspended solids (TSS) and dissolved constituents from CLA-1 and CLA-4 to the Crown, Morgan, Baldwin and Nottingham PWIs, the results of which are summarized below (USAERDC 2013a, USAERDC 2013c):

(1) *Transport of Dredged Material Solids During Active Placement at the Open-lake Areas (Short-Term)* – Total Suspended Solids and dissolved constituents are detrimental to water treatment and can increase costs and impair finished drinking water quality. Dissolved organic constituents increase the required disinfectant dosages and the formation of harmful disinfection by-products. Modeling showed that solids and dissolved constituents losses resulting from dredged material placement at these two areas are not expected to have any significant impact on water column TSS concentrations at these PWIs. Under the worst-case scenario modeled for CLA-4, TSS contributions of up to one mg/L from dredged material placement would occur at the Morgan PWI only about one percent of the time during annual placement operations lasting up to eight weeks (Spring dredge) (USAERDC 2013a). The duration of the contributions from a placement event typically lasts less than an hour. During this time period, water column TSS would increase less than 15 percent from eight mg/L (background) to nine mg/L. During these same time periods, TOC at the Morgan PWI is predicted to increase less than five percent and the dissolved organic content is predicted to increase less than two percent. No measurable TSS contributions are expected to occur at any of the other PWIs. Similarly, no measureable TSS contributions are expected to occur at any of the four PWIs from dredged material placement operations at CLA-1.

Note that the hydrodynamic data used for this modeling represents currents that could potentially occur in May. Stronger currents tend to occur in April and could occur in May as well. It is estimated that stronger currents typical in April might increase background concentrations by approximately 30 percent. Nevertheless, TSS contributions from dredged material placement would still be expected to be around 15 percent above background and would occur with similar frequency. Additional modeling was employed to ascertain dissolved contaminant contributions at the PWIs from fine-grained and organic matter attributable to the open-lake placement of this dredged material (USAERDC 2013c). As a worst-case scenario, this effort used the maximum increased water column TSS concentration that may occur at the Morgan PWI from placement of dredged material at CLA-4, along with the highest measured, normalized bulk contaminant concentrations associated with fine-grained and organic matter. All calculated dissolved phase contaminant concentrations were below National Primary Drinking Water Regulation Maximum Contaminant Levels (MCLs) (USEPA 2014b) and Drinking Water Standards for Ohio Public Water Systems (OEPA 2010b). The very conservative approach used in these modeling efforts indicate that no meaningful contribution of suspended solids, dissolved constituents or contaminants from dredged material placement operations at CLA-1 and CLA-4 would be expected at any PWI.

(2) *Transport of Dredged Material Solids after Placement at the Open-lake Areas (Long-Term)* – No additional solids contributions to the PWIs are expected after the active placement

operations and CLA-1 and CLA-4 are concluded. Typical circulation velocities are about 0.2 feet per second (fps) and maximum circulation velocities are less than 0.4 fps. With these currents, the density and cohesion of the settled dredged material are sufficient to restrict erosion and resuspension of the deposited dredged material. Peak velocities under severe sustained storm events such as Super Storm Sandy produced velocities of 1.0 to 1.2 fps (NOAA 2014b). These velocities are sufficient only to resuspend the disaggregated clay fraction of the dredged material (less than 0.3 percent of all solids) which would no longer be present at the open-lake areas following dispersion during active placement. Finally, water depths at CLA-1 and CLA-4 are too deep for surface waves from storm winds to meaningfully increase the bottom shear stress and cause erosion of the dredged material (USAERDC 2014b).

(3) *Potential Influence of Dissolved Ammonia on Breakpoint Chlorination*—In a letter dated September 9, 2013, the University of Akron expressed concerns that the release of ammonia from the dredged material to the water column at CLA-4 could influence breakpoint chlorination and result in either increased disinfection byproducts (DBPs), or reduced disinfection and increased water-borne pathogens (Appendix D). Elutriate testing and conservative water column modeling through STFATE examined the potential impacts of ammonia releases from the dredged material on the water quality at the PWIs that would result from placement at CLA-4 (USAERDC 2013b). During active dredged material placement, concentrations of ammonia were predicted to increase less than 30 percent at the Morgan PWI for one percent of the time during 15 percent of the year, or about 12 hours per year. Impacts in this regard at the other PWIs were predicted to be much less. These impacts are not considered significant.

4.2.2.4 HABs

Given the current increase of Lake Erie algal blooms and because the dredged material contains phosphorus and would result in a release of phosphorus during open-lake placement, it is important to evaluate whether open-lake placement could potentially influence the development of HABs. This is consistent with a letter from USEPA dated September 17, 2013 recommending a description of anticipated impacts of open-lake placement on nutrient levels (Appendix D). In a letter dated September 13, 2013, the Cuyahoga Soil and Water Conservation District (SWCD) expressed a concern that phosphorus in the dredged material could have an impact on excessive nutrients in the Central Basin through open-lake placement (Appendix D). Further, they recommended that measured concentrations of total phosphorus and dissolved reactive phosphorus (DRP) associated with the dredged material (i.e., in sediment elutriate) be compared to levels that have been associated with Lake Erie HABs.

Bulk concentrations of phosphorus in the dredged material range from 462 to 637 mg/kg and are below those at the open-lake placement areas (range 775 to 851 mg/kg) (USACE 2013a). Dissolved phosphorus concentrations in lake water and elutriates from CLA-1 and CLA-4 sediments were similar, while the dredged material elutriates (based on the SET) were up to four times greater (USACE 2013a). All dissolved orthophosphate concentrations in these samples were below detection. The SET data show that initial dissolved phosphorus releases from the dredged material would generally range from 65 to 124 µg/L.

The USACE performed a detailed evaluation of the potential of phosphorus releases during open-lake placement of the dredged material to influence HABs (USAERDC 2013d; USACE 2013a). The dissolved concentrations of phosphorus released from the dredged material during open-lake

placement would rapidly mix and dilute in the water column. Model predictions showed that the extent and duration of the predicted phosphorus plumes within the open-lake placement areas would be very small and short-lived. These modeled dissolved phosphorus plumes would be inadequate to trigger or pose an effect on the occurrence of HABs, or to significantly impact water quality in the Central Basin of Lake Erie. Two of the lower water column phosphorus criteria were used to evaluate the potential for HAB development: (1) 7 µg/L dissolved phosphorus, which is considered a conservative value below which little chance for cyanobacteria dominance in algal biomass; and (2) 10 µg/L dissolved phosphorus, which is considered a more realistic value above which the frequency of cyanobacteria dominance over algal biomass increases according to the GLWQA. These two criteria should be noted as being very conservative since a concentration of DRP (which is a fraction of dissolved phosphorus and the bioavailable form of phosphorus involved in HABs) of 30 µg/L has been shown to be a critical value to avoid the development of *Microcystis* blooms (Wetzel 2001). Modeling using dissolved phosphorus elutriate data showed that a dissolved water column concentration of less than 7 µg/L would be achieved within five minutes of the discharge and the plume concentrations would continue to rapidly decline over time. The maximum area exceeding the 7 ug/L criteria for up to five minutes was 354 by 148 feet. This modeling strongly suggests that the dissolved phosphorus plumes generated during open-lake placement of dredged material would be insufficient to play any role in HAB development.

4.2.2.5 Central Basin Hypoxia

In a letter dated September 13, 2013, the Cuyahoga SWCD expressed a concern that phosphorus in the dredged material during open-lake placement could migrate into the zone of hypoxia in the Central Basin and thereby influence hypoxia (Appendix D). Since lake currents at CLA-1 and CLA-4 are predominantly in an easterly or east-northeasterly direction (USAERDC 2013a), phosphorus plumes arising from open-lake placement, as modeled in USAERDC (2013d), were not predicted to reach the zone of hypoxia. No impacts are therefore anticipated to occur in this regard.

4.2.3 Sediment Quality

No Action (Without Project Conditions) – Since this alternative may involve no dredging or dredged material management, there would be no potential for any adverse impacts relating to sediment quality.

Selected Plan – Open-lake placement of this dredged material would result in no significant sediment quality-related adverse impacts. All impacts in this regard would be minor, adverse, and short- and long-term. In general, limited impacts would include increases in bulk concentrations of PAHs and toluene; however, these increases would be toxicologically insignificant. The Clean Water Act Section 404(b)(1) Evaluation (Appendix B) specifically evaluates the potential toxicological impacts associated with the discharge of this dredged material at CLA-1 and CLA-4. Section 2.4 of that evaluation (termed “Contaminant Determination”) focuses on the potential biological effects of contaminants in the dredged material on the water column and benthic communities, which are addressed in detail in USACE (2013a). Table 1 in Appendix A provides a summary of the evaluation of these biological effects. The following sections address several specific sediment-quality related impacts and address specific comments that have been received in this regard.

4.2.3.1 Sediment Sampling Protocol

Several comments were received with respect to concerns regarding the protocol used to sample the channel material in DMMU-1, DMMU-2a and DMMU-2b. Such comments from two University of Akron letters (Appendix B) both dated September 9, 2013 generally included: (1) collection of surface grab instead of core sediment samples to represent/characterize the dredged material; (2) location the sediment samples were taken; and (3) collection of too few sediment samples and lack of sample replication. Also note that OEPA reviewed and provided comments on the sampling and analysis plan (SAP) for the Upper Cuyahoga River Channel sediments in a letter dated March 30, 2012 (OEPA 2012), and USACE responded to those comments in letter dated April 16, 2012 (USACE 2012). Many of these sampling protocol concerns were previously addressed in USACE (2012).

With regard to the type of samples collected, surface grab samples were used to represent the dredged material since the channel sediment is maintenance dredged semi-annually or annually. Such material is normally vertically (and often spatially) homogenous and is not expected to be layered with respect to contamination. The shoal material is new and is predominantly comprised of sediment that has washed down from the upper reach of river, and there is no reason to believe that it would be layered with respect to contamination such that vertical profiles would provide any additional useful information. This approach to sampling channel material that is regularly maintenance-dredged is consistent with federal guidance (USEPA/USACE 1998a, 1998b). With regard to the sediment sampling locations, review of pre- and post-dredging surveys of the Cuyahoga River Channel over the last several dredging events shows that material in DMMU-1, DMMU-2a and DMMU-2b is dredged nearly to the full extent of channel dimensions. Therefore, there are minimal areas within this reach of the channel where “shoulders” form that are not dredged regularly, and the centerline within this reach provides a reasonable representation of material to be dredged. Regarding the number of sediment samples and sampling replication, since the shoal material is expected to be homogenous with respect to contamination, additional samples and sample replication would have added little value. With respect to quality assurance/quality control (QA/QC), no field blanks were employed and measured during the field sampling activities as these are not typically completed as a standard practice for USACE sediment sampling projects. Samples were run in replicate through standard laboratory QA/QC procedures including laboratory duplicates (LD). Data verification was conducted on all laboratory test results to ensure appropriate holding times were not exceeded, method blanks (MB), laboratory control samples (LCS), and matrix spike/matrix spike duplicates (MS/MSD) were prepared and analyzed for all batches, all analyte recovery limits were within criteria, results were appropriately flagged by the laboratory, and that quantitation limits were met in accordance with the project quality assurance protection plan (QAPP). Exceptions to any of the above were appropriately flagged by the data validators. Composite samples were created by using equal amounts of sediment from each discrete sample within a given management unit.

4.2.3.2 Changes in Sediment Quality at CLA-1 and CLA-4

USACE (2013a) includes a comprehensive discussion of bulk contaminant concentrations in the dredged material and at CLA-1 and CLA-4. Overall, bulk concentrations of most contaminants (e.g., metals, PCBs, pesticides) in the dredged material were quite comparable to those at CLA-1 and CLA-4. Three exceptions, including ammonia, PAHs and toluene, all of which were identified as preliminary contaminants of concern (COCs) associated with the dredged material, are discussed below:

a. Ammonia – At several discrete sites, ammonia levels in the management unit sediments exceeded CLA-1 and CLA-4 (USACE 2013a). In a letter dated September 9, 2013, the University of Akron expressed a concern that the dredged material contained significant levels of ammonia and that ammonia can be toxic to aquatic organisms in the NH_3 form (Appendix B). A detailed characterization of potential ammonia toxicity during open-lake placement of the dredged material is discussed in USACE (2013a). While it may be toxic to some benthic organisms in sediments at very high concentrations, ammonia can leach from dredged material during open-lake placement and temporarily reach high enough concentrations in the water column to become acutely toxic to fish. Therefore, ammonia toxicity is most appropriately characterized through the water column pathway. STFATE simulation modeling showed that after immediate mixing in the water column, ammonia released from the dredged material would not be of any significant concern with respect to fish toxicity (USAERDC 2013b). This modeling also showed that ammonia effluent would achieve an outside mixing zone maximum (OMZM) WQS of 2.9 µg/L for the protection of aquatic life during the first two minutes after discharge within the actual discharge footprint, and well within the boundaries of the open-lake placement areas (OEPA 2014).

b. PAHs – In a letter dated October 4, 2013, OEPA expressed concern regarding total bulk sediment concentrations of PAHs at CLA-1 (average 4.9 mg/kg) and CLA-4 (average 9.68 mg/kg) being several times that measured at CLA-R07 (average 0.24 mg/kg) (Appendix B). However (when excluding an outlier at CLA-4), the range in average PAH concentrations at CLA-1 (4.90 mg/kg) and CLA-4 (1.77 mg/kg) is similar to the range of average concentrations measured at other nearby open-lake reference areas offshore of Rocky River (3.21 mg/kg), Fairport (4.61 mg/kg) and Ashtabula (4.12 mg/kg) (USACE 2013b). On an OC-normalized basis, the average for CLA-1/CLA-4 is 143 mg/kg-OC, which is less than the average of 199 mg/kg-OC for the Rocky River/Fairport/Ashtabula open-lake reference areas. These data indicate that the Cleveland open-lake areas are somewhat less contaminated with respect to PAHs than the other open-lake reference areas in Lake Erie.

Average total PAH concentrations in the management units ranged from 8.28 to 12.8 mg/kg (Section 3.4.1.2). Despite the fact that PAH concentrations in the dredged material were higher relative to CLA-1 and CLA-4, standard benthic bioassay data showed that they were not significantly toxic (Section 4.2.4.2 [b]). Further, PAHs are known to biodegrade in the aquatic environs, but an array of anthropogenic sources also continuously serve to load PAHs into the Great Lakes and the adjoining watersheds.

In a letter dated September 9, 2013, the University of Akron cited that the PAH concentrations were not identified as a COC and that several compounds exceeded various residential and industrial screening levels in an upland setting (Appendix B). Such screening levels are not relevant to this dredged material evaluation because the material is proposed for open-lake placement, which requires a comparison to aquatic-based toxicological endpoints. Note that PAHs were initially identified as a dredged material COC in USACE (2013a).

c. Toluene – Discrete sample concentrations in management unit sediments were quite variable and higher at values ranging from 0.23 to 14,500 µg/kg (see Paragraph 3.4.1.2 [a]). These concentrations were well over those observed at CLA-1 and CLA-4 (<0.092 to <92.7 µg/kg) (USACE 2013a). A detailed characterization of potential toluene toxicity during open-lake placement of the dredged material is discussed in USACE (2013a). Toluene is not bioaccumulative, it readily partitions to water and air, and volatilizes such that much of it would be liberated during

the dredging process. It also rapidly biodegrades in the aquatic environs. Nevertheless, evaluation of the potential toxicity of this toluene contamination through bioavailability and STFATE simulation modeling indicated that it would not be toxic to benthic organisms, or fish and other water column organisms at the concentrations observed (USAERDC 2013b; USACE 2013a).

4.2.3.3 Placement of Dredged Material at CLA-1

In a letter dated September 17, 2013, USEPA recommended evaluating whether open-placement of dredged material at CLA-1 would have the potential for disturbing any "legacy material" which may have formerly been placed at the area (Appendix D). The formerly placed dredged material is predicted to be covered with at least one foot of background lake sediment that has deposited on top of it over the past 45 or more years. Both the formerly placed dredged material as well as the at least one foot of overlying deposition are fully consolidated cohesive sediment below the shallow bioactive (bioturbated) zone, and are resistant to erosion and displacement. Hydrodynamic forces at CLA-1 during open-lake placement would be insufficient to erode the overlying one foot layer of depositional sediment (USAERDC 2014b). Only about the top two inches of bioactive zone could be disturbed, which would be enveloped in the newly placed dredged material. Therefore, the placement of new dredged material at CLA-1 would not be expected to disturb any "legacy material" to an extent that it would create any significant risk of exposure.

4.2.4 Plankton and Benthos

No Action (Without Project Conditions) - Since this alternative may involve no dredging or dredged material management, no significant change in the existing planktonic and benthic community at the open-lake areas would occur.

Selected Plan – Open-lake placement of this dredged material would result in no significant adverse impacts to plankton and benthos.

4.2.4.1 Plankton

a. Community – The open-lake placement of dredged material at CLA-1 and CLA-4 may result in minor, short-term adverse impacts to the plankton community within a portion of each area. Localized plankton at the two areas may be temporarily displaced during open-lake placement. Turbidity plumes during and shortly after dredged material placement operations would also temporarily reduce some light penetration into the water column.

b. Toxicity – Open-lake placement of this dredged material would not result in any significant acute toxicity to plankton. The standard *C. dubia* water column bioassay is designed to evaluate the toxic effects of dissolved contaminants that are released from the dredged material, as represented by elutriates, during open-lake placement. USACE (2013a) discusses the results of these bioassays applied to DMMU-1, DMMU-2a and DMMU-2b sediments in detail (the bioassay data are summarized in Table 29 of USACE [2013a] [Appendix B]). This bioassay showed no significant acute toxicity for any of the management unit sediment elutriate treatments, yielding survivals ranging from 76±17 to 100 percent (lake and control water survivals were 80±28 and 92±18 percent, respectively). These bioassay results indicate that the release of dissolved sediment contaminants from the dredged material during open-lake place would not result in any significant toxicity to plankton.

4.2.4.2 Benthos

a. Community—In a letter dated September 12, 2013, the USFWS cited concerns regarding the impact of open-lake placement of dredged material on the benthic habitat and species at CLA-1 and CLA-4. The resident benthic communities at CLA-1 and CLA-4, as described in Section 3.2.2, are low in diversity, generally dominated by pollution tolerant species and are typical of what would be expected in a deep-water, mud-bottom Lake Erie environs lacking bottom structure. Open-lake placement of dredged material would be spatially limited to one square mile at CLA-1 and two-thirds square mile at CLA-4. The impacts to benthos resulting from the open-lake placement of dredged material at these open-lake areas would be adverse minor, localized, and short-term. The open-lake placement of dredged material would impact the resident macroinvertebrate community through smothering and short-term suspended sediments, which would result in a temporary localized loss of benthic organisms. However, the new bottom substrate at the areas would be similar to pre-placement conditions and would be expected to recolonize with benthic organisms residing in the dredged material and surrounding lake bottom.

Due to the similarity in the sediment grain size and toxicity between the dredged material and lake bottom sediments, significant long-term changes in the benthic community resulting from the placement of this new material would be unlikely. The physical change in bottom elevation and contours at the open-lake areas may actually diversify the benthic community to some degree compared to the surrounding lake bottom. A 2003 study conducted on the macroinvertebrate community in the vicinity of the Toledo Harbor open-lake placement area in the Western Basin of Lake Erie (Heidelberg College 2003) concluded that the taxonomic richness and abundance of invertebrates at the placement area were similar to other areas in the Western Basin. Further, a cluster analysis showed that there was no association among sampling areas in relation to their proximity to the open-lake placement area. These results indicate that the open-lake placement of dredged material would have no significant effect on the quality of the benthic macroinvertebrate community either within or outside the open-lake placement areas.

b. Toxicity—Open-lake placement of this dredged material would not result in any significant acute toxicity to benthos. The standard benthic *H. azteca* and *C. dilutus* bioassays are designed to evaluate the toxic effects of sediment contaminants after open-lake placement. USACE (2013a, 2013b) discusses the results of these bioassays applied to DMMU-1, DMMU-2a and DMMU-2b sediments in detail (the bioassay data are summarized in Table 14 of USACE [2013a] [Appendix B]). The *H. azteca* bioassay showed that the survivals associated with the management unit sediments (range 82±25 to 94±6%) were not significantly different than CLA-1 (84±15) or CLA-4 (92±11). Similarly, the *C. dilutus* bioassay showed that the survivals associated with the management unit sediments (range 80±7 to 90±10%) were not significantly different than CLA-1 (90±10) or CLA-4 (88±5). Further, the growth of *C. dilutus* (range 2.17±0.30 to 3.51±0.12 mg) was acceptable (CLA-1/CLA-4 range 1.69±0.14 to 1.72±0.16 mg). These data demonstrate that the open-lake placement of this dredged material meets Federal guidelines because it would not result in any significant acute toxicity to benthos (USACE 2013a).

With respect to chronic toxicity to benthos, this toxicity measurement endpoint is not required under federal guidelines when determining whether dredged material is suitable for open-lake placement. However, an assessment of chronic toxicity to benthos is an important consideration if the potential for chronic toxicity exists. In a letter dated October 4, 2013, OEPA expressed the concern that placement of the dredged material in the open-lake would result in chronic toxicity to benthic organisms (Appendix B). The USACE responded to these concerns on December 20, 2013

(USACE 2013b). Weight-of-the-evidence strongly suggests that contamination in the dredged material would not result in any significant chronic toxicity. First, SEM-AVS testing and evaluation indicated insignificant chronic toxicity attributable to cationic metals. Second, the measurement and evaluation of PAH sediment pore water concentrations indicate a low potential for PAH-associated chronic toxicity. Finally, the *H. azteca* and *C. dilutus* bioassays provide useful information concerning potential chronic toxicity. PAH-related chronic toxicity in the *H. azteca* does not occur until sediment concentrations exceed the concentration at which acute toxicity occurs. Therefore, the low acute toxicity data associated with the dredged material are also indicative of a lack of chronic toxicity attributable to PAHs. With regard to the *C. dilutus* bioassay, even though the sublethal growth endpoint is derived using a relatively short-term exposure, the acceptable growth data suggest that chronic toxicity associated with the dredged material is unlikely.

4.2.5 Aquatic Vegetation

No Action (Without Project Conditions) - Since this alternative may involve no dredging or dredged material management, no disturbance of any existing established vegetation would be anticipated.

Selected Plan – Any adverse impacts to aquatic vegetation resulting from the open-lake placement of dredged material would be highly localized, minor and short-term. Open-lake placement of the dredged material would not significantly affect any submerged aquatic vegetation because such vegetation is not expected to be present at CLA-1 and CLA-4 due to depth. Temporary increases in turbidity and suspended solids generated during dredged material placement activities may cause localized minor decreases in primary production and photosynthesis through reduced light penetration into the water column. A study conducted at Ashtabula, Ohio, showed no statistically significant differences in algal populations that exist between open-lake placement and unaffected open-lake areas (Sweeney 1978). With respect to potential impacts relative to HABs, please see paragraph 4.2.2.4.

4.2.6 Fisheries

No Action (Without Project Conditions) - Since this alternative may involve no dredging or dredged material management, there would be no potential for any adverse impacts to fish or fisheries.

Selected Plan – Open-lake placement of this dredged material would result in localized minor, adverse, short-term impacts to some fish. However, it would not result in any significant adverse long-term impacts to fish or fisheries. Additional coordination with ODNR will be completed regarding the possible need for an in-water work restriction between March 15 and June 30.

4.2.6.1 Spawning Habitat and Fish Behavior

Since there are no known fish spawning grounds within either CLA-1 or CLA-4, open-lake placement of dredged material would not have any significant impacts in this regard. Fish behavior relative to the open-lake placement of dredged material depends on the species being affected. They may avoid the area or swim through the turbidity plume. Intermittent, short-term increased turbidity generated by dredged material placement at the open-lake areas would not have a significant adverse effect on fish. An historic study examining 16 species of warmwater fish in laboratory aquaria did not evidence any observable behavioral reactions to turbidity TSS as concentrations approached 20000 mg/L (Wallen 1951). Regarding sub-lethal responses in adult

warmwater fish sensitive to suspended sediments, the minimum dose of TSS that elicited a sub-lethal effect in white perch was 650 mg/L after 5 days (Sherk *et al.* 1974). These studies, in tandem with the STFATE plume modeling which predicted initial post-dredged material placement TSS concentrations of 1500 mg/L with rapid settling and dispersion of disaggregated silt/clay particles and fine organic matter (Section 4.2.2.1), show that there would be a very low likelihood of any significant turbidity-related adverse effects to fish.

4.2.6.2 Bioaccumulation of PCBs and DDT

The open-lake placement of this dredged material would not yield any biologically significant increase in the bioaccumulation of PCBs or the DDTs, and would therefore not result in any significant adverse impacts to fish or fisheries. In a letter dated October 4, 2013 OEPA raised several concerns with respect to the bioaccumulation of PCBs from the dredged material (Appendix B). Their primary concern in this regard pertained to the potential bioaccumulation of PCBs from the dredged material in Lake Erie fish, which often show tissue residues of PCBs that exceed various Great Lakes thresholds (Section 3.2.5 [b]). The USACE responded to these comments on December 20, 2014 (USACE 2013b).

a. **PCBs**—The benthic bioaccumulation of sum and total PCBs from the dredged material, as measured through the *L. variegatus* bioaccumulation experiments, varied in comparison to CLA-1 and CLA-4 (Tables 15 and 16 of USACE 2013a). This is not unusual as the benthic bioaccumulation of neutral organic chemicals such as PCBs from sediments will vary depending on factors such as concentration, congener distribution, as well content and nature of TOC. Table 2 in Appendix A summarizes how bioaccumulation of PCBs from the dredged material was evaluated with respect to its placement at the two open-lake areas.

(1) *CLA-1*

(a) Benthic Bioaccumulation

- Statistical Comparisons – The benthic bioaccumulation of the sum (Σ) of PCBs from DMMU-1 sediments (55.6±2.7µg/kg) was statistically higher relative to CLA-1 (32.2±4.7µg/kg). The benthic bioaccumulation of ΣPCBs from DMMU-2a and DMMU-2b sediments (33.2±4.2 and 36.6±2.7 µg/kg, respectively) were not statistically higher relative to CLA-1. The increased bioaccumulation of PCBs from DMMU-1 sediments relative to CLA-1 was further evaluated. . In letters dated September 9, 2013 and October 4, 2013, the University of Akron and OEPA, respectively, expressed concerns with regarding the concentrations of PCBs in *L. variegatus* tissues associated with the dredged material and its placement at CLA-1 and CLA-4 (Appendix B).

- American Society of Testing and Materials (ASTM) Guidance – The magnitude of difference (MOD) between the bioaccumulation of ΣPCBs from DMMU-1 sediments and CLA-1 is 1.7. Standard guidance in ASTM (2010) indicates that a two-fold difference between tissue residues in test and reference sediments should in most cases provide a sufficient signal for potential ecological and human health concerns. This implies that tissue concentrations less than twice those of reference tissue concentrations should not be considered a biologically significant difference within the context of bioaccumulation evaluation of dredged material. Since the MOD of 1.7 shows that the bioaccumulation of PCBs from DMMU-1 sediments is less than

twice that associated with CLA-1, the placement of material dredged at CLA-1 is not predicted to result conclusively in biologically significant accumulation of PCBs.

- Regional Open-lake Reference Area Sediment Comparisons – Existing data confirm that the benthic bioaccumulation of PCBs from lake sediments varies and that it is often higher offshore of urban/industrialized areas on Lake Erie. Although the benthic bioaccumulation of PCBs from DMMU-1 sediments was statistically higher relative to CLA-1, the biologically relevant lipid-normalized total PCB concentration of 5930 µg/kg-lipid is well within the range of that observed or predicted across open-lake reference area sediments sampled over the last 10 years east and west of Cleveland, including offshore of Rocky River, Fairport and Ashtabula (1391 to 16800 µg/kg-lipid) (USACE 2013b). Further, it is within the range of that predicted from Western Basin open-lake reference area sediments offshore of urbanized Toledo within the last 10 years (2000 to 7620 µg/kg-lipid) (USACE 2013b). This indicates that the benthic bioaccumulation of PCBs from DMMU-1 sediments is comparable to that which occurs from pooled open-lake reference area sediments, particularly with respect to lake sediments located offshore of urban/industrialized areas.

Based on the above information, material dredged from DMMU-1, DMMU-2a and DMMU-2b meets federal guidelines for placement at CLA-1 with respect to PCB bioaccumulation.

(2) *CLA-4*

(a) <u>Benthic bioaccumulation</u>

- Statistical Comparisons – The benthic bioaccumulation of ΣPCBs from DMMU-1, DMMU-2a and DMMU-2b sediments (55.6±2.7, 33.2±4.2 and 36.6±2.7µg/kg, respectively) was statistically higher relative to CLA-4 (12.9±1.22 µg/kg). The increased bioaccumulation of PCBs from these management unit sediments relative to CLA-4 was further evaluated.

- ASTM Guidance – The MODs between the bioaccumulation of ΣPCBs from DMMU-1, DMMU-2a and DMMU-2b sediments and CLA-4 are 4.3, 2.6 and 2.8, respectively. Since the MODs show that the bioaccumulation of PCBs from these management unit sediments is more than twice that associated with CLA-4, the placement of material dredged at CLA-4 may result in a biologically meaningful accumulation of PCBs. Therefore, this increased bioaccumulation of PCBs from these management unit sediments relative to CLA-4 was further evaluated.

- Regional Open-Lake Reference Area Sediment Comparisons – Although the benthic bioaccumulation of PCBs from DMMU-1, DMMU-2a and DMMU-2b sediments was statistically higher and more than twice that associated with CLA-4, lipid-normalized total PCB concentrations (5930, 4345 and 4430 µg/kg-lipid, respectively) are well within the range of that observed or predicted across open-lake reference area sediments sampled over the last 10 years east and west of Cleveland, including offshore of Rocky River, Fairport and Ashtabula (1391 to 16800 µg/kg-lipid) (USACE 2013b). Further, they are within the range of that predicted from Western Basin open-lake reference area sediments offshore of urbanized Toledo within the last 10 years (2000 to 7620 µg/kg-lipid) (USACE 2013b). This indicates that the benthic bioaccumulation of PCBs from these management unit sediments is comparable to that which occurs from pooled open-lake reference area sediments, particularly with respect to lake sediments located offshore of urban/industrialized areas. Nevertheless, the increased

bioaccumulation of PCBs from DMMU-1, DMMU-2a and DMMU-2b sediments relative to CLA-4 was further evaluated.

(b) Potential Bioaccumulation Exposure to Receptors

The bioaccumulation of PCBs from the dredged material in higher food web organisms was examined through an estimation of potential bioaccumulation exposure to receptors, including yellow perch and walleye. Evaluation of this pathway employed the spatially explicit screening-level exposure comparison (SESLEC) approach and bioaccumulation exposure factor (BEF) model, which is discussed in detail in USACE (2013a and 2013b). It is important to note that the BEF is not a prediction of bioaccumulation; rather, it merely estimates potential bioaccumulation exposure. This approach addresses the relatively small spatial area of dredged material placement compared to the overall area utilized by a receptor to obtain food (i.e., its home range). Fish with a home range larger than an open-lake placement area will obtain only a fraction of their diet from the area influenced by the placement of dredged material, resulting in a reduction in net bioaccumulation compared to what is reflected in laboratory bioaccumulation experiments alone. The BEF model is essentially a simplification of a dietary exposure portion of the USACE food web model *TrophicTrace* (USAERDC 2014a). The SESLEC approach included two conservative assumptions in the BEF model: (1) unrealistically minimum receptor home range values, which serves to maximize BEF projections; and (2) an assumption that 100 percent of the receptor's diet is directly or indirectly linked to benthic macroinvertebrates (e.g., it doesn't consider that a portion of receptor's diet [which in this case is substantial] is derived directly or indirectly from the water column). As described below, this evaluation showed that the bioaccumulation of PCBs to *P. flavescens* and *S. vitreus* would not be biologically significant because of a low level of exposure:

- CLA-4 Comparison – Assuming that the placement of dredged material at CLA-4 would be limited to a two-thirds square mile area, the worst-case scenario using exposure of DMMU-1 sediments to *P. flavescens* (the receptor with the smallest home range) showed that exposure via the bioaccumulation pathway to PCB residues in invertebrates associated with the dredged material (i.e., the BEF) would be 1.2. This indicates that the maximum estimated increased exposure of both receptors to PCB residues in benthic macroinvertebrates associated with the dredged material would be 20 percent or less, which is within the generally accepted range of analytical variability (USACE 2013a).

- Regional Open-lake Reference Area Sediment Comparisons – Because the benthic bioaccumulation of PCBs varies, the receptors will in reality be exposed to a range of PCB residues in macroinvertebrates across their home range; that is, the measured total PCB mean residue at CLA-4 (19.3±2.8 µg/kg total PCBs) is not by itself truly representative of exposure in the field. Therefore, if it is more realistically assumed that average total PCB concentrations in lake bottom sediments east, offshore and west of Cleveland are on the order of 73.8 µg/kg (using a mean across data on CLA-4 and CLA-R07, and Rocky River, Fairport and Ashtabula open-lake reference areas) with a corresponding average TOC content of 2.2 percent, an average reference total PCB benthic bioaccumulation of 36.6 µg/kg is yielded using theoretical bioaccumulation potential (TBP) relationships (USACE 2013b). Using this benthic bioaccumulation value in the BEF model as a more representative reference area exposure to *P. flavescens* and *S. vitreus* (while still failing to acknowledge that sediments at CLA-1 also contribute to background contamination) produces BEFs of 1.01 to 1.07, with an average of 1.03. A BEF of 1.03 is approximately equal to 1.0 and implies no impacts to the receptor. This shows that the bioaccumulation pathway for PCBs from the dredged material to receptors is not

expected to increase in any meaningful way such that significant adverse impacts to the aquatic ecosystem and human health would not be expected.

Based on the above information, material dredged from DMMU-1, DMMU-2a and DMMU-2b meets federal guidelines for placement at CLA-4 with respect to PCB bioaccumulation.

b. **ΣDDT** – The benthic bioaccumulation of ΣDDT from the dredged material varied in comparison to CLA-1 and CLA-4 (Table 21 of USACE 2013a). As with PCBs, this is not unusual since the benthic bioaccumulation of ΣDDT from sediments will vary depending on factors such as concentration, and content and nature of TOC.

(1) *CLA-1*

(a) Benthic Bioaccumulation

- Statistical Comparisons – The benthic bioaccumulation of ΣDDT from DMMU-1, DMMU-2a and DMMU-2b sediments (5.30±2.7, 3.41±0.38 and 5.64±0.66 µg/kg, respectively) were not statistically higher relative to CLA-1 (5.40±0.55). Based on this information, material dredged from DMMU-1, DMMU-2a and DMMU-2b meets federal guidelines for placement at CLA-1 with respect to ΣDDT bioaccumulation.

(2) *CLA-4*

(a) Benthic bioaccumulation

- Statistical Comparisons – The benthic bioaccumulation of ΣDDT from DMMU-2a sediments (3.41±0.38) was not statistically higher relative to CLA-4 (2.65±2.2). The benthic bioaccumulation of ΣDDT from DMMU-1 (5.30±0.36) and DMMU-2a (5.64±0.66) sediments was statistically higher relative to CLA-4 (2.65±2.2). The increased bioaccumulation of ΣDDT from DMMU-1 and DMMU-2b sediments relative to CLA-4 was further evaluated.

- ASTM Guidance – The MODs between the bioaccumulation of ΣDDT from DMMU-1 and DMMU-2b sediments and CLA-4 are 2.0 and 2.2, respectively. Since the MODs show that the bioaccumulation of ΣDDT from these management unit sediments is more than twice that associated with CLA-4, the placement of material dredged at CLA-4 may be result in a biologically meaningful accumulation of ΣDDT. Therefore, this increased bioaccumulation of ΣDDT from DMMU-1 and DMMU-2b sediments relative to CLA-4 was further evaluated.

(b) Potential Bioaccumulation Exposure to Receptors

The bioaccumulation ΣDDT from the dredged material in higher food web organisms was examined through an estimation of potential bioaccumulation exposure to *P. flavescens* and *S. vitreus* as receptors. Evaluation of this pathway employed the SESLEC approach and BEF model (USACE 2013a and 2013b). As with the modeling of PCB bioaccumulation exposure, the SESLEC approach included the same conservative assumptions pertaining to receptor home ranges and 100 percent dietary exposure to benthic macroinvertebrates. This evaluation showed that the bioaccumulation of ΣDDT to *P. flavescens* and *S. vitreus* would not be biologically significant because of a low level of exposure. Assuming that the placement of dredged material at CLA-4 would be limited to a one square mile area, the worst-case scenario using exposure of DMMU-2b sediments to *P. flavescens*

showed that exposure via the bioaccumulation pathway to ΣDDT residues in invertebrates associated with the dredged material (i.e., the BEF) would be 1.12. This indicates that the maximum estimated increased exposure of both receptors to ΣDDT residues in benthic macroinvertebrates associated with the dredged material would be 20 percent or less, which is within the generally accepted range of analytical variability (USACE 2013a).

Based on the above information, material dredged from DMMU-1, DMMU-2a and DMMU-2b meets federal guidelines for placement at CLA-4 with respect to ΣDDT bioaccumulation.

4.2.6.3 Toxicity

Open-lake placement of this dredged material would not result in any significant acute toxicity to fish. The standard *P. promelas* water column bioassay is designed to evaluate the toxic effects of dissolved contaminants that are released from the dredged material, as represented by elutriates, during open-lake placement. The results of this bioassay are summarized in Table 29 of USACE (2013a). This bioassay showed meaningful toxicity for the DMMU-2a and DMMU-2b sediments in the 100 percent elutriate treatment. However, the follow-up TRE showed that this initial toxicity was attributable to ammonia and evidenced no other toxicity. Ammonia is transient and not environmentally persistent, and would rapidly dilute in the water and not be toxic to fish (or other water column organisms) at the concentrations observed upon dilution during open-lake placement. The results of this bioassay for the remaining lower elutriate concentrations yielded survivals ranging from 96±5 to 100 percent (lake and control water survivals were both 100 percent), indicating that the release of dissolved sediment contaminants from the dredged material during open-lake place would not result in any significant toxicity to fish.

4.2.7 Wetlands

No Action (Without Project Conditions) – No wetland areas are present at either CLA-1 or CLA-4. Since this alternative may involve no dredging or dredged material management, prolonged shoaling in the upper Cuyahoga River in the vicinity of the federal navigation channel could occur which could over time create water depths shallow enough for wetland vegetation to become established along some margins of the river.

Selected Plan – No wetland areas are present at either CLA-1 or CLA-4, therefore no impacts to wetlands would occur as a result of the project.

4.2.8 Terrestrial Vegetation

No Action (Without Project Conditions) - Since this alternative involves no dredging or dredged material management, associated impacts to area terrestrial vegetation would not occur.

Selected Plan – Open-lake placement of dredged material would have no impact on terrestrial vegetation.

4.2.9 Wildlife

No Action (Without Project Conditions) – Since this alternative may involve no dredging or dredged material management, no immediate affects to wildlife or wildlife habitat would occur.

Selected Plan – Disruption and disturbance by equipment during dredged material placement operations would result in the short-term avoidance of the placement areas by some bird and other species. However, some bird species, such as gulls, may be attracted to dredged material placement activities while foraging. Any adverse wildlife impacts in this regard would be minor, localized and short-term. The proposed project will not affect any species from the ODNR Natural Heritage Database or listed in their comment letter of January 17, 2014 (Appendix D).

4.2.10 Threatened and Endangered Species

No Action (Without Project Conditions) – Since this alternative may involve no dredging or dredged material management, associated impacts to any Threatened or Endangered Species or their Critical Habitat would occur.

Selected Plan – In a letter dated September 12, 2013, the USFWS indicated that due to the project type, location, and on-site habitat, no Threatened and Endangered species would be expected within the project area and that no impacts to such species would be expected (Appendix D). In correspondence dated January 14, 2014, ODNR identified a number of potential rare and state endangered species in the harbor vicinity (Appendix D). However, due to the project type, location, and type of on-site habitat none of the species would be expected within the project area and therefore no impacts to such species would be expected.

4.3 SOCIO-ECONOMIC IMPACTS

4.3.1 Community and Regional Growth; Business and Industry/Labor Force; Employment and Income; Public Facilities and Services; Community Cohesion; Transportation

No Action (Without Project Conditions) – If the Upper Cuyahoga River Channel was not maintained, commercial navigation and associated enterprises would be adversely affected, hindering community economic and social well-being and continued community and regional growth and cohesion. Developments and associated employment and income may be reduced, and public facilities and services may have to be altered accordingly.

Under this alternative, the Upper Cuyahoga River Channel would rapidly shoal in and commercial navigation in the area would become restricted. Operating depths in the channel would eventually be reduced such that some commercial interests would have to increase the number of vessel trips per year in order to move their commodities through the harbor. As shoaling of the channel progresses due to lack of dredging, vessel transits through the harbor would eventually become less economical and use of the harbor for commercial navigation could decline. If the Upper Cuyahoga River Channel were not dredged and is no longer available to commercial navigation traffic over time, commodities may need to be moved by alternative modes of transportation, such as rail or truck. Truck and rail transport is much less efficient than that of a Great Lakes carrier which can travel approximately 607 miles on one gallon of fuel per ton of cargo, compared to 202 miles for a freight train and 59 miles for a truck. In one delivery, a Great Lakes carrier supplies 70,000 tons of cargo, which would require nearly 3,000 semi-truck loads and their associated fuel consumption (USACE 2009b). As the Federal navigation channels continue to shoal in over time, a substantial reduction in the bulk commodities that pass through the harbor and generate $1.7 B annually in direct revenue while supporting 15,003 direct, indirect and induced jobs that produce over $1B per year in personal income would perpetuate. Losses of between one and two feet of channel depth would result in increased transportation costs of between $2.3M and $5.2M annually (USACE

2013c). Consequently, individuals and enterprises dependent on this mode of transportation for their livelihood could suffer economically. A number of primary and secondary enterprises may also be impacted. In turn, associated deep-draft harbor community and regional benefits would be diminished. Business, industry, employment, and income would be adversely affected. Associated land use dilapidation or redevelopment may likely occur in the long-term. Industrial and commercial processes, transportation interfaces, and public facilities, services and utilities would also be altered. Several community sustenance and cohesion factors could be disrupted. Such impacts would likely be significant, adverse and long-term.

Selected Plan – Maintenance of the Upper Cuyahoga River Channel would facilitate continued harbor and associated community facilities and activities (including associated public facilities and services), and would be likely to help preserve the area's potential for desirable community and regional growth and cohesion.
Dredging and dredged material management activities would result in a short-term increase in business/employment/ income opportunities, specifically in the marine trades. The maintenance of a functional commercial harbor at Cleveland would help to preserve existing business/ employment/ income opportunities associated with shipping and cargo handling. Dredging and dredged material management activities would not adversely affect any public services or facilities. Open-lake placement of the Upper Cuyahoga River Channel dredged material could facilitate and/or serve as a precursor to delisting the AOC's BUI for restrictions on dredging activities which in turn could further facilitate community or regional growth (See last bullet of Section 4.4).

4.3.2 Displacement of People/Displacement of Farms

No Action (Without Project Conditions) – Since this alternative may involve no dredging or dredged material management, the Upper Cuyahoga River Channel is expected to shoal in over time, thereby significantly limiting deep-draft commercial navigation in the harbor. If this channel was not maintained, interests dependent upon these harbor facilities would be adversely impacted and could eventually be displaced to other areas (e.g., cost of goods). Such impacts could be substantial, adverse and long-term.

Selected Plan – Maintenance of the Upper Cuyahoga River Channel would facilitate continued harbor and associated community facilities and activities. No displacement of people/farms would be anticipated as a result of the proposed project.

4.3.3 Recreational Resources

No Action (Without Project Conditions) – Since this alternative may involve no dredging or dredged material management, the Upper Cuyahoga River Channel is expected to shoal in over time. Recreational navigation and associated enterprises are not to be significantly adversely affected, at least in the short term.

Selected Plan – The ability to continue maintenance dredging of the Upper Cuyahoga River Navigation Channel because of the availability of open lake placement would facilitate continued harbor operations for recreational watercraft and associated facilities in the long term.

Dredging and dredged material management activities may temporarily disrupt some commercial and recreational vessel traffic due to restrictions within the vicinity of the dredging operations. All

dredging equipment would be adequately marked and lighted to avoid any potential navigation hazards with recreational boating.

4.3.4 Property Value and Tax Revenue

No Action (Without Project Conditions) – Since this alternative may involve no dredging or dredged material management, the Upper Cuyahoga River Channel is expected to shoal in over time, thereby significantly limiting deep-draft commercial navigation in the harbor. Commercial navigation and associated enterprises would be adversely affected, ultimately likely impacting tax revenues and land values associated with these activities. Land use could change to lesser value developments. Associated property value and tax revenue would likely decrease. Such impacts may be substantial, adverse and long-term.

Selected Plan – The ability to continue maintenance dredging of the Upper Cuyahoga River Navigation Channel because of the availability of open lake placement would facilitate the continued economic viability of the harbor and associated facilities and activities, thus helping to sustain property values.

4.3.5 Noise and Aesthetics

No Action (Without Project Conditions) – Since this alternative may involve no dredging or dredged material management, minor noise levels that may be associated with dredging operations would not occur.

Selected Plan – Dredging equipment would be observed in the project area (CLA-1 & CLA-4) and activities would result in a short-term increase in local noise levels as compared to past conditions in the open lake environment. Noise generated by the dredging operation would not exceed ambient noise levels in the harbor area nor would it be expected to affect any sensitive noise receptors (e.g., schools, hospitals) which would be greater than five miles away.

Water color and clarity in the vicinity of the placement operations may be altered due to the generation of localized turbidity for a relatively short period of time. The turbidity plumes generated would dissipate before affecting shoreward areas. Organic matter contained in the dredged material could result in the liberation of short-term, localized malodors. Such impacts would be minor, adverse and short-term.

4.3.6 Health and Safety

No Action (Without Project Conditions) – Since this alternative may involve no dredging or dredged material management, the Upper Cuyahoga River Channel is expected to shoal in over time, thereby likely substantially limiting deep-draft commercial navigation in the harbor. No immediate effects to human health would be expected. However, the overall value of the harbor as a water resource to commercial navigation would progressively deteriorate to a point at which deep-draft commercial vessels would no longer be able to navigate the at least the upper navigation channel due to inadequate depths. Should this occur, navigational safety concerns may develop. Such impacts could be adverse and long-term.

Selected Plan – The concentration of heavy equipment in the project area during dredged material placement operations could potentially pose a navigation hazard. However, standard USACE

contract specifications require the maintenance of a safe, restricted work area during these periods. The contractor is required to prepare a detailed job hazard analysis for each major phase of work, including all anticipated hazards and specific actions which would be taken to prevent personal injury. The contractor is required to comply with Occupational Safety and Health Administration Standards. The human health impacts associated with this alternative would be indiscernible. However, there is a slightly increased safety risk associated with use of CLA-1 over CLA-4 because of its increased distance (approximately four miles) the dredge scow would need to be moved from the mouth of the Cuyahoga River.

In a letter dated September 10, 2013 the U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS) indicated that Federal Aviation Administration (FAA) safety guidelines recommend a distance of at least five statute miles between the farthest edge of an airport's air operations area and a hazardous wildlife attractant if the attractant could cause hazardous wildlife movement into or across the approach or departure airspace (FAA Advisory Circular 150/5200-33B) (Appendix D). In this letter APHIS states that "the proposed open lake placement sites are greater than 5 miles beyond BKL and the open lake placement method at the proposed sites is preferable to the CDF method. The concern for the open lake placement is the effect it will have on the management and focus on the existing CDFs 10B and 9 adjacent to BKL which are clearly" within five miles of the Burke Lakefront Airport. Specifically, APHIS is concerned that placement of dredged material at the open lake sites may delay filling of these CDF and therefore prolong the time during which any open water in these CDFs could attract hazardous wildlife. The USACE will continue to work with BKL and APHIS to identify any feasible dredged material placement strategies which could minimize this risk. The USACE is concurrently evaluating a Short-Term Decision Document which evaluates various measures to provide approximately one million cubic yards of new confinement capacity in CDFs 9, 10B, and/or 12 (e.g., mounding of material within existing CDFs) (Section 2.3.2). However, such measures would likely include a shift from hydraulic to mechanical placement into the disposal facilities to reduce the amount of water needing to be managed, allow for faster drying, and to facilitate grading necessary to stack sediment higher. Compared to past conditions, it is likely that these measures would minimize the risk these CDFs pose to attract hazardous wildlife to the vicinity of BKL.

4.3.7 Cultural Resources

No Action (Without Project Conditions) – Since this alternative may involve no dredging or dredged material management, there is no potential for project related impacts to occur to cultural resources.

Selected Plan – Based on assessment of the proposed placement sites, review of pertinent records, and completion of a hydrographic survey, USACE believes that there would be a low likelihood for the area of potential effect to yield cultural resources. Therefore, as a result of a reasonable and good-faith effort conducted, the USACE has determined that "no historic properties will be affected" as a result of the proposed undertaking. A Section 106 Project Summary Form and Effects Determination were submitted to the SHPO on February 19, 2014 documenting this determination.

4.4 SUMMARY AND CUMULATIVE IMPACTS

A cumulative impact is defined as resulting from the "incremental impact of the action when added to other past, present, or reasonably foreseeable future action regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR Parts 230.11[g], 1508.7). Such impacts can result from individually minor, but collectively significant actions taking place over a period of time. Evaluations of cumulative impacts include consideration of the proposed action with known past and present actions, as well as reasonably foreseeable future actions. In assessing cumulative effects, the key determinant of importance or significance is whether the incremental effect of the proposed action will alter the sustainability of resources when added to other present and reasonably foreseeable future actions. Implementation of open-lake placement of this dredged material would substantially benefit the sustainability of unrestricted commercial navigation in Cleveland Harbor.

Cumulative environmental effects for the proposed project were assessed in accordance with guidance provided by the President's Council on Environmental Quality (CEQ) (CEQ, 1997). This guidance provides an eleven-step process for identifying and evaluating cumulative effects during NEPA analyses. The overall cumulative impact of the proposed project is considered to be socially and economically beneficial. The most substantial cumulative effect resulting from this project would be to facilitate continued unrestricted navigation which would benefit the associated upland industries within Cleveland Harbor. Implementation of the proposed project would work toward sustaining the integrity of Cleveland Harbor from economic and social perspectives. Dredged material management through open lake placement would have minor, localized adverse short-term affects, most of which are related to water quality and the benthic community. The ability to properly manage dredged material through open-lake placement would enable the continued maintenance of the Upper Cuyahoga River Channel which would facilitate the continued use of Cleveland Harbor at its upstream federal navigation channel limit, and the associated community facilities and activities that it benefits. In this way, it would substantially benefit community and regional sustenance and growth needs. The long-term socioeconomic benefits of this dredging on the region's socio-economic condition would far outweigh the temporary, localized minor adverse effects.

Placement of dredged material at CLA-1 and CLA-4 over time would create a slight mound on the lake bottom which would result in some local bottom surface relief. This mound would be subject to consolidation and tend to flatten over time following the cessation of annual dredged material placement. Available relevant evidence indicates that the aquatic ecosystem at the open-lake placement areas are resilient, and that the periodic disturbance created by open-lake placement of dredged material is absorbed or accommodated by the ecosystem because its structure and function would not fundamentally change over the long-term to a different state. Ecosystem resilience signifies ecosystem health (gauged by species diversity) and stability (the probability that all species persist) (e.g., Scrimgeour and Wicklum 1996).

The placement of dredged material at CLA-4 may temporarily increase the benthic bioaccumulation of PCBs. This increase would be biologically insignificant because benthic tissue residues associated with the dredged material are within the range of those observed at other offshore Lake Erie areas in the general vicinity of Cleveland. In addition, any associated uptake in receptors would be insignificant because the area has spatially limited exposure to benthic feeding receptors and benthos at the area contribute (both directly and indirectly) a very small portion of the receptors' diet. Any residual increase in the benthic bioaccumulation of PCBs at CLA-4 would fail

to exacerbate impaired Lake Erie fish tissue concentrations because it would not translate into any significant increase in exposure.

Any temporary increase in benthic bioaccumulation of PCBs at CLA-4 would be temporary and localized because it relates to a lower concentration of TOC in the dredged material (rather than PCB contamination, which is very similar to CLA-4) relative to the immediately surrounding lake area sediments. The productivity of Lake Erie and biological activity at CLA-4 would serve to amend TOC concentration in the dredged material such that it would increase and approach background levels at the area. Consequently, this natural transition would serve to reduce the localized bioavailability of PCBs such that benthic bioaccumulation would tend to equalize with the surrounding lake environs.

Other on-going or reasonably foreseeable actions by USACE or others in the vicinity of Cleveland Harbor are listed below. Many of these do not directly relate to the proposed open lake placement of Upper Cuyahoga River navigation channel sediments at either CLA-1 or CLA-4 and are included for general context. No adverse impacts to the sustainability of resources are expected as a result of open lake placement activities in light of any of the below activities.

- *Cuyahoga River Bed Load Interception Studies* – Reference Section 2.3.1 of this EA.

- *On-going Cleveland Dredged Material Management Investigations* – Reference Section 2.3.2 of this EA.

- *Gorge Dam* – Reference Section 2.3.3 of this EA.

- *Cleveland Downtown Lakefront Plan* – In 2012, the City of Cleveland Planning Commission approved the Cleveland Downtown Lakefront Plan to "guide mixed-use commercial development of the waterfront between West 3rd and East 18th Streets." The Plan proposes redevelopment strategies for three areas of the downtown lakefront: Harbor West, North Coast Harbor, and Burke Development District (Cleveland Planning Commission, 2014).

- *Cleveland-Europe Express Liner Service* – Starting in the spring of 2014, the only regular, scheduled international container service on the Great Lakes is scheduled to begin between Cleveland and Europe, according to a press release dated November 21, 2013. Initially, one vessel call per month is anticipated between Cleveland and an undetermined major European city which will offer a faster, more cost-effective and greener solution to get goods to global markets, according to the Press Release (CPA, 2013).

- *Cuyahoga River Area of Concern (AOC)* – Cleveland Harbor is located within the designated Cuyahoga River AOC, which includes the lower 45 miles of the river between the Ohio Edison Dam and mouth, and approximately 19 miles of Lake Erie shoreline from Edgewater Park eastward to Wildwood Park (USEPA 2014a). Beneficial use impairments (BUIs) for the AOC currently include restrictions on fish and wildlife consumption, degradation of fish and wildlife populations, beach closings, fish tumors and other deformities, degradation of aesthetics, degradation of benthos, restriction on dredging activities, and loss of fish and wildlife habitat. The proposed action to place dredged

sediments into the open lake has direct bearing on efforts to delist this AOC. In accordance with the State of Ohio Restoration Target for the Cuyahoga River AOC, the restrictions on dredging BUI may be delisted if sediments "meet Ohio EPA guidelines for open water disposal." The USACE sediment evaluation has demonstrated that the material from the Upper Cuyahoga River Navigation Channel does meet all applicable State Water Quality guidelines, which is currently awaiting OEPA concurrence. Therefore, the proposed action should be perceived as a benefit to possible future delisting efforts for the dredging BUI and the overall Cuyahoga AOC.

SECTION 5 – COMPLIANCE WITH ENVIRONMENTAL PROTECTION REQUIREMENTS

In order to characterize the affected environment of the project area and to assess the environmental impacts of the proposed action, information has been obtained from existing literature and through coordination with federal, state, and local agencies. Agencies, interest groups, and the general public that have been contacted during this process are listed in Section 6.0. A Scoping Information Packet was distributed to these individuals on August 14, 2013, and a Section 404(a) Public Notice was distributed on December 2, 2013. Comments received regarding the Scoping Information Packet and Public Notice are included in Appendix D. The following is a list of the applicable, relevant, and appropriate federal statutes, executive orders and memorandum that were considered for the proposed project.

5.1 Abandoned Shipwreck Act of 1987 (43 USC 2101 – 2106); Archaeological and Historical Preservation Act of 1979 (16 USC 470 *et seq.*); National Historic Preservation Act of 1966 (16 USC 470 *et seq.*); Executive Order 11593 (Protection and Enhancement of the Cultural Environment), May 13, 1971 – The project's impact on cultural resources has been evaluated in accordance with Engineer Regulation (ER) 1105-2-50 and 36 CFR Part 800. A reasonable and good faith effort was conducted by USACE in accordance with 36 CFR 800.4(b)(1) to identify any possible significant submerged resources located within or adjacent to the proposed open-lake placement areas. No resources that could potentially be affected through the implementation of the selected plan were identified through this effort. The impact assessments for the federal navigation channel (i.e. dredging area) have been addressed in previous planning and environmental documentation. The USACE has consulted with the National Park Service, Ohio SHPO, and Great Lakes Historical Society with a Scoping Information Packet issued on August 14, 2013 and a Section 404(a) Public Notice issued on December 2, 2013, although no comments were received in this regard. Additionally, a Section 106 Review – Project Summary Form and Determination of Effects report summarizing this effort was coordinated with the SHPO on February 19, 2014. The conclusion of this report was that the open-lake placement of dredged material at CLA-1 and CLA-4 would have no effect upon cultural resources, and therefore the USACE has determined a finding of No Historic Properties Affected. Concurrence on this finding from Ohio SHPO has not yet been received. This EA has been submitted to the National Park Service and SHPO for final review and comment on this determination.

5.2 American Indian Religious Freedom Act (42 USC 1996); Native American Graves Protection and Repatriation Act (25 USC 3001 *et seq.*) – Coordination with the Indian nations listed in Section 6.0 of this EA was initiated via the scoping process. No sacred sites or objects were identified at either CLA-1 or CLA-4 through tribal consultation. Therefore, it is not expected that any adverse effect would be incurred to religious rights as a result of the proposed project. No Native American grave sites or other sensitive sites are expected to be affected by the project. Information on how to access a copy of this EA will be submitted to the applicable Indian nations for final review and comment on this determination.

5.3 Clean Air Act, as Amended, 42 USC 7401 – 7671g – Project coordination was initiated with the USEPA and the OEPA via the scoping process. As indicated in this EA, no significant adverse impacts to air quality would be expected due to project implementation. In addition, copies of the draft EA will be sent to the Regional Administrator of the USEPA requesting comments in compliance with the Clean Air Act.

5.4 Clean Water Act, as Amended (Federal Water Pollution Control Act Amendments of 1972); 33 USC 1251 *et seq.* – The USACE has prepared a Section 404(a) Public Notice and Section 404(b)(1) Evaluation (including a Finding of Compliance) for the project pursuant to the Clean Water Act (Appendix D and B, respectively). On November 27, 2013, the USACE submitted an application to OEPA requesting Section 401 WQC for the proposed open-lake placement of dredged material at CLA-1 and CLA-4 and is included as Appendix B. The decision on this WQC is pending.

5.5 Coastal Zone Management Act of 1972, as Amended, 16 USC 1451 - 1464 – The proposed project has been analyzed with respect to the 41 management policies presented in the State of Ohio Coastal Management Program and Final Environmental Impact Statement (March 1997). This analysis determined that the proposed open-lake placement of dredged material at CLA-1 and CLA-4 would be consistent, to the maximum extent practicable, with this program. A Coastal Management Program Federal Consistency Determination was prepared and coordinated with the ODNR on January 29, 2014, and is included with this EA as Appendix C. Concurrence on this determination from ODNR is pending.

5.6 Comprehensive Environmental Response, Compensation, and Liabilities Act (CERCLA), as Amended; 42 USC 9601-9675 – Project coordination was initiated with agencies and interests including the USEPA via the scoping process and no comments were received in this regard. This project will not impact CERCLA or RCRA designated sites or sites that are part of the National Priorities List (NPL). Assessment of the project site has not identified any areas of concern with potential to encounter hazardous, toxic, or radiological waste. In addition, "since April 1988, with publication of the USACE maintenance dredging and disposal regulations at 33 CFR 335-338, the USACE has asserted that dredged material is not a hazardous waste and should not be regulated under RCRA (Federal Register Vol 53, No. 80, April 28, 1988, pages 14903 and 14910). The USEPA excluded dredged material as a hazardous waste on November 30, 1998, providing the dredged material is regulated under either the CWA or MPRSA (Federal Register Vol 63, No. 229, November 30, 1998) (40 CFR Part 261.4).

5.7 Endangered Species Act, as Amended; Bald Eagle Protection Act, as Amended; Migratory Bird Conservation Act; as Amended; Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds) – Consultation with the USFWS and ODNR relative to the possible presence of threatened or endangered species or their critical habitat within the affected area was initiated on August 14, 2013 and December 2, 2013 via the Scoping and Public Notice, respectively. The USFWS and ODNR noted that the proposed project lies within range of several federal and state-listed Endangered (E) and Candidate (C) species. However, the USFWS noted that due to the project type and location, the proposed project would have no effect on these species. The ODNR also commented that the Natural Heritage Database has no other records for rare or endangered species at the open lake locations.

5.8 Farmland Protection Policy Act (Subtitle I of Title XV of the Agriculture and Food Act of 1981), 7 USC 4201 *et seq.*; Executive Memorandum – Analysis of Prime and Unique Farmlands, CEQ Memorandum, August 30, 1976, January 4, 1979 – Coordination was initiated with the U.S. Department of Agriculture - Farm Service Agency and Natural Resources Conservation Service via the project scoping. No comments were received in this regard. Since the proposed work would not affect prime and unique farmlands in any manner, the recommended action is in compliance with this Act.

5.9 Federal Water Project Recreation Act, as Amended; 16 USC 460l-12 – 4601-22, 662 – In planning the proposed project, full consideration has been given to opportunities afforded by the project for outdoor recreation and fish and wildlife enhancement. Since the proposed project involves placement of dredged material into the open lake environment of Lake Erie there are no anticipated benefits or detriments to public recreation. A review copy of this EA will be provided to the U.S. Department of the Interior in regard to recreation and fish and wildlife activities for conformance with the comprehensive nationwide outdoor recreation plan formulated by the Secretary of the Interior.

5.10 Fish and Wildlife Coordination Act (Fish and Wildlife Conservation and Water Resource Developments-Coordination), 16 USC 661 *et seq.* – Coordination on the proposed project was initiated with the USFWS via the scoping process. The USFWS provided information on fish and wildlife resources in the project areas in a letter dated September 12, 2013. This letter provided information relative to the expected impacts of alternative measures and plans along with some questions or items to address in the EA. These comments have been considered and addressed in the EA. In addition, an email was received from the USFWS on August 30, 2013 stating that "at this point we do not think it will be necessary to complete a USFWS Coordination Act Report. We will provide comments on the scoping document prior to the due date, and will review the Draft EA when it is available."

5.11 Flood Control Act of 1944, 16 USC 460d *et seq.*, 33 USC 701 *et seq.* – Other than routine maintenance dredging, this project will have no effects on any flood control projects.

5.12 Land and Water Conservation Fund Act of 1965; 16 USC 460l-4 *et seq.* – Project coordination was initiated with agencies and interests, including the U.S. Department of the Interior, via the scoping process and no comments were received in this regard. No property that was acquired or developed with assistance from this fund is present in the project area, or would be affected by the project.

5.13 National Environmental Policy Act of 1969, as amended; 42 USC 4321 - 4347 – Project coordination was initiated with agencies and interests via the scoping process in August 2013. The Draft EA and FONSI have been prepared in accordance with the CEQ's "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act," 40 CFR 1500-1506; and Corps of Engineers Regulation ER 200-2-2, "Environmental Quality: Policy and Procedures for Implementing NEPA." With the circulation of this draft EA and FONSI, the proposed project is in partial compliance with this Act. Full compliance will be attained once the public review period has been concluded, no significant adverse impacts are identified that would reverse the District Commander's preliminary FONSI, and the final FONSI is signed.

5.14 Resource Conservation and Recovery Act of 1976, 42 USC 6901 *et seq.* – Project coordination was initiated with agencies and interests including the USEPA via the scoping process. No hazardous waste would be encountered or generated during open lake placement activities, and no potential hazardous waste sites have been identified that would be impacted by the project. Therefore, the project is in compliance with this Act. See also Section 5.6.

5.15 River and Harbor and Flood Control Act of 1970 (P.L. 91-611) – The USACE planning actions have fulfilled the requirements of the Act. All 17 points identified in Section 122 of the Act (P.L. 91-611) have been evaluated in this EA.

5.16 Safe Drinking Water Act, 15 USC 1261 *et seq.* – Extensive sampling, analysis and modeling efforts were undertaken to determine whether the placement of dredged material at either CLA-1 or CLA-4 would have the potential to adversely affect the quality of public water supply sources. These efforts indicate that no meaningful contribution of suspended solids, dissolved constituents or contaminants from dredged material placement operations at CLA-1 and CLA-4 would be expected at any PWI. See Section 4.2.2.3 (b) for a more detailed description of the evaluation of these potential impacts. The project is accordingly in compliance with this Act.

5.17 Toxic Substances Control Act, 15 USC 2601-2671 *et seq.* – Project coordination was initiated with agencies and interests including the USEPA via the scoping process and no comments were received in this regard. See also Section 5.6 of this EA.

5.18 Water Resources Planning Act, 42 USC 1962 *et seq.* – This project has been formulated and evaluated following the guidelines outlined in the U.S. Water Resource Council's "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" (1983), as is required by the Act.

5.19 Watershed Protection and Flood Prevention Act, 16 USC 1001, et seq. – Project coordination was conducted among numerous agencies and individuals with an interest in watershed protection and flood prevention, including: the Federal Emergency Management Agency, USEPA, the U.S. Department of Housing and Urban Development, USFWS, U.S. Department of Agriculture - Natural Resource Conservation Service, ODNR, and other state, regional and local interests (Section 6.0). No significant adverse impacts to watershed protection or flood prevention would be expected with the implementation of the proposed project, as described, and no concerns were expressed in this regard during the NEPA scoping or Clean Water Act Section 404(a) public notice periods.

5.20 Wild and Scenic Rivers Act, as amended; 16 USC 1271, *et seq.* – Project coordination was initiated with agencies and interests including the U.S. Department of the Interior and ODNR via the scoping process and no comments were received in this regard. Although not part of the project area, the federal navigation channel portion of the Cuyahoga River is not designated as a wild, scenic or recreational river.

5.21 Executive Order 11988, Flood Plain Management, May 24, 1977 – The proposed project is located 5-9 miles out into Lake Erie and there are no floodplains that would be affected.

5.22 Executive Order 11990, Protection of Wetlands, May 24, 1977 – There are no wetlands located at either CLA-1 or CLA-4.

5.23 Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, February 11, 1994 – Coordination was initiated with the USEPA via the scoping process and no comments regarding environmental justice were received for this project. The proposed project would not generate any disproportionately high or adverse human health or environmental effects on predominantly low income or minority populations within the project area. Therefore the proposed project is in compliance with the order. The project is expected to benefit the harbor and region economically and socially.

SECTION 6 – PUBLIC/AGENCY COORDINATION

Copies of this Scoping Fact Sheet, Public Notice, and this EA have been sent to the following agencies and individuals for review and comment:

Federal

Federal Aviation Administration
- Detroit Airports District Office

Federal Emergency Management Administration
Federal Maritime Commission
U.S. Coast Guard, Cleveland
U.S. Department of Agriculture
- Animal and Plant Health Inspection Service
- Farm Service Agency
- Forest Service
- Natural Resource Conservation Service

U.S. Department of Commerce
- National Oceanic and Atmospheric Administration

U.S. Department of Energy
U.S. Environmental Protection Agency, Region 5
U.S. Department of Health
- Centers for Environmental Health & Disease Control

U.S. Department of Housing and Urban Development Region 5 Field Office
U.S. Department of the Interior
- National Park Service
- Office of Environmental Policy and Compliance
- U.S. Fish & Wildlife Service

U.S. Department of State
U.S. Department of Transportation
- Federal Highway Administration
- Federal Highway Administration, Midwest Resource Center
- Federal Railroad Administration, Region 2

State

Ohio Department of Health
Ohio Department of Natural Resources
- Office of Coastal Management

Ohio Environmental Protection Agency
- Northeast District Office

Ohio Department of Transportation
- Office of Environmental Services

Ohio Historic Preservation Office
Ohio Sea Grant

Local

Cuyahoga County
- Board of Commissioners
- Board of Health
- Cleveland-Cuyahoga County Port Authority

County Administrator
County Engineer
Cuyahoga River Remedial Action Plan Commission
Cuyahoga Soil and Water Conservation District
Parks & Recreation
Planning Commission
Public Health and Welfare

Northeast Ohio Regional Sewer District

City of Cleveland
City Planning Commission
Cleveland Airport Systems
Department of Port Control, Burke Lakefront Airport
Division of the Environment
Metroparks
Mayor's Office
Water Pollution Control

Indian Nations

Bad River Band of the Lake Superior Tribe of Chippewa Indians, Wisconsin
Bay Mills Indian Community, Michigan
Chippewa-Cree Tribe of the Rocky Boy's Reservation, Montana
Citizen Potawatomi Nation, Oklahoma
Delaware Tribe of Indians, Oklahoma
Forest County Potawatomi Community
Hannahville Indian Community, Michigan
Huron Potawatomi, Inc., Michigan
Keweenaw Bay Indian Community, Michigan
LacCourte Oreilles Band of Lake Superior Chippewa Indians, Wisconsin
Little River Band of Ottawa Indians, Michigan
Little Traverse Bay Bands of Odawa Indians, Michigan
Match-e-be-nash-she-wish Band of Pottawatomi Indians, Michigan
Ottawa Tribe of Oklahoma
Pokagon Band of Potawatomi Indians, Michigan & Indiana
Prairie Band of Potawatomi Nation, Kansas
Red Cliff Band of Lake Superior Chippewa Indians of Wisconsin
Red Lake Band of Chippewa Indians, Minnesota
St. Croix Chippewa Indians of Wisconsin
Seneca Nation of New York
Seneca-Cayuga Tribe of Oklahoma
Sokaogon Chippewa Community, Wisconsin
Tonawanda Band of Seneca Indians, New York
Turtle Mountain Band of Chippewa Indians, North Dakota
Wyandotte Tribe of Oklahoma

Regional/Other Interests

ArcelorMittal Steel Company
Audubon Society
Building Cleveland by Design

Case Western University
Cleveland State University
Cleveland Restoration Society and Preservation Resource Center of Northeastern Ohio
Cleveland Neighborhood Development Coalition
Cleveland Foundation
Cleveland Plain Dealer
Cuyahoga Community College
Detroit Columbia Gulf
Ducks Unlimited
Dike 14 Nature Preserve Committee
Earth Day Coalition
Essroc
Filtrexx
Ford Motor Company
Forest City Yacht Club
Friends of the Crooked River
George Gund Foundation
Great Lakes Commission
Great Lakes Shipping
Great Lakes Towing
Greater Cleveland Partnership
Green City Blue Lake
Heritage Ohio
Interested Citizens
International Salt Company
The Joyce Foundation
Jim Cox & Assoc.
Kenmore Companies
Kurtzman Bros. Inc.
Lake Carriers Association
Lakeside Yacht Basin
League of Ohio Sportsmen
Lower Lakes Marine Historical Society
Mobile Oil Corporation
Ontario Stone Corporation
Peachman Lake Erie Shipwreck Research Center
PB Americas
St. Clair-Superior Development Corp.
Samsel Rope & Marine Supply
Sherwin-Williams Company
Sierra Club
Trout Unlimited
URS
Western Reserve Land Conservancy
Western Reserve Historical Society

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OPERATIONS AND MAINTENANCE

OPEN-LAKE PLACEMENT OF MATERIAL DREDGED FROM CLEVELAND HARBOR FEDERAL NAVIGATION CHANNELS IN THE UPPER CUYAHOGA RIVER

CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

APPENDIX A: TABLES AND FIGURES

FIGURE 1: Cleveland Harbor, Ohio Vicinity Map

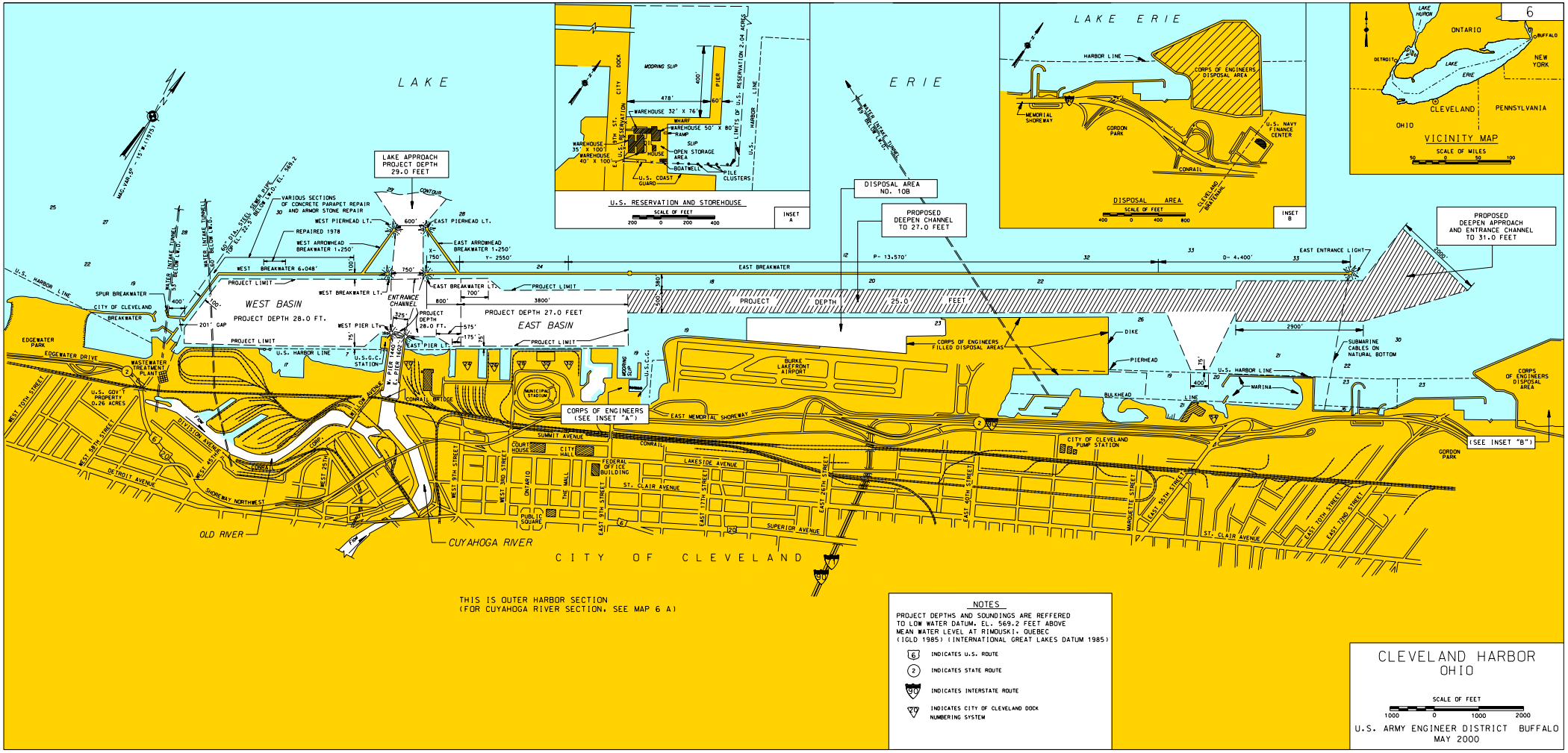


FIGURE 2: Cleveland Harbor Project Map

FIGURE 3: Cleveland Harbor Upper River Reach Discrete Sample Locations and DMMU Boundaries.

FIGURE 4: Potential project locations for Cleveland 204 Study

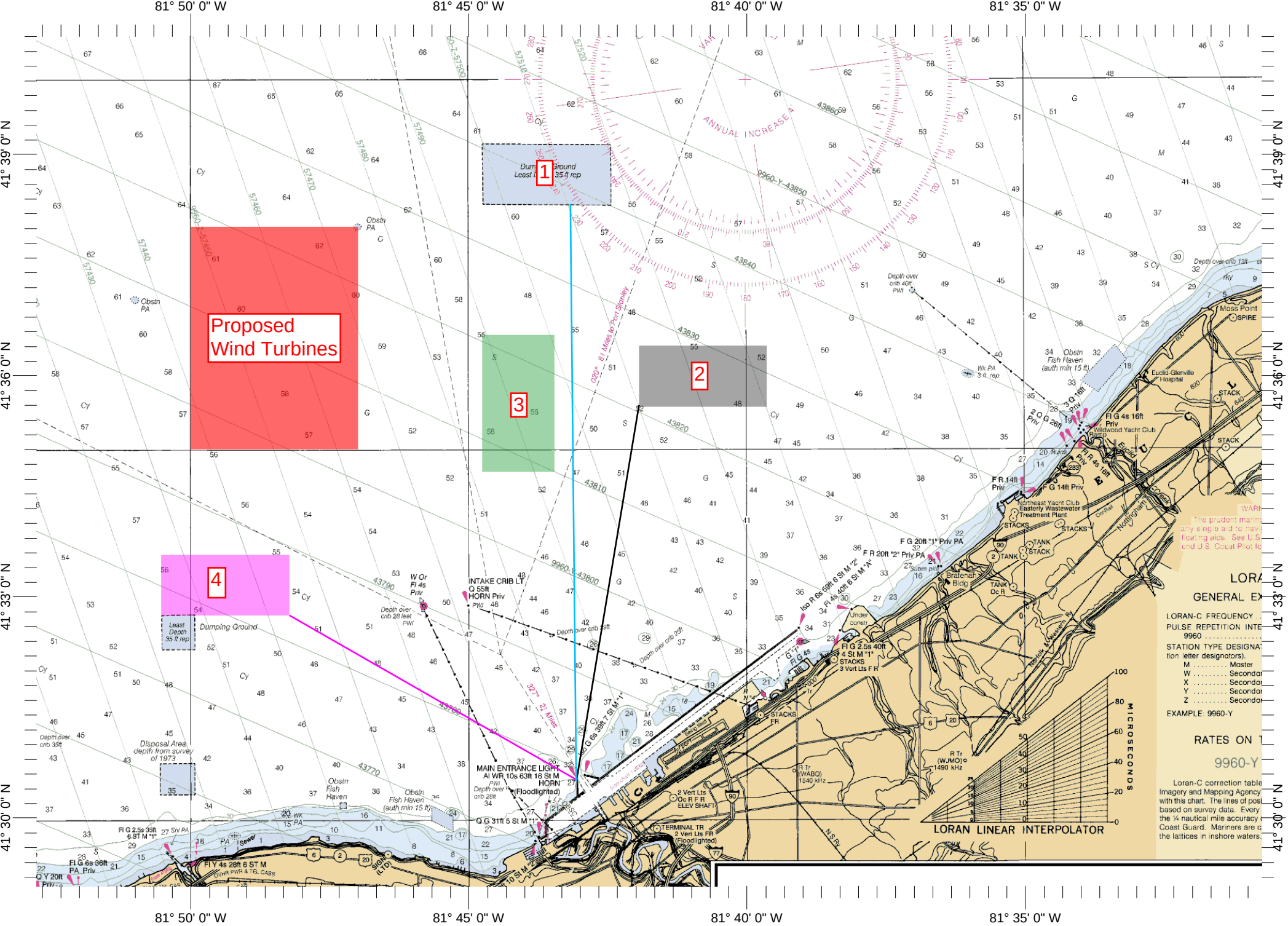
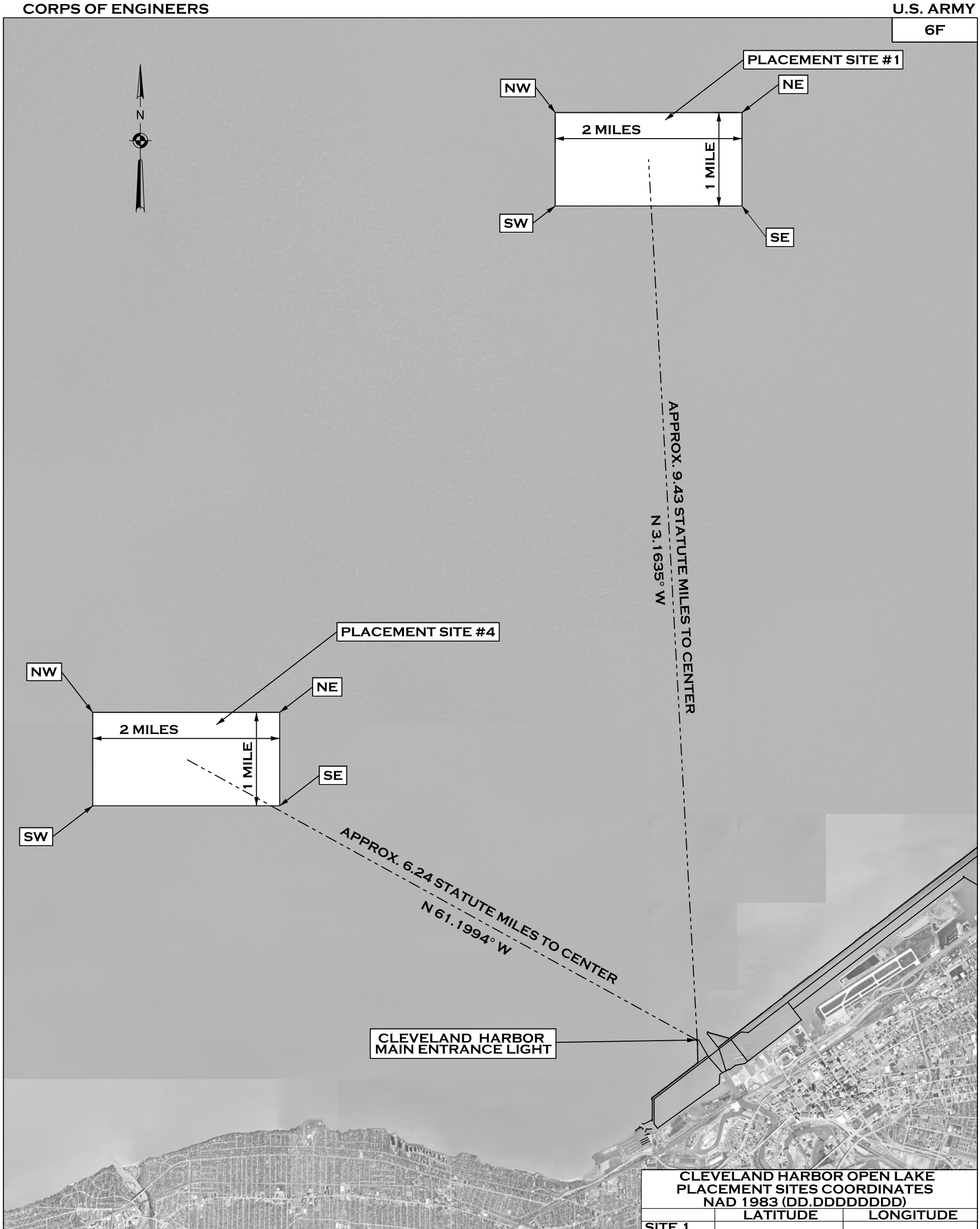


FIGURE 5: Four Originally Proposed Cleveland Harbor Open-Lake Placement Areas

CORPS OF ENGINEERS

U.S. ARMY

6F



CLEVELAND HARBOR OPEN LAKE PLACEMENT SITES COORDINATES NAD 1983 (DD.DDDDDDDD)		
	LATITUDE	LONGITUDE
SITE 1		
CENTER	41.645504988	81.726066535
NE	41.652619543	81.706661473
SE	41.638130041	81.706837175
SW	41.638387177	81.745467376
NW	41.652876734	81.745300230
SITE 4		
CENTER	41.553171131	81.822554593
NE	41.560302010	81.803187373
SE	41.545811921	81.803341480
SW	41.546037006	81.841917596
NW	41.560527144	81.841772022

CLEVELAND HARBOR

OHIO

OPEN LAKE PLACEMENT SITE LOCATION

SCALE OF MILES

1 ½ 0 1

U.S. ARMY ENGINEER DISTRICT BUFFALO

NOVEMBER 2013

LOCATION OF PLACEMENT AREAS WERE CALCULATED AS FOLLOWS:

1. THE LAT/LON COORDINATES WERE PROVDIED TO TD-DS IN A EMAIL FROM PM-EA ON 17 OCT. 2013.
2. THE COORDINATES WERE CONVERTED TO STATE PLANE COORDINATES USING CORPSCON AND PLOTTED IN A CADD FILE.
3. THE SOUTHWEST CORNER WAS HELD AS THE STARTING POINT WITH LINES DRAWN DUE EAST AT 2 MILES AND DUE NORTH AT 1 MILE, THEN COPIED PARALLEL TO FORM THE 2 MILE X I MILE SITE.
4. THE XY STATE PLANE COORDINATES OF THE CORNERS FROM THE DRAWN PLACEMENT SITE WERE THEN CONVERTED TO LAT/LON FOR INCLUSION ON THIS MAP.
5. THE BEARING AND DISTANCE TO THE CENTERS WAS CALCULATED BY DRAWING A LINE FROM THE CENTER OF THE PLACEMENT SITE TO THE LIGHTHOUSE SHOWN ON A GEOREFERENCED SID FILE OBTAINED FROM THE OHIO GRAPHICALLY REFERENCED INFORMATION PROGRAM.

FIGURE 6: Cleveland Lake Area (CLA)-1 and CLA-4 Location Map

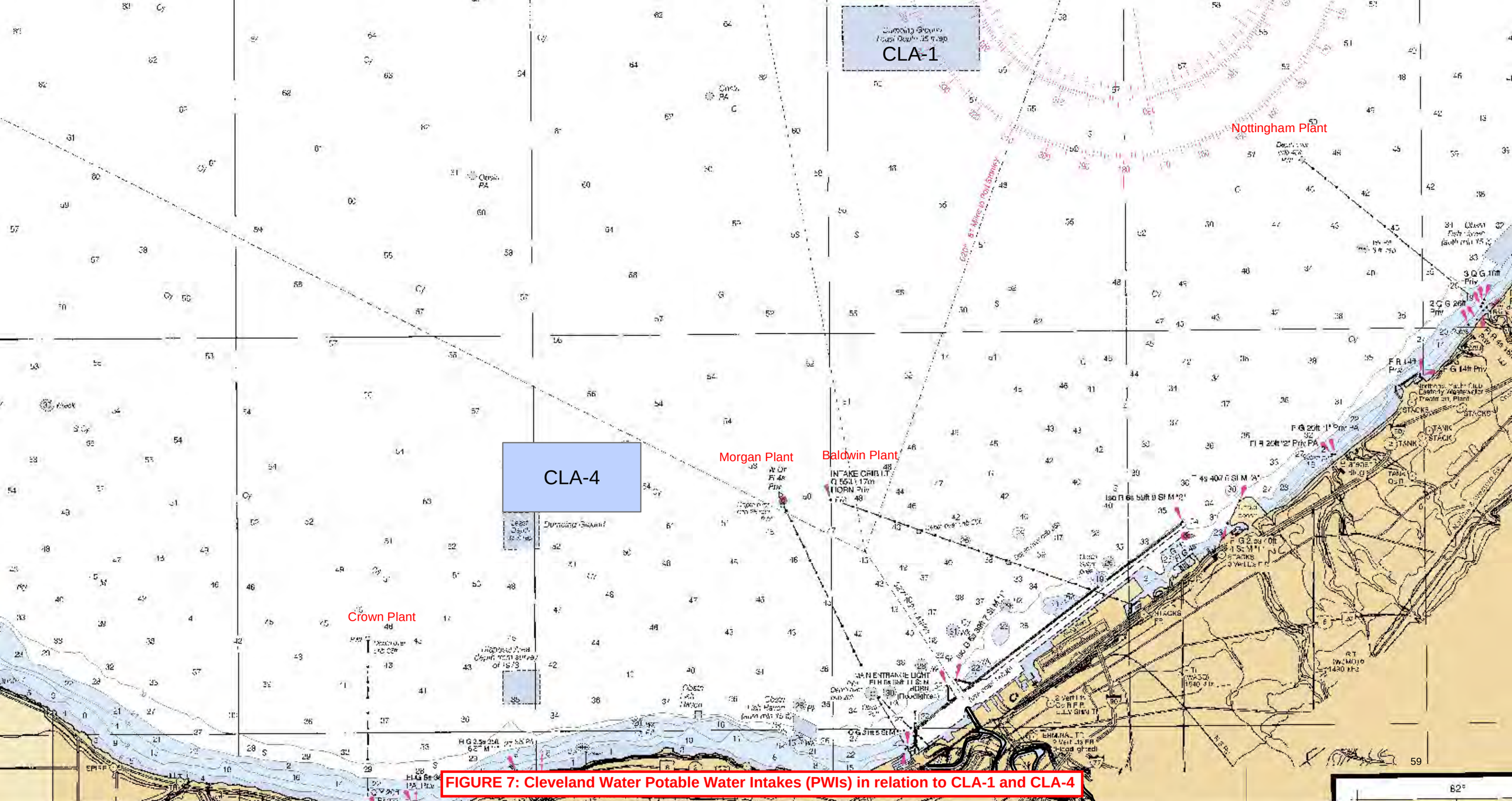


FIGURE 7: Cleveland Water Potable Water Intakes (PWIs) in relation to CLA-1 and CLA-4

TABLE 1. Summary of toxicological impacts of open-lake placement of Upper Cuyahoga River Channel dredged material according to contaminant determination Clean Water Act Section 404(b)(1) Guidelines, and with regard to potable water intake (PWI) and harmful algal bloom (HAB)-related concerns.

TOXICOLOGICAL IMPACT	TEST/SCREENING MODEL	MEASUREMENT ENDPOINT	CRITERIA	RESULTS	EVALUATION
Placement of dredged material at CLA-1 and CLA-4	*Hyalella azteca* sediment bioassay	Survival (benthic)	Survival not statistically lower in comparison to open-lake placement/reference area sediments	Survival not statistically different than open-lake placement/reference area sediments	All management units meet Federal guideline at Tier 3
	Chironomus dilutus sediment bioassay	Survival (benthic)	Survival not statistically lower in comparison to open-lake placement/reference area sediments	Survival not statistically different than open-lake placement/reference area sediments	All management units meet Federal guideline at Tier 3
	C.dilutus sediment bioassay	Growth (benthic)	Growth of ≥0.6 mg	Growth exceeded 0.6 mg	All management units meet Federal guideline at Tier 3
	Lumbriculus variegatus bioaccumulation	Bioaccumulation of PCBs (benthic)	Bioaccumulation not statistically higher in comparison to open-lake placement/reference area sediments; bioaccumulation less than 2 times open-lake placement/reference area sediments	Bioaccumulation from DMMU-2a and DMMU-2b was not statistically different in comparison to CLA-1; while bioaccumulation from DMMU-1 was statistically greater, it was less than 2 times less than CLA-1 and also within the range of lake background; bioaccumulation from all management units was statistically higher and more than 2 times higher in comparison to CLA-4 but was within the range of lake background	All management units meet Federal guideline at Tier 3 in comparison to CLA-1; placement of dredged material at CLA-4 requires additional evaluation at Tier 3 and/or Tier 4
	Receptor (walleye and perch) bioaccumulation exposure model	Bioaccumulation exposure factor (BEF) (pelagic)	BEF of <2	BEFs for DMMU-1, DMMU-2a and DMMU-2b were all equal to or less than 1.2 (if placement is limited to one-square mile at CLA-1 and two-thirds square mile at CLA-4) and fell within the general range of analytical variability; an additional statistical comparison of pre- vs. post-placement area-weighted *L. variagatus* tissue residues shows that the difference is insignificant and would not translate into any significant increased bioaccumulation risk to receptors	DMMU-1, DMMU-2a and DMMU-2b meet Federal guideline for placement at CLA-4 at Tier 3 and/or Tier 4
	L. variegatus bioaccumulation	Bioaccumulation of DDTs (benthic)	Bioaccumulation not statistically higher in comparison to open-lake placement/reference area sediments; bioaccumulation less than 2 times open-lake placement/reference area sediments	Bioaccumulation from all management units was not statistically different in comparison to CLA-1; bioaccumulation from DMMU-2b was not statistically different in comparison to CLA-4; bioaccumulation from DMMU-1 and DMMU-2b was statistically greater and more than 2 times that of CLA-4	All management units meet Federal guideline at Tier 3 in comparison to CLA-1; placement of dredged material from DMMU-1 and DMMU-2b at CLA-4 requires additional evaluation at Tier 3 and/or Tier 4
	Receptor (walleye and perch) bioaccumulation exposure model	BEF (pelagic)	BEF of <2	BEFs for DMMU-1, DMMU-2a and DMMU-2b were all less than 1.13 and fell within the general range of analytical variability	DMMU-1, DMMU-2a and DMMU-2b meet Federal guideline for placement at CLA-4 at Tier 3 and/or Tier 4
	Standard elutriate test and short-term fate model	Ohio water quality standards (WQSs) (water column)	Compliance with applicable WQSs	Except for ammonia and toluene, all sediment contaminant releases were below applicable numeric WQSs; ammonia and toluene would comply with applicable WQSs after rapid water column mixing	Open-lake placement of all management unit dredged material complies with applicable Ohio WQSs
	Pimephales promelas elutriate bioassay	Survival (water column)	Survival in comparison to control	No significant toxicity observed for DMMU-1; although significant toxicity was observed in only 100% elutriates for DMMU-2a and DMMU-2b, toxicity was concluded to be due to ammonia, which rapidly dilutes in the water column	All management units meet Federal guideline at Tier 3
	Ceriodaphnia dubia elutriate bioassay	Survival (water column)	Survival in comparison to control	No significant toxicity observed for any of the management units	All management units meet Federal guideline at Tier 3
Potential impact of plumes on quality of water at PWIs	Particle tracking model (PTM)	Transport of suspended solids	Solids plume characterization	After settling, bedded dredged material placed at CLA-1 and CLA-4 would not erode due to depth and low current velocities; modeling showed that currents at CLA-1 would transport any suspended solids after placement well north of all PWIs; under a worst-case scenario assuming placement at the closest southeast corner, solids losses from dredged material placement at CLA-4 would increase background suspended solids from about 5 to 6 mg/L at the Morgan PWI about 1% of the time	Solids losses resulting from dredged material placement at CLA-1 and CLA-4 would not have any significant impact on suspended solids water column concentrations at any of the PWIs
	PTM and modeled contaminant concentrations associated with suspended solids	Ohio WQSs and Federal water quality criteria (WQC)	Comparisons to applicable WQSs for the protection of human health	Under the worst-case scenario assuming dredged material placement at the closest southeast corner of CLA-4, the highest dissolved contaminant concentrations at the Morgan PWI would be below Ohio WQSs (as well as Federal WQC) for the protection of human health	No meaningful contribution of contaminants from dredged material placement at CLA-1 and CLA-4 would occur at any of the PWIs
Potential influence of plumes on HABs	Short-term fate model for dissolved phosphorus	Protection from growth of cyanobacteria and HABs	Various dissolved and unfiltered total phosphorus concentrations	All dissolved and unfiltered phosphorus elutriate concentrations are achieved within 1200 feet and 35 minutes	Dredged material placement would occur outside conditions conducive to nuisance algae proliferation (e.g., lake temperature); the extend and duration of phosphorus plumes from placement at CLA-4 is very small and short-lived, and insufficient to pose an effect on the occurrence of HABs or adversely impact water quality in the Central Basin

TABLE 2. Impact assessment of bioaccumulation of PCBs from the dredged material following placement at open-lake areas CLA-1 and CLA-4.

Management unit (total PCB level in worm tissue)	Bioaccumulation assessment of placement at open-lake area (total PCB level in worm tissue)	
	CLA-1 (48.2 µg/kg)	CLA-4 (19.3 µg/kg)
DMMU-1 (72 µg/kg)	•Increase in benthic bioaccumulation is statistically significant relative to CLA-1	•Increase in benthic bioaccumulation is statistically significant relative to CLA-4
	•Benthic bioaccumulation exeeds calculated average regional background of 45 µg/kg	•Benthic bioaccumulation exeeds calculated average regional background of 45 µg/kg
	•Since total PCB magnitude of difference (MOD) of 1.5 is less than 2 per ASTM guidance, increase in benthic bioaccumulation is not biologically significant	•Since total PCB MOD of 3.7 exceeds 2 per ASTM guidance, bioaccumulation may be biologically significant, and is further evaluated
	•Since increase in benthic bioaccumulation is not biologically significant, increase in potential risk to fish is considered insignificant. Conservative prediction of potential bioaccumulation exposure (as represented by a bioaccumulation exposure factor [BEF]) to yellow perch as a receptor with respect to regional lake sediments is 1.03 and biologically insignificant	•Conservative prediction of potential bioaccumulation exposure (as represented by a BEF) to yellow perch as a receptor with respect to regional lake sediments is 1.03 and biologically insignificant
	•Bioaccumulation of PCBs from dredged material is not biologically significant	•Bioaccumulation of PCBs from dredged material is not biologically significant
	•Discharge of dredged material at CLA-1 complies with applicable Ohio water quality standards for the protection of aquatic life	•Discharge of dredged material at CLA-4 complies with applicable Ohio water quality standards for the protection of aquatic life
DMMU-2a (50.6 µg/kg)	•Increase in benthic bioaccumulation is not statistically significant relative to CLA-1	•Increase in benthic bioaccumulation is statistically significant relative to CLA-4
	•Benthic bioaccumulation is comparable to calculated average regional background of 45 µg/kg	•Benthic bioaccumulation is comparable to calculated average regional background of 45 µg/kg
	•Since benthic bioaccumulation is not statistically significant, risk to fish is considered insignificant	•Since total PCB MOD of 2.6 exceeds 2 per ASTM guidance, bioaccumulation may be biologically significant, and is further evaluated
	•Bioaccumulation of PCBs from dredged material is not biologically significant	•Conservative prediction of potential bioaccumulation exposure (as represented by a BEF) to yellow perch as a receptor with respect to regional lake sediments is 1.01 and biologically insignificant
		•Bioaccumulation of PCBs from dredged material is not biologically significant
	•Discharge of dredged material at CLA-1 complies with applicable Ohio water quality standards for the protection of aquatic life	•Discharge of dredged material at CLA-4 complies with applicable Ohio water quality standards for the protection of aquatic life
DMMU-2b (52 µg/kg)	•Increase in benthic bioaccumulation is not statistically significant relative to CLA-1	•Increase in benthic bioaccumulation is statistically significant relative to CLA-4
	•Benthic bioaccumulation is comparable to calculated average regional background of 45 µg/kg	•Benthic bioaccumulation is comparable to calculated average regional background of 45 µg/kg
	•Since benthic bioaccumulation is not statistically or biologically significant, risk to fish is considered insignificant	•Since total PCB MOD of 2.7 exceeds 2 per ASTM guidance, bioaccumulation may be biologically significant, and is further evaluated
	•Bioaccumulation of PCBs from dredged material is not biologically	•Conservative prediction of potential bioaccumulation exposure (as represented by a BEF) to yellow perch as a receptor with respect to regional lake sediments is 1.01 and biologically insignificant
		•Bioaccumulation of PCBs from dredged material is not biologically significant
	•Discharge of dredged material at CLA-1 complies with applicable Ohio water quality standards for the protection of aquatic life	•Discharge of dredged material at CLA-4 complies with applicable Ohio water quality standards for the protection of aquatic life

OPERATIONS AND MAINTENANCE

OPEN-LAKE PLACEMENT OF MATERIAL DREDGED FROM CLEVELAND HARBOR FEDERAL NAVIGATION CHANNELS IN THE UPPER CUYAHOGA RIVER

CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

APPENDIX B:

- **SECTION 404(B)(1) EVALUATION**
- **2014 SECTION 401 STATE WATER QUALITY CERTIFICATION APPLICATION (INCLUDES CLEVELAND HARBOR DREDGED MATERIAL EVALUATIONS)**
- **COMMENTS RECEIVED ON USACE EVALUATION (UNIVERSITY OF AKRON [2]; OEPA)**
- **USACE RESPONSE TO OEPA ASSESSMENT**

OPERATIONS AND MAINTENANCE

OPEN-LAKE PLACEMENT OF MATERIAL DREDGED FROM CLEVELAND HARBOR FEDERAL NAVIGATION CHANNELS IN THE UPPER CUYAHOGA RIVER

CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

• SECTION 404(B)(1) EVALUATION

SECTION 404(b)(1) EVALUATION

OPERATIONS & MAINTENANCE
(DREDGING WITH DISCHARGE OF DREDGED MATERIAL)
CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

Section 404(b)(1) of the Clean Water Act (33 USC 1344) requires that disposal sites for discharges of dredged or fill material proposed for placement into waters of the United States be evaluated through the application of guidelines developed by the Administrator of the U.S. Environmental Protection Agency (USEPA) in conjunction with the Secretary of the Army. This evaluation addresses the open-lake placement of dredged material from Cleveland Harbor's Federal navigation channels in the upper Cuyahoga River Channel and is based on the regulations found at 40 CFR 230, "Guidelines for the Specification of Disposal Sites for Dredged and Fill Material."

1. PROJECT DESCRIPTION

1.1 Location.

Cleveland Harbor is located in Cuyahoga County, Ohio and is situated on the south shore of Lake Erie at the mouth of the Cuyahoga River, approximately 190 miles southwest of Buffalo, NY and 110 miles east of Toledo, OH.

1.2 General Description.

1.2.1 *Cleveland Harbor Federal Navigation Project*. The Federal navigation project at Cleveland Harbor is designed to accommodate commercial navigation and is maintained by the U.S. Army Corps of Engineers (USACE). The harbor consists of a breakwater protected lakefront harbor on Lake Erie and improved navigation channels in the Cuyahoga and Old Rivers. A series of authorized Federal navigation channels are designed and maintained so that deep-draft commercial vessels can safely navigate the harbor. The harbor includes an Outer Harbor section and Cuyahoga River section, consisting of a River Channel, Turning Basin, Old River Channel and Outer Harbor channels. Project maps of the Outer Harbor and Cuyahoga River sections of Cleveland harbor are provided as Figures 1 and 2, respectively.

Cleveland Harbor requires maintenance dredging on an annual basis to facilitate commercial, deep-draft navigation. About 80 percent of the harbor's annual dredging needs are typically in the upper reach of the Cuyahoga River Channel between the upstream limit (Station 799+00) and downstream upper Turning Basin (Station 736+00). This reach is referred to as the Upper Cuyahoga River Channel. The quantity of material annually dredged from this reach is on the order of 200,000 cubic yards, the vast majority of which has been placed in Federal and non-Federal confined disposal facilities (CDFs) since about 1968.

1.2.2 *Upper Cuyahoga River Channel*. In 2013, sediments within the Upper Cuyahoga River Channel were evaluated using data collected in 2012, to determine their suitability for open-lake

placement. Based on joint USEPA/USACE guidelines for the testing and evaluation of Great Lakes dredged material (USEPA/USACE 1998), it was determined that material within this reach is suitable for open-lake placement. Therefore, the proposed operation and maintence plan for this area of the harbor is annual dredging, with placement of up to 200,000 cubic yards of dredged material at one of two proposed open-lake placement areas in Lake Erie. These areas, referred to as CLA-1 and CLA-4, are shown in Figure 3.

The maintenance dredging would be performed by a private firm contracted by the Federal government. The dredging would be completed by mechanical means using a clamshell bucket, with placement of the dredged material in a scow for transport to the designated open-lake placement area for discharge.

1.3 Authority and Purpose.

The Federal navigation project at Cleveland Harbor, including its operation and maintenance was authorized by the River and Harbor Acts of 1875, 1886, 1888, 1896, 1899, 1902, 1907, 1910, 1916, 1917, 1935, 1937, 1945, 1946, 1958, 1960, 1962, the Water Resources Development Acts of 1976 and 1986, the Supplemental Appropriations Act of 1987 and the Energy & Water Appropriations Act of 1988.

The purpose of this project is to maintain authorized dimensions (i.e., depths and widths) of the Upper Cuyahoga River Channel in Cleveland Harbor. Shoaling of the channel causes a reduction in navigable depths for deep-draft commercial navigation. Dredging restores channels to authorized project dimensions (both width and depth), which facilitates safe commercial navigation and its associated benefits.

1.4 General Description of Dredged or Fill Material.

1.4.1 *General Characteristics of the Material*. Physical analyses of Upper Cuyahoga River Channel sediments are described in USACE (2013a). The dredged material is composed of fine sands, silts, clays and water with residual bulk concentrations of contaminants and organic matter. Residual concentrations of contaminants are similar to those in the open-lake environs and not of toxicological significance.

1.4.2 *Quantity of Material*. An estimated 200,000 cubic yards of dredged material would be dredged annually from the Upper Cuyahoga River Channel and discharged in the open-lake.

1.4.3 *Source of Material*. The source of the dredged material will be the Upper Cuyahoga River Channel. Sediments enter Cleveland Harbor's Cuyahoga River Channel mainly from the upstream river reach. These sediments are deposited in the channel where widening and deepening have created low current velocities.

The Cuyahoga River Watershed drains 813 square miles of land in Geauga, Portage, Summit, and Cuyahoga Counties. This is less than 3% of the land in Ohio, however houses over 16% of the state's population. This drainage system is called a watershed or a river basin and includes the total land area drained by a river and its tributaries. The Cuyahoga River Watershed collects all

the surface water that enters the basin as precipitation and sends it south, west, and north over a 100-mile course which ends at Lake Erie. The lower region of the Cuyahoga River watershed in Cuyahoga County is dominated by industry and dense urban development. Industry occupies 12% of the land area in the lower region, and two-thirds of the watershed's population resides here. Industrial and urban areas are developed right up to the banks of the River. The highways, roads, culverts, and sewers are part of the Cuyahoga drainage, the sewer system being the dominant drainage.

1.5 General Description of the Proposed Discharge Sites.

1.5.1 *Location*. The two proposed open-lake placement areas, CLA-1 and CLA-4, are located in the Central Basin of Lake Erie, north of the harbor (Figure 3). CLA-1 and CLA-4 are located in a larger offshore Lake Erie environment running west-to-east between Rocky River, Ohio and Cleveland, in depths ranging from 0 (the general lake shoreline) to 62 feet below LWD. This larger lake area is largely influenced by urban activities as well as urban point and non-point source discharges.

Open-lake area CLA-1 represents the historic open-lake placement area for Cleveland Harbor (per 1941 USACE drawing). While this area was historically used for dredged material placement prior to the implementation of the Clean Water Act, it is not an authorized area under the Act (Section 404) and thus has not been authorized for further use. This site is approximately two square miles (two miles in length and one mile in width) in area, the center of which is located approximately 9.43 miles north of the West Breakwater Light (Main Entrance Light) at a bearing of N3.1635°W (azimuth 357°).

Open-lake area CLA-4 represents a proposed new open-lake placement area for Cleveland Harbor and has not been historically used. The area is approximately two square miles (two miles in length and one mile in width) in area, the center of which is located approximately 6.24 miles northwest of the West Breakwater Light at a bearing of N61.1994°W (azimuth 299°), directly north of the existing, authorized Rocky River Harbor placement area.

1.5.2 *Size*. CLA-1 and CLA-4 are each two square miles in area. CLA-1 is at an approximate depth of 62 ft LWD[1] and CLA-4 is at an approximate depth of 55 ft LWD.

1.5.3 *Type of Site*. CLA-1 and CLA-4 are both deep water open-lake areas. Physical analysis of the sediments is described in USACE (2013); both sites consist predominantly of silts and clays. Open-lake area CLA-1 was previously used for the placement of material dredged from Cleveland Harbor over 40 years ago. Currents and velocities at both areas are principally wind-driven and unstratified, and are predominantly in an easterly or east-northeasterly direction, running parallel to the shoreline.

1.5.4 *Type of Habitat*. CLA-1 and CLA-4 are essentially comprised of warm-water, mud-

1 Low Water Datum (LWD) for Lake Erie is defined as 569.2 feet above mean sea level at Rimouski, Quebec, Canada (IGLD 1985).

bottom (mainly silt/clay) benthic substrate with overlying water column. Bottom sediments at these areas are colonized by a community of benthic invertebrates that are relatively low in species diversity and dominated by oligochaetes and chironomids. The water column at these areas is used by most fish, nekton and plankton on a transient basis as required for foraging and migration. Aquatic birds use the water surface and water column on a transient basis for resting and foraging. Examples of key biological receptors at these open-lake areas include pelagic and/or demersal fish species such as walleye, yellow perch and rainbow smelt.

A detailed description and assessment of the benthic macroinvertebrate communities at CLA-1 and CLA-4 is contained in Kennedy *et al.* 2014. Four sediment grab samples were collected from both CLA-1 and CLA-4 to characterize the associated benthic communities. The most abundant phylum identified was the segmented annelid worms, which consisted of three genera from the oligochaete family Tubificidae and one specimen from the leech family Glossiphoniidae. The second most abundant phylum was Arthropoda (e.g., insects, crustaceans), which was represented only by the insect family Chironomidae (midges). Mollusks were the third most abundant phylum, consisting of sphaeriid clams and dreissenid (zebra/quagga) mussels. Finally, the phylum Nematoda (segment-less worms) was represented by only four individual specimens (<2% of the total). Benthic communities at CLA-1 and CLA-4 were comparable in terms of abundance and total richness. Taxonomic composition of the areas was fairly similar, with slight dissimilarity occurring due to presence/absence of leeches (one specimen in one sample), dreissenid mussels (present in one sample), and Nematode worms (present in two samples). Differences in diversity and similarity between the two areas were caused by the greater diversity of tubificid worm genera at CLA-1 and the greater diversity of chironomid genera at CLA-4. Overall, the benthic macroinvertebrate communities at the areas were similar, with slightly greater diversity at CLA-4. The communities in both areas had a relatively low density and low taxonomic richness, and the majority of the organisms were pollution tolerant.

1.5.5 *Timing and Duration of Discharge*. Dredged material placement at CLA-1 and CLA-4 would be limited to one-square-mile or less. Open-lake placement of dredged material would occur during the harbor's dredging operations which generally occur between May 1 and December 30. Dredged material discharges from a scow would consist of a series of episodic, discrete, short-term discharges throughout the dredging project.

1.6 Description of Discharge Method.

Material from the Upper Cuyahoga River Channel would typically be mechanically dredged using a clamshell bucket, then placed in a scow for transport and discharged at the designated open-lake placement area. The dredged material is composed of sands, silts, clays and water with residual bulk concentrations of contaminants and organic matter. During discharge, dredged material is released from the scow and descends through the water column until it hits the bottom substrate, then collapses and spreads out before coming to rest on the lake bottom.

2. FACTUAL DETERMINATIONS

2.1 Physical Substrate Determinations.

2.1.1 *Substrate Elevation and Slope*. The discharge of dredged material at CLA-1 and CLA-4 would serve to slightly increase the elevation of the existing lake bottom. This increase in bottom relief would have a slight slope. Over time, this increase in surface relief would flatten out.

2.1.2 *Sediment Type*. Sediments at CLA-1 and CLA-4 are primarily comprised of silts and clays. The dredged material primarily consists of silt and clay, with fine sand.

2.1.3 *Dredged Material Movement*. Dredged material placed at CLA-1 and CLA-4 would be subject to any lake-bottom currents. The placed sediment would behave in a manner similar to the adjacent and surrounding lake bottom sediments; deeper depths of the open-lake placement areas would serve to allay the potential for sediment erosion, resuspension and movement. Dredged material movement following active open-lake placement would not occur because the bottom shear stress at CLA-1 and CLA-4 are too small to erode and resuspend the deposited material, even under severe storm conditions. This is attributable to the deeper depths of these areas, which are too great to be influenced by surface waves and where circulation velocities are low.

2.1.4 *Physical Effects on Benthos*. The particle size distribution of the dredged material is similar to that of the substrate at CLA-1 and CLA-4. Since the dredged material particle size is similar to bottom sediments at the open-lake placement areas, significant alterations in physical sediment characteristics at CLA-1 and CLA-4 would not occur.

2.1.5 *Other Effects*. Some compaction of the existing substrate at the open-lake area may occur as a result of dredged material placement.

2.1.6 *Actions Taken to Minimize Impacts*:

Dredged material placement at CLA-1 and CLA-4 would be limited to one square mile or less in spatial area. Dredged material placement would be diffusive in nature, resulting in minimal effect on bottom slope and elevation.

2.2 Water Circulation, Fluctuation and Salinity Determinations.

2.2.1 *Water*:

a. Salinity—Not applicable.

b. Water Chemistry—Reference Section 2.3.2.

c. Clarity—Reference Section 2.3.1.

d. Color—Reference Section 2.3.1.

e. Odor—The atmospheric exposure of organic matter which may be contained in the dredged material would result in a short term, localized malodor.

f. Taste—No significant effects.

g. Dissolved Gas Levels—Reference Section 2.3.2.

h. Nutrients—Reference Section 2.3.3.

i. Eutrophication—Reference Section 2.3.3.

2.2.2 *Current Patterns and Circulation*:

a. Current Pattern and Flow—No significant effects.

b. Velocity—No significant effects.

c. Stratification—No significant effects.

d. Hydrologic Regime—No significant effects.

2.2.3 *Normal Water Level Fluctuations*. No significant effects.

2.2.4 *Salinity Gradients*. Not applicable.

2.2.5 *Actions Taken to Minimize Impacts*. No further actions are deemed appropriate.

2.3 Suspended Particulate/Turbidity Determinations.

2.3.1 *Expected Changes in Suspended Particulates and Turbidity in the Vicinity of the Placement Site*. The open-lake placement of dredged material would result in episodic, short-term, localized increases in turbidity. The dredged material is typically released from a scow into the water column and therefore settles very rapidly as a mass that is similar to flocculent settling. Because it settles as a mass, very little turbidity is generated via a plume before the material reaches the lake bottom. Turbidity plumes from the discharge would be small in spatial extent and magnitude, and decay to background within a matter of hours.

Bailey et al. (2013) details project-specific modeling parameters used to predict the fate and transport of dredged material in Lake Erie during placement operations, including operations data (proposed method, volume, location, and rate of discharge), placement site conditions and hydrodynamic considerations (current patterns, water circulation and fluctuations, wind and wave action, and other physical factors on the movement of suspended particulates), and suspended sediment source data (classification and concentrations of suspended particulate/turbidity in the vicinity of the disposal site, the shape, size and duration of the plume

of suspended particulates). The Particle Tracking Model (PTM) study (Bailey et al. 2013) concluded that solids losses resulting from the placement of Cleveland Harbor dredged material at the open-lake placement areas would not be expected to have any significant impact on water column total suspended solids (TSS) concentrations at local potable water intake (PWI) structures (Crown, Morgan, Baldwin and Nottingham). Under the worst-case scenario, TSS contributions of 1.37 mg/L from dredged material placement at CLA-4 would occur at the Morgan PWI only about 1% of the time. During this time period, water column TSS would increase from about 5 mg/L (background) to 6 mg/L. No measurable TSS contributions are expected to occur at any of the other PWIs.

2.3.2 *Effects on Chemical and Physical Properties of the Water Column*:

a. Light Penetration—The open-lake placement of dredged material would result in negligible reductions in light penetration into the water column resulting from episodic, minor, short term increases in turbidity.

b. Dissolved Oxygen—Dredged channel sediments are typically anoxic; the open-lake placement of dredged material would result in episodic, short-term, minor reductions in dissolved oxygen in the water column.

c. Toxic Metals and Organics—Metals and organics would be present in effluent resulting from the open-lake placement of dredged material and primarily be associated with suspended solids. Elutriate testing was conducted to predict the release of contaminants to the water column from the dredged material discharge (USACE 2013a). Pesticides and PCBs were not detected in the elutriate samples. Low dissolved releases of PAHs, metals and inorganics (cyanide, ammonia, nitrate, phosphorus) were detected. The low releases comply with applicable water quality standards (WQSs) that are protective of aquatic life. Ammonia concentrations in the elutriate were greater than water quality standards that are protective of aquatic life and were thus further evaluated through the Short-Term Fate (STFATE) model. While toluene was not analyzed in the elutriate, it was detected in bulk sediment samples and also evaluated for potential short-term releases to the water column during barge discharges. The model results, based on site-specific chemistry, sediment, site and operations data, determined that water quality criteria for short-term and long-term exposures would be met within 2,300 ft of the point of discharge and within 32 minutes of the dredged material release (Borrowman and Schroeder 2013). This limited exposure would not represent an unacceptable impact to the water column at the open-lake placement areas. Ammonia is transient and not environmentally persistent, and would rapidly dilute in the water and not be toxic to fish (or other water column organisms) at the concentrations observed upon dilution during open-lake placement.

With respect to PWIs, worst-case contaminant contributions were determined for the Morgan PWI, based on the PTM results. Dissolved phase contaminant concentrations at the PWI were determined through equilibrium partitioning modeling based on the following conservative assumptions: a worst case TSS concentration of 1.37 mg/L, maximum contaminant concentrations associated with the effective clay and organic fractions, and all of the contaminants in the dredged material are associated with the fraction of particles that would be

transported to the PWI. All calculated dissolved phase concentrations were well below Ohio and Federal drinking water standards and criteria; no meaningful contribution of contaminants from dredged material placement operations at the open-lake placement areas are expected at any PWI (Schroeder and Borrowman 2013).

d. Pathogens—The open-lake placement of dredged material would not significantly influence pathogens.

e. Aesthetics—The short-term increases in turbidity resulting from the open-lake placement of dredged material would be temporarily aesthetically displeasing. The turbidity plume would be localized and dissipate before affecting widespread areas.

2.3.3 *Effects on Biota*:

a. Primary Production and Photosynthesis—The open-lake placement of dredged material would result in negligible changes in primarily production and photosynthesis at CLA-1 and CLA-4. Relatively small amounts of nitrogen and phosphorus would be expected to be released during dredged material placement. Dredged sediment-associated nutrients will rarely have an adverse effect on eutrophication-related water quality at placement areas mainly because the events are short-lived, there is typically fairly rapid dilution of the disposed of sediment, and relative to dilution, nutrient release is small (Jones and Lee 1981).

Specific to Cleveland harbor, short-term releases of total phosphorus to the water column during barge discharges were evaluated using STFATE modeling (Borrowman et al. 2013). It was determined that the extent and duration of phosphorus releases associated with dredged material discharges would be small and short-lived, insufficient to pose an effect on the occurrence of Harmful Algal Blooms (HABs) or significantly impact water quality in the Central Basin of Lake Erie.

Bulk concentrations of phosphorus in the dredged material range from 462 to 637 mg/kg and are below those at the open-lake placement areas (range 775 to 851 mg/kg) (USACE 2013a). Elutriate data show that initial dissolved phosphorus releases from the dredged material would generally range from 65 to 124 µg/L; however, these concentrations would rapidly mix and dilute in the water column. Model predictions showed that the extent and duration of the predicted phosphorus plumes within the open-lake placement areas would be very small and short-lived. These modeled dissolved phosphorus plumes would be inadequate to trigger or pose an effect on the occurrence of HABs, or to significantly impact water quality in the Central Basin of Lake Erie.

Two of the lower water column phosphorus criteria were used to evaluate the potential for HAB development: (1) 7 µg/L dissolved phosphorus, which is considered a conservative value below which little chance for cyanobacteria dominance in algal biomass; and (2) 10 µg/L dissolved phosphorus, which is considered a more realistic value above which the frequency of cyanobacteria dominance over algal biomass increases according to the GLWQA. These two criteria should be noted as being very conservative since a concentration of DRP (which is a fraction of dissolved phosphorus and the bioavailable form of phosphorus involved in HABs) of

30 µg/L has been shown to be a critical value to avoid the development of *Microcystis* blooms (Wetzel 2001). Modeling, using dissolved phosphorus elutriate data, showed that a dissolved water column concentration of less than 7 µg/L would be achieved within five minutes of the discharge and the plume concentrations would continue to rapidly decline over time. The maximum area exceeding the 7 ug/L criteria for up to minutes was 354 x 148 feet. The modeling strongly suggests that the dissolved phosphorus plumes generated during open-lake placement of dredged material would be insufficient to play any role in HAB development.

b. Suspension/Filter Feeders—Suspension and filter feeder populations in the vicinity of CLA-1 and CLA-4 may be temporarily adversely affected by increases in suspended solids and turbidity during open-lake placement of dredged material. Such effects would be minor and localized.

c. Sight Feeders—During dredged material placement operations, the modes of impact indicate that adverse impacts to fish are minor and short-term. The increase in suspended sediments and turbidity resulting from the open-lake placement of dredged material would be spatially and temporally small, and therefore unlikely to trigger any significant adverse effects to fish. Impacts on fish over the full range of possible effects include either avoidance or no noticeable effect. Many fishes have a wide tolerance for turbidity, and fish behavior in response to a dredged material placement event depends on the species. The placement of dredged material at the open-lake area may result in some mortality to demersal fish eggs (e.g., from broadcast spawning species) existing on the lake bottom in very close proximity to the actual placement of dredged material due to suffocation from burial or siltation, and/or oxygen deficiency at the sediment-water interface.

2.3.4 *Actions Taken to Minimize Impacts*.

- The contractor would be required to minimize accidental spills of petroleum, oil or lubricants. The contractor would be required to prepare and implement an Environmental Protection Plan and Oil Spill Contingency Plan.
- No placement activities would occur during Lake Erie storm events; this ensures accurate placement and minimal turbidity plume migration.

2.4 Contaminant Determinations.

This evaluation pertains to the contaminant determination at 40 CFR 230.11(d), and its purpose is to determine the degree to which the dredged material proposed for discharge would introduce, relocate or increase contaminants. A comprehensive evaluation of the dredged material from the upper reach of the Cuyahoga River Channel, in accordance with the protocols and guidelines prescribed in USEPA/USACE (1998), is contained in "Evaluation of Cleveland Harbor Federal Navigation Channel (Upper Cuyahoga River) Dredged Material with Respect to Suitability for Open-Lake Placement" (USACE 2013a) and the response to Ohio Environmental Protection Agency (OEPA) comments on the evaluation (USACE 2013b).

2.4.1 *Potential Sources of Sediment Contamination*. Cleveland Harbor is located within the Cuyahoga River Area of Concern (AOC), which includes the lower 45 miles of the river between

the Ohio Edison Dam and mouth, and approximately 19 miles of Lake Erie shoreline between Edgewater Park eastward to Wildwood Park (USEPA 2014). There are a number of potential sources of sediment contamination, both anthropogenic and natural. These sources include: municipal and industrial discharges, urban and agricultural runoff, sewer overflows/bypassing, atmospheric deposition, biological production (detritus) and mineral deposits.

2.4.2 *Dredged Material Evaluation*. In 2012, sediments from the Upper Cuyahoga River Channel were sampled and analyzed as discrete sites CH-1 through CH-15 (Figure 4); sediments from the open-lake placement areas were sampled as discrete sites CLA1-1 through CLA1-4 (CLA-1) and CLA4-1 through CLA4-4 (CLA-4). Discrete sediment samples were also composited into a dredged material management unit (DMMU) sample or open-water placement area sample for further analysis and testing; composite DMMU-1 (discrete sites CH-1 through CH-5), composite DMMU-2a (discrete sites CH-6 through CH-10), composite DMMU-2b (discrete sites CH-11 through CH-15), CLA-1 (discrete sites CLA1-1 through CLA1-4) and composite CLA-4 (discrete sites CLA4-1 through CLA4-4). Testing generally included bulk sediment physical and chemical analyses, cationic metal simultaneously extracted metals/acid volatile sulfide (SEM/AVS) analysis, elutriate testing, standard sediment and elutriate bioassays, and sediment bioaccumulation testing for polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE). Data generated from this effort were used to evaluate whether this material meets Federal (USEPA/USACE) guidelines for open-lake placement, which includes compliance with applicable WQSs or criteria (WQC).

a. Bulk Sediment Analyses—Discrete samples from the harbor and lake were analyzed for target analyte list (TAL) metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, thallium, vanadium and zinc), total cyanide (CN), ammonia-nitrogen (ammonia-N or NH_3), total phosphorus (TP), total Kjedlahl nitrogen (TKN), total organic carbon (TOC), PCBs (as Aroclors), pesticides, polycyclic aromatic hydrocarbons (PAHs) (16 USEPA priority pollutants and methylnaphthalenes), percent organic matter, simultaneously extracted metals/acid volatile sulfide (SEM/AVS), benzene-toluene-ethylbenzene-xylenes (BTEX), solid-phase microextraction (SPME) fiber burdens and total extractable hydrocarbons. Composite samples representing harbor management units (DMMU-1, DMMU-2a and DMMU-2b) and the lake (CLA-1 and CLA-4) were analyzed for the same parameters, including congener analysis of PCBs. Additionally, the composite samples' sediment pore water was analyzed for 34 PAHs (including common parent and alkylated PAH compounds).

•Metals: The bulk concentration of most metals in discrete and composite sediment samples were comparable or lower than those at the open-lake placement areas. Further evaluation of sediment cationic metal partitioning, through SEM/AVS analysis, determined that solid phase concentrations of metals in the sediment are protective of benthic organisms.

•PAHs: Total PAH concentrations in management unit discrete samples were greater than those relative to open-lake placement area CLA-1, however less than concentrations in CLA-4. The

potential risk of PAH mixtures in these sediment samples to the freshwater amphipod *Hyelalla azteca* was estimated using hydrocarbon narcosis and equilibrium partitioning (EqP) models (USEPA 2003). Calculated final acute values were all less than 1, suggesting no unacceptable PAH-associated acute toxicity resulting from total PAH concentrations in harbor sediments. Sediment pore water concentrations of 34 PAH structures (18 non-alkylated parent compounds and 16 groups of generic alkylated forms) were measured in the composite samples; Total Toxic Units (TUs) were determined based on comparison to PAH specific Final Chronic Values from USEPA 2003. The total TUs were all less than 1, indicating the PAH contamination in the harbor sediments is protective of benthic organisms.

•PCBs: On a TOC-normalized basis, PCB concentrations at several sites across the three harbor management units exceeded those of the maximum open-lake placement areas. Based on this information, the potential for PCB bioaccumulation was further evaluated through bioaccumulation testing.

•Pesticides: Most pesticides in the management unit samples were undetectable; sum DDT concentrations, however, exceeded the maximum sediment concentrations at the open-lake placement areas. Based on this information, sum DDT was further evaluated through bioaccumulation testing.

•BTEX: Toluene was the only volatile organic compound detected in the harbor sediments. Toluene is not bioaccumulative and tends to not be environmentally persistent. Equilibrium partitioning sediment benchmarks (ESB), protective of benthic organisms, were compared to the bulk sediment concentrations. With the exception of two discrete samples, none of the bulk sediment concentrations exceeded the ESB. The two exceptions were minor in extent (10% to 21% greater) and within the range of generally accepted analytical variability.

b. 10-day *H. azteca* and *Chironomus dilutus* Solid Phase Bioassays—10-day solid phase bioassays employing the test species *H. azteca* and *C. dilutus* (midge fly) were applied to harbor composite samples DMMU-1, DMMU-2a and DMMU-2b, and lake composite samples CLA-1 and CLA-4. The biological measurement endpoints for these tests were survival, and survival and growth, respectively. The primary purpose of these bioassays was to assess the potential toxicity of the dredged material to benthic organisms relative to lake bottom sediments. These test results are presented in Table 1.

The mean survival of *H. azteca* exposed to the management unit samples ranged from 82±25% to 94±6%, and were not statistically different from the open-lake placement areas (CLA-1 mean survival 84±15% [Dunnett's test; α=0.05]; CLA-4 mean survival 92±11% [Steel's many-one rank test; α=0.05]). The mean survival of *C. dilutus* exposed to the management unit samples ranged from 80±7% to 90±10% and was not reduced by 20% and not statistically different from that associated with the open-lake reference areas (CLA-1 mean survival 90±10% [Steel's many-one rank test; α=0.05]; CLA-4 mean survival 88±5% [Dunnett's Test; α=0.05]). With respect to *C. dilutus* growth, mean biomass expressed as mean dry weight (MDW) exposed to the management unit ranged from 2.17±0.299 mg to 3.51±0.116 mg. All values exceeded those

associated with the open-lake placement area MDWs as well as a MDW of 0.6 mg (USEPA/USACE 1998b).

The solid phase bioassay data did not show any significant acute or sublethal toxicity associated with the management unit sediments.

c. 28-day *Lumbriculus variegatus* PCB and DDT/DDD/DDE bioaccumulation testing – 28-day *L. variegates* bioaccumulation testing for PCBs (analysis of primary PCB congeners) was applied to harbor composite samples (DMMU-1, DMMU-2a and DMMU-2b) and lake reference area composite samples (CLA-1 and CLA-4). *L. variegatus* tissues from these experiments were also analyzed for DDT, DDD and DDE residues. Lipid content in *L. variegates* was determined. Test results for PCB and DDT/DDD/DDE bioaccumulation are provided in Tables 2 and 3 respectively.

Mean ∑PCB residues in *L. variegatus* tissues exposed to DMMU-1 (55.6±4.30 µg/kg), DMMU-2a (33.2±4.20 µg/kg) and DMMU-2b (36.6±2.66 µg/kg) samples were significantly greater relative to sediments at open-lake placement area CLA-4 (12.0±1.22 [one-tailed LSD test; α=0.1]). Further, mean ∑PCB residues in *L. variegatus* tissues exposed to the DMMU-1 sample was significantly greater relative to sediments at open-lake placement area CLA-1 (32.2±4.70 [one-tailed LSD test; α=0.1]). Mean ∑PCB residues in *L. variegatus* tissues exposed to the DMMU-2a and DMMU-2b samples were not significantly greater relative to sediments at open-lake placement area CLA-1 (one-tailed LSD test; α=0.1). Although the bioaccumulation of a contaminant is an important consideration, bioaccumulation in and of itself is not a hazard. The critical issue is whether bioaccumulation results in body burdens that result in adverse effects on individual organisms (prey and predator species) and ultimately on populations or whole ecosystems (USEPA 2000). Several factors regarding potential bioaccumulation of PCBs were further assessed including the toxicological importance of the contaminants, potential for effects at the observed concentrations, magnitude of increase observed, and concentrations found in species living in the vicinity of the proposed dredged material placement area.

•Regional Open-Lake Reference Area Sediment Comparisons: Although the benthic bioaccumulation of PCBs from DMMU-1, DMMU-2a and DMMU-2b sediments was statistically higher and more than twice that associated with CLA-4, lipid-normalized total PCB concentrations (5930, 4345 and 4430 µg/kg-lipid, respectively) are well within the range of that observed or predicted across open-lake reference area sediments sampled over the last 10 years east and west of Cleveland, including offshore of Rocky River, Fairport and Ashtabula (1391 to 16800 µg/kg-lipid) (USACE 2013a). This indicates that the benthic bioaccumulation of PCBs from these management unit sediments is comparable to that which occurs from pooled open-lake reference area sediments, particularly with respect to lake sediments located offshore of urban/industrialized areas. Total PCB concentrations were estimated using methodology consistent with USEPA (2002); the primary PCB congeners that were analyzed are summed and then doubled to estimate total PCB concentrations.

•Toxicological Significance: Bioaccumulation of most congeners from the management unit sediments was greater relative to open-lake placement area CLA-4 sediments. However few of these congeners were among the dioxin-like, aryl hydrocarbon hydroxylase (AHH)-inducing PCBs. AHH-inducing PCBs are structurally-similar to 2378-tetrachlorodibenzo-p-dioxin (TCDD), and include no ortho, two para and two or more meta chlorines, their monoortho analogs, and some di-ortho congeners. These congeners elicit similar toxic responses by promoting induction of AHH enzyme system in invertebrates which can result in weight loss, immunotoxicity, and adverse effects in reproduction and development. Trowbridge and Swackhamer (2002) found that 14 dioxin-like PCB congeners preferentially biomagnified in a lower-trophic-level food web relative to the remaining congeners. These AAH-inducing PCBs include congeners 81, 77, 123, 118, 114, 105, 138, 158, 128, 167, 156, 157, 169 and 189. Of these congeners (except for PCB 189 which was not analyzed for), only PCBs 81/87, 105, 118 and 138 were detected in *L. variegates* tissues among the DMMU-1, DMMu-2a and DMMU-2b samples (assuming the coeluting 87/81 congener was PCB 81). PCBs 81/87, 118 and 138 were also detected in *L. variegatus* tissues associated with one or both of the open-lake placement area sediments, but usually at lower concentrations. Similarly, PCBs 81, 105, 118 and 138 were also detected at lower concentrations in *L. variegatus* exposed to sediments from open-lake reference areas offshore of Ashtabula Harbor, Ohio (PCB 81 [up to 0.016 µg/kg], 105 [average 0.21 µg/kg], 118 [average 0.53 µg/kg] and 138 [average 1.8 µg/kg]) (USACE 2010). Congeners 105, 118 and 138 should be of low toxicological concern. Van den Berg *et al.* (1998) does not include the di-ortho-substituted PCB 138 in its listing of congeners with assigned toxic equivalence factors (TEFs) because of insufficient evidence toward AHH receptor activity. Van den Berg *et al.* also concluded that fish are extremely insensitive to the mono-orthosubstituted PCBs 105 and 118 and, consequently assigned them the lowest TEFs for fish (0.000005). These data on relative toxicity of the congeners measured in *L. variegatus* tissue indicate that with the exception of the detection of PCB 87 (the concentration of which is ambiguous due to co-elution with PCB 87), the magnitude of total PCBs that have toxicological significance is low.

•Magnitude of Increase Observed: The magnitude of difference (MOD) between mean ∑PCB residues in *L. variegatus* tissues exposed to DMMU-1, DMMU-2a and DMMU-2b samples vs. sediments at open-lake placement area CLA-4 was 4.3, 2.6 and 2.8, respectively. Further, the MOD between ∑PCB residues in *L. variegatus* tissues exposed to the DMMU-1 sample and sediments at open-lake placement area CLA-1 was 1.7. Standard guidance in American Society of Testing Materials (ASTM) (2010) indicates that a two-fold difference between tissue residues in test and reference sediments should in most cases provide a sufficient signal for potential ecological and human health concerns. This implies that tissue concentrations less than twice those of reference tissue concentrations should not be considered a biologically significant difference within the context of bioaccumulation evaluation of dredged material. Since the MOD of 1.7 shows that the bioaccumulation of PCBs from DMMU-1 sediments is less than twice that associated with CLA-1, the placement of material dredged at CLA-1 would not result in biologically significant accumulation of PCBs.

• Potential Bioaccumulation Exposure to Receptors: Predictions of potential exposure to PCBs, and the associated risk to ecological receptors and human health, require explicit consideration of

both spatial and temporal factors within food web models. The spatially explicit screening-level exposure procedure has been developed to address the relatively small spatial area for dredged material placement compared to the overall area utilized by receptors to obtain food. This area is referred to as the receptor's home range. Fish with a home range larger than the open-lake placement area will obtain only a fraction of their diet from the area influenced by the placement of dredged material, thus resulting in a reduction in net bioaccumulation compared to what is reflected in laboratory bioaccumulation experiments alone. This approach generates a value referred to as a bioaccumulation exposure factor (BEF), which is a spatially weighted average concentration in prey benthic invertebrate tissues (oligochaetes in this case) after dredged material placement, divided by the spatially weighted average concentration in oligochaete tissues prior to placement. In this way, bioaccumulation exposure is assessed through a benthic food chain linkage to pelagic fish. The model was applied using *P. flavescens* and *S. vitreus* as the receptor species' and assuming that the placement of dredged material at CLA-4 would be limited to a two-thirds square mile area. The worst-case scenario using exposure of DMMU-1 sediments to *P. flavescens* (the receptor with the smallest home range) showed that exposure via the bioaccumulation pathway to PCB residues in invertebrates associated with the dredged material (i.e., the BEF) to be 1.2. This indicates that the maximum estimated increased exposure of both receptors, specific to PCB residues in benthic macroinvertebrates associated with the dredged material, would be 20% or less, which is within the generally accepted range of analytical variability (USACE 2013a). The model shows that the bioaccumulation pathway for PCBs from the dredged material to receptors is not expected to increase in any meaningful way such that significant adverse impacts to the aquatic ecosystem and human health would be expected.

Mean ∑DDT residues in *L. variegatus* tissues exposed to DMMU-1 (5.3±0.36 µg/kg) and DMMU-2b (5.64±0.66 µg/kg) samples were significantly greater relative to sediments at open-lake placement area CLA-4 (2.65±2.22 [one-tailed LSD test; α=0.1]). Mean ∑DDT residues in *L. variegatus* tissues exposed to the DMMU-1, DMMU-2a and DMMU-2b samples were not significantly greater relative to sediments at open-lake placement area CLA-1 (5.40±0.55 [one-tailed LSD test; α=0.1]). In addition, mean ∑DDT tissue residues exposed to the DMMU-2a sample were not significantly greater relative to sediments at open-lake placement area CLA-4 (one-tailed LSD test; α=0.1). As with PCBs, several factors were used to assess the biological significance of the exceedance of ΣDDT bioaccumulation relative to open-lake placement area CLA-4 (USEPA/USACE 1998b). These include toxicological importance of the contaminants, potential for effects at the observed concentrations, magnitude of increase observed, and concentrations found in species living in the vicinity of the proposed dredged material placement area.

•Magnitude of Increase Observed: The MOD in reference to CLA-4 for the DMMU-1 and DMMU-2b samples was 2 and 2.2, respectively. These differences approach the two-fold difference between tissue residues in test and reference sediments that is a sufficient signal for potential ecological and human health concerns (ASTM 2010). ΣDDT tissue residues observed in *L. variegatus* associated with the DMMU-1 and DMMU-2b samples (range 5.3 µg/kg to 5.6 µg/kg) were low. Total DDT in Lake Erie walleye are on the level of µg/kg and declining, and

are below a Great Lakes Water Quality Agreement (GLWQA) tissue criterion of 1 mg/kg for top predator fish (USEPA 2013).

• Potential Bioaccumulation Exposure to Receptors: The bioaccumulation of ΣDDT from the dredged material in higher food web organisms was examined through an estimation of potential bioaccumulation exposure to P. flavescens and S. vitreus as receptors. Evaluation of this pathway employed the SESLEC approach and BEF model, similar to the PCB bioaccumulation evaluation described previously. This evaluation showed that the bioaccumulation of ΣDDT to P. flavescens and S. vitreus would not be biologically significant because of low level of exposure. Assuming that the placement of dredged material at CLA-4 would be limited to a one square mile area, the worst-case scenario using exposure of DMMU-2b sediments to P. flavescens showed that exposure via the bioaccumulation pathway, specific to ΣDDT residues in invertebrates associated with the dredged material (i.e., the BEF), to be 1.12. This indicates that the maximum estimated increased exposure of both receptors to ΣDDT residues in benthic macroinvertebrates associated with the dredged material would be 20% or less, which is within the generally accepted range of analytical variability (USACE 2013a).

d. 48-hour *Ceriodaphnia dubia* and 96-hour *Pimephales promelas* bioassays (water column) – 48-hour *C. dubia* (water flea) and 96-hour *P. promelas* (fathead minnow) bioassays were performed on 100% elutriate from harbor composite samples DMMU-1, DMMU-2a and DMMU-2b. Survival was the biological measurement endpoint for both tests. The primary purpose of these bioassays was to assess the toxicity of contaminants potentially released to the water column during dredged material placement in the lake environs. These test results are provided in Table 4.

The mean survival of *C. dubia* associated with the lake site water (80±28%) was not statistically different than the laboratory control (100%). The mean survival of this test species exposed to the undiluted (100%) elutriate ranged from 76±17% (DMMU-2b) to 100% (DMMU-1). Relative to the site water, the undiluted elutriates showed no statistically significant differences in mean survival. These bioassay data indicate no significant acute toxicity and show that the release of contaminants from the dredged material to the water column during open-water placement would not result in any contaminant-related unacceptable, adverse impacts. The mean survival of *P. promelas* associated with both the lake site water and laboratory control were 100%. The mean survival of this test species exposed to the undiluted elutriate ranged from 0 (DMMU-2a and DMMU-2b) to 98±4% (DMMU-1). Other than the undiluted elutriates of DMMU-2a and DMMU-2b, no other elutriate concentration showed statistically significant differences in mean survival relative to lake site water. The DMMU-2a and DMMU-2b bioassay data both yielded a no observed effect concentration (NOEC), lowest observed effect concentration (LOEC) and LC50 of 50%, 100% and 67%, respectively.

The collective results of these water column bioassays suggest that the toxicity observed in the *P. promelas* tests on the DMMU-2a and DMMU-2b elutriate was related to ammonia. First, the toxicity occurred in the *P. promelas* bioassay and not in the *C. dubia* bioassay; *C. dubia* (and other invertebrates) is generally less sensitive to ammonia relative to fish. Further, ammonia

levels measured in the DMMU-2a and DMMU-2b elutriates were sufficient to cause the observed toxicity to *P. promelas*. Unionized ammonia (usually the form most responsible for causing toxicity) was 1.0 mg/L and 0.9 mg/L for the DMMU-2a and DMMU-2b elutriates, respectively, and was much lower at <0.1 mg/L for the DMMU 1 elutriate. The unionized ammonia concentrations in the undiluted DMMU-2a and DMMU-2b elutriates were equal to or exceeded *P. promelas* LC50 values reported in the literature (e.g., Nimmo *et al.* 1989; Buhl *et al.* 2002).

In an attempt to decipher the cause of the observed toxicity to *P. promelas*, a TRE was performed on the DMMU-2a and DMMU-2b samples. In order to accomplish this, the undiluted elutriates, and undiluted elutriate treatments slightly modified for pH, zeolite ammonia stripping and ethylenediaminetetraacetic acid (EDTA) metal chelating were performed. As with the first round of tests, 100% mortality resulted in the undiluted DMMU-2a and DMMU-2b elutriates. For both elutriates, the zeolite stripping treatment completely reduced toxicity and the EDTA treatment did not reduce toxicity. While zeolite can also bind some metals, SET data indicate that all dissolved metal concentrations in the DMMU-2a and DMMU-2b sediment elutriates were protective of aquatic life. These TRE results strongly indicate that ammonia was the cause of toxicity in the DMMU-2a and DMMU-2b undiluted elutriates. Therefore, an application factor of 10 was used to compute a limited permissible concentration (LPC) of 6.7%, as opposed to using an application factor of 100 to compute a LPC of 0.67% if the toxicity were a result of toxicants other than ammonia.

Assuming a LPC of 6.7% for the dredged material discharge from DMMU-2a and DMMU-2b, application of the ST-Fate model indicated that the effluent would achieve the LPC during the first five minutes after discharge and within 140 ft of the discharge. If the toxicity were not caused by ammonia and an LPC of 0.67% were used (as a worst-case), application of the ST-Fate model indicated that the effluent would achieve the LPC during the first forty minutes after discharge under the lowest velocity conditions and within 2300 ft of the discharge under the highest velocity conditions. Collectively, the mixing model and water column bioassay data show that the release of contaminants from the dredged material to the water column during open-water placement would not result in any contaminant-related unacceptable, adverse impacts to the aquatic ecosystem.

2.4.3 *Determination*. Bulk sediment contaminant concentrations, toxicity and bioaccumulation modeling and bioassays have not indicated unacceptable water column and benthic impacts associated with open-lake placement of the dredged material at CLA-1 and CLA-4.

2.5 Aquatic Ecosystems and Organisms Determinations.

2.5.1 *Effects on Plankton*. Only minor short-term adverse impacts would be expected on plankton populations due to limited, temporary increases in suspended solid and turbidity levels during the open-lake placement of dredged material. Localized plankton at CLA-1 and CLA-4 would be temporarily displaced during open-lake placement.

2.5.2 *Effects on Benthos.* The impacts to benthos resulting from the open-lake placement of

dredged material at CLA-1 and CLA-4 would be minor, adverse and short-term. The open-lake placement of dredged material would impact the resident macroinvertebrate community through smothering and short-term suspended sediments, which would result in a temporary localized loss of benthic organisms. However, the new bottom substrate at the areas would be similar to pre-placement conditions and be recolonized by benthic organisms residing in the dredged material and surrounding lake bottom. Due to the similarity in the sediment grain size and toxicity between the dredged material and lake bottom sediments, significant long-term changes in the benthic community resulting from the placement of this new material would be unlikely. The physical change in bottom elevation and contours at the open-lake areas may diversify the benthic community to some degree from the surrounding lake bottom. A 2003 study conducted on the macroinvertebrate community in the vicinity of the Toledo Harbor open-lake placement area in the Western Basin of Lake Erie (Heidelberg College 2003) concluded that the taxonomic richness and abundance of invertebrates at the placement area were similar to other areas in the Western Basin. Further, a cluster analysis showed that there was no association among sampling areas in relation to their proximity to the open-lake placement area. These results indicate that the open-lake placement of dredged material would have no significant effect on the quality of the benthic macroinvertebrate community either within or outside the open-lake placement areas.

2.5.3 *Effects on Nekton*. Placement of dredged material at CLA-1 and CLA-4 would result in localized minor, adverse, short-term impacts to some fish. There are no notable fish spawning grounds within the open-lake placement area or in areas potentially impacted by turbidity plumes. Fish behavior relative to the open-lake placement of dredged material depends on the species being affected. They may avoid the area or swim through the turbidity plume. Intermittent, short-term increased turbidity generated by dredged material placement at the open-lake area would not have a significant adverse affect on fish. An historic study examining 16 species of warmwater fish in laboratory aquaria did not evidence any observable behavioral reactions to turbidity until TSS concentrations approached 20,000 mg/L (Wallen 1951). Regarding sublethal responses in adult warmwater fish sensitive to suspended sediments, the minimum dose of TSS that elicited a sublethal effect in white perch was 650 mg/L after 5 days (Sherk et al. 1974). Given these studies and the short-term duration of turbidity plumes from dredged material placement, there appears to be a very low likelihood of turbidity-related adverse effects to fish.

2.5.4 *Effects on Aquatic Food Web*. Only very minor, temporary effects on the aquatic food web are expected to occur as a result of the open-lake placement of dredged material, due primarily to the smothering of some benthic organisms. Rapid re-colonization of the impacted area by benthos is anticipated and no significant long term degradation of the benthic community would be expected to occur. Disruption and disturbance by equipment during the dredged material placement operation would result in a short-term avoidance by local wildlife species, primarily fish and aquatic birds.

The placement of dredged material at CLA-4 may temporarily increase the benthic bioaccumulation of PCBs. This increase would be biologically insignificant because benthic tissue residues associated with the dredged material are within the range of those observed at other offshore Lake Erie areas in the general vicinity of Cleveland. In addition, any associated uptake in receptors would be insignificant because the area has spatially limited exposure to benthic feeding receptors and benthos at the area contribute (both directly and indirectly) a very

small portion of the receptors' diet. Any increase in benthic bioaccumulation of PCBs at CLA-4 would be temporary and localized because it relates to a lower concentration of TOC in the dredged material (rather than PCB contamination, which is very similar to CLA-4) relative to the immediately surrounding lake area sediments. The productivity of Lake Erie and biological activity at CLA-4 would serve to amend TOC concentration in the dredged material such that it would increase and approach background levels at the area. Consequently, this natural transition would serve to reduce the localized bioavailability of PCBs such that benthic bioaccumulation would tend to equalize with the surrounding lake environs.

The bioaccumulation of PCBs from the dredged material in higher food web organisms was examined through an estimation of potential bioaccumulation exposure through the benthic food chain to receptors, including yellow perch and walleye. Evaluation of this pathway employed the SESLEC approach and BEF model, which is discussed in detail in USACE (2013a). As described in USACE 2013a and Section 2.4.2, this evaluation showed that the bioaccumulation of PCBs to walleye and yellow perch would not be biologically significant because of a low level of exposure.

2.5.5 *Effects on Special Aquatic Sites*:

a. Sanctuaries and Refuges—Not applicable.

b. Wetlands—No significant effects are expected.

c. Mud Flats—No significant effects are expected.

d. Vegetated Shallows—No significant effects are expected.

e. Coral Reefs—Not applicable.

f. Riffle and Pool Complexes—Not applicable.

2.5.6 *Threatened and Endangered Species*. Correspondence with the USFWS (letter dated September 12, 2013) and Ohio ODNR (letter dated January 17, 2014) noted the potential for a variety of threatened and endangered species in the project vicinity; however, due to the project type and location, no impact to threatened or endangered species was expected.

2.5.7 *Other Wildlife*. Disruption and disturbance by equipment during the dredged material placement operation would result in a short-term avoidance of CLA-1 and CLA-4 by local wildlife species, primarily aquatic birds. However, some bird species, such as gulls, may be attracted to dredged material placement activities while foraging. Wildlife impacts in this regard would be minor, adverse and short-term.

2.5.8 *Actions Taken to Minimize Impacts*.

- The contractor would be required to minimize accidental spills of petroleum, oil or lubricants. The contractor would be required to prepare and implement an Environmental

Protection Plan and Oil Spill Contingency Plan.

- Spatially limiting the placement of material dredged from DMMU-1, DMMU-2a and DMMU-2b to a one-square mile area within CLA-1.
- Spatially limiting the placement of material dredged from DMMU-1 to a two-third square mile area within CLA-4.
- Use of mechanical equipment to dredge and discharge the dredged material.

2.6 Proposed Discharge Site Determinations.

2.6.1 *Mixing Zone Determination*. The mixing zone has been designated as the one-mile by two-mile zone of CLA-1 and CLA-4.

2.6.2 *Determination of Compliance with Applicable Water Quality Standards*. Compliance with WQSs is demonstrated in USACE 2013a. Standard Elutriate testing on harbor (DMMU-1, DMMU-2a and DMMU-2b) and lake (CLA-1 and CLA-4) composite samples were analyzed for TAL metals, CN, NH3, TP, TKN, TOC, water hardness, TSS, turbidity, PCBs (as Aroclors), pesticides and PAHs (16 USEPA priority pollutants and methylnaphthalenes). With the exception of ammonia, the elutriate test data indicate that the release of contaminants during open-lake placement would comply with applicable State WQSs for the protection of aquatic life (Tables 5 - 8). Ammonia concentrations were further evaluated after considering mixing in the water column (reference section 2.3.2c). Pursuant to Section 401 of the Clean Water Act, USACE-Buffalo District has applied to OEPA for a water quality certification (WQC) confirming that discharges of dredged material comply with relevant and promulgated State WQSs.

2.6.3 *Potential Effects on Human Use Characteristics*:

a. Municipal and Private Water Supply—Reference Section 2.3.2.

b. Recreational and Commercial Fisheries—The placement of dredged material at CLA-1 and CLA-4 may result in minor, short-term disturbances to recreational and commercial fisheries in the vicinity.

c. Water-Related Recreation—The placement of dredged material at CLA-1 and CLA-4 may result in minor, short-term disturbances to recreational boating activities in the vicinity.

d. Aesthetics—The placement of dredged material at CLA-1 and CLA-4 may temporarily detract from aesthetics in the vicinity.

e. Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves—Not applicable.

2.7 Determination of Cumulative Effects on the Aquatic Ecosystem.

Placement of dredged material at CLA-1 and CLA-4 would create a slight mound, which would result in some local bottom surface relief. This mound would be subject to consolidation and

tend to flatten over time, following the cessation of dredged material placement. Available relevant evidence indicate that the aquatic ecosystem at open-lake placement areas are resilient, and that the periodic disturbance created by open-lake placement of dredged material is absorbed or accommodated by the ecosystem because its structure and function would not fundamentally change over the long-term to a different state. Ecosystem resilience signifies ecosystem health (gauged by species diversity) and stability (the probability that all species persist) (e.g., Scrimgeour and Wicklum, 1996).

2.8 Determination of Secondary Effects on the Aquatic Ecosystem.

No significant, adverse secondary effects on the aquatic ecosystem would be expected to occur as a result of the discharge of dredged material.

FINDING OF COMPLIANCE

1. No Significant adaptations of the Section 404(b)(1)Guidelines were made relative to this evaluation.

2. The proposed plan was selected based on its ability to best address the identified community needs and to sufficiently satisfy national goals and planning objectives. It reasonably maximizes National Economic Development (NED) benefits consistent with protecting the Nation's Environmental Quality.

3. The discharge of dredged material would not violate applicable State Water Quality Standards, nor will it violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

4. The discharge of dredged material would not jeopardize the continued existence of any Federal-listed threatened or endangered species, or their designated critical habitat.

5. The discharge of dredged material would not contribute to significant degradation of waters of the United States, nor would it result in significant adverse effects on human health and welfare; municipal and private water supplies; recreation and commercial fishing; plankton, fish, shellfish, wildlife, or special aquatic sites; life stages of organisms dependent on the aquatic ecosystem; ecosystem diversity, productivity and stability; or recreational, aesthetic, and economic values.

6. Appropriate and practicable steps would be taken to minimize potential adverse impacts of the discharges associated with this dredging operation on the aquatic ecosystem.

7. On the basis of the guidelines, the discharge of dredged material is specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution and adverse effects on the aquatic ecosystem.

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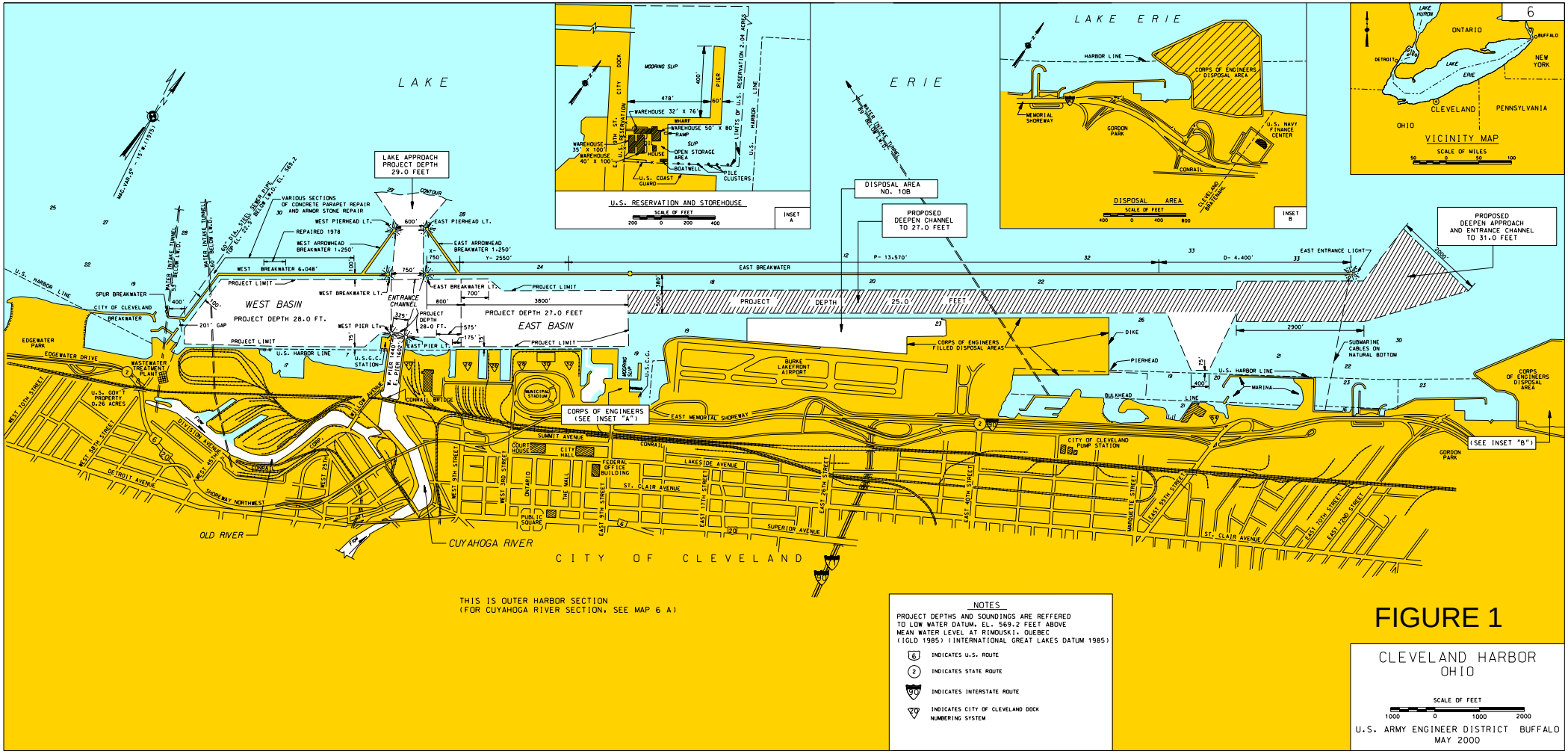
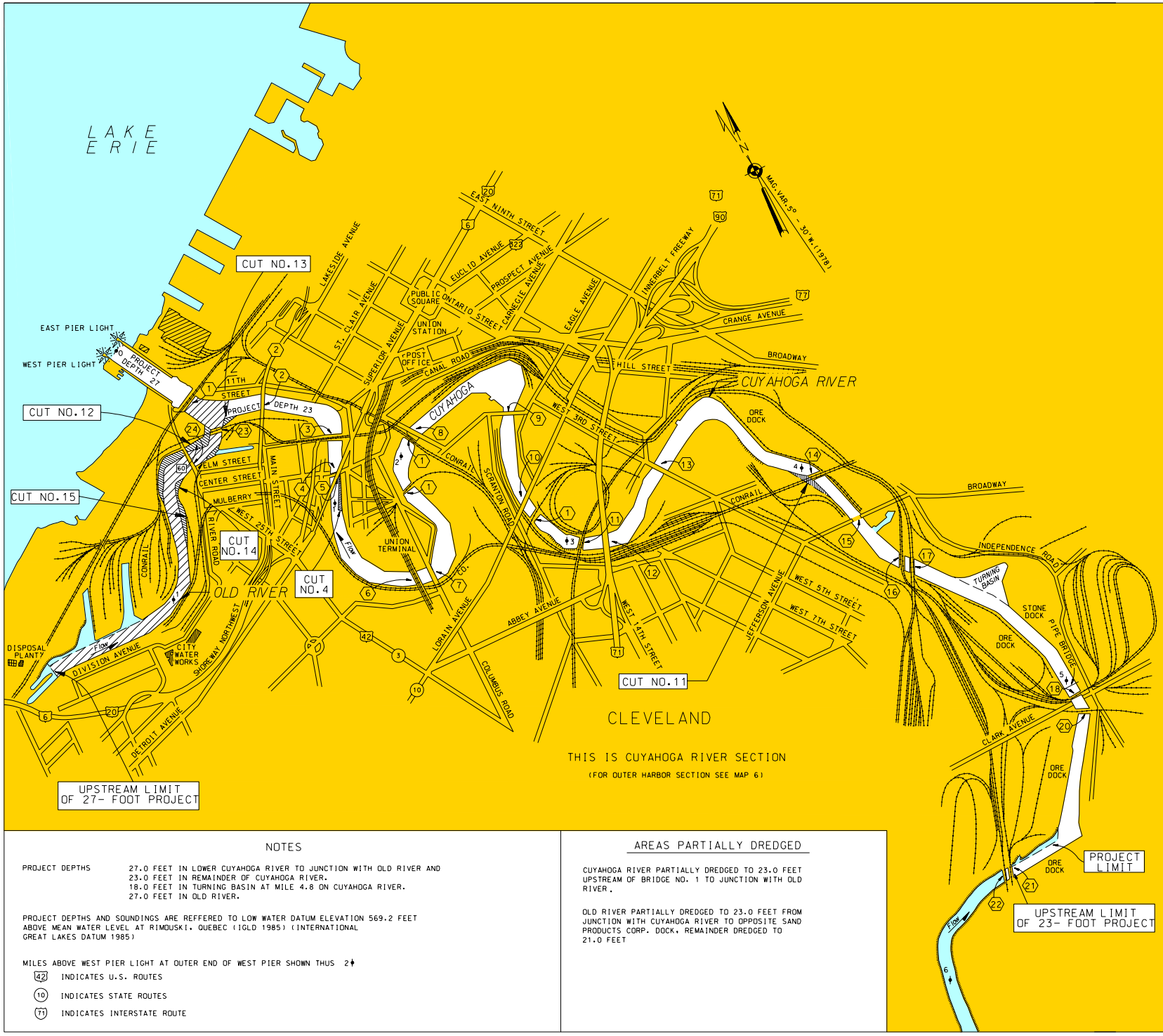
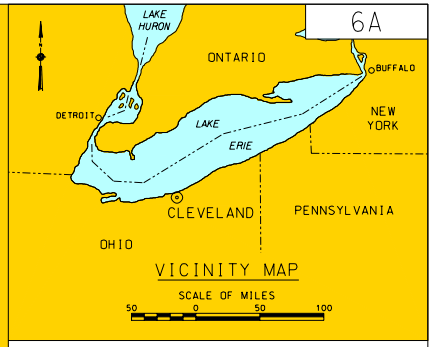
FIGURES


LAKE ERIE
LAKE APPROACH PROJECT DEPTH 29.0 FEET
DISPOSAL AREA NO. 10B
PROPOSED DEEPEN CHANNEL TO 27.0 FEET
PROPOSED DEEPEN APPROACH AND ENTRANCE CHANNEL TO 31.0 FEET
WEST BASIN
PROJECT DEPTH 28.0 FT.
EAST BASIN
PROJECT DEPTH 27.0 FEET
PROJECT DEPTH 25.0 FEET
EAST BREAKWATER
WEST BREAKWATER
ENTRANCE CHANNEL
CORPS OF ENGINEERS (SEE INSET "A")
(SEE INSET "B")
U.S. RESERVATION AND STOREHOUSE
INSET A
INSET B
DISPOSAL AREA
VICINITY MAP
OLD RIVER
CUYAHOGA RIVER
CITY OF CLEVELAND
THIS IS OUTER HARBOR SECTION
(FOR CUYAHOGA RIVER SECTION, SEE MAP 6 A)
NOTES
PROJECT DEPTHS AND SOUNDINGS ARE REFFERED TO LOW WATER DATUM, EL. 569.2 FEET ABOVE MEAN WATER LEVEL AT RIMOUSKI, QUEBEC (IGLD 1985) (INTERNATIONAL GREAT LAKES DATUM 1985)
INDICATES U.S. ROUTE
INDICATES STATE ROUTE
INDICATES INTERSTATE ROUTE
INDICATES CITY OF CLEVELAND DOCK NUMBERING SYSTEM
FIGURE 1
CLEVELAND HARBOR
OHIO
SCALE OF FEET
U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 2000





INDEX TO BRIDGES

SHOWN THUS (1)

* 1	CONRAIL
2	MAIN AVE. HIGH LEVEL BRIDGE
* 3	FLATS DEVELOPMENT INC.
4	CENTER STREET BRIDGE
5	DETROIT SUPERIOR HIGH LEVEL BRIDGE
6	UNION TERMINAL (RAILWAY) HIGH LEVEL BRIDGE
7	COLUMBUS RD. BRIDGE
8	CARTER RD. BRIDGE
9	EAGLE AVE. BRIDGE
10	LORAIN CARNEGIE HIGH LEVEL BRIDGE
*11	NORFOLK AND WESTERN RAILWAY
12	INNER BELT FREEWAY HIGH LEVEL BRIDGE
13	3RD. ST. BRIDGE
**14	CONRAIL
15	JEFFERSON AVE. BRIDGE SUPERSTRUCTURE REMOVED
16	NEWBURG AND SOUTH SHORE RAILWAY BRIDGE
17	BALTIMORE AND OHIO RAILWAY BRIDGE
18	RIVER TERMINAL RAILWAY BRIDGE
*19	NORFOLK AND WESTERN RAILWAY, BRIDGE NO. 2 (L) WESTERN AND LAKE ERIE RAILROAD (O)
20	NORFOLK AND WESTERN RAILWAY, BRIDGE NO. 3 (L) WESTERN AND LAKE ERIE RAILROAD (O)
21	NEWBURG AND SOUTH SHORE RAILWAY BRIDGE
**22	FLATS DEVELOPMENT INC. } OLD RIVER
*23	WILLOW AVE. BRIDGE } OLD RIVER

NOTE: FEDERAL PARTICIPATION IN REPLACEMENT
* COMPLETED
** AUTHORIZED

NOTES

PROJECT DEPTHS
27.0 FEET IN LOWER CUYAHOGA RIVER TO JUNCTION WITH OLD RIVER AND
23.0 FEET IN REMAINDER OF CUYAHOGA RIVER.
18.0 FEET IN TURNING BASIN AT MILE 4.8 ON CUYAHOGA RIVER.
27.0 FEET IN OLD RIVER.

PROJECT DEPTHS AND SOUNDINGS ARE REFFERED TO LOW WATER DATUM ELEVATION 569.2 FEET ABOVE MEAN WATER LEVEL AT RIMOUSKI, QUEBEC (IGLD 1985) (INTERNATIONAL GREAT LAKES DATUM 1985)

MILES ABOVE WEST PIER LIGHT AT OUTER END OF WEST PIER SHOWN THUS 2♦

(42) INDICATES U.S. ROUTES

(10) INDICATES STATE ROUTES

(71) INDICATES INTERSTATE ROUTE

AREAS PARTIALLY DREDGED

CUYAHOGA RIVER PARTIALLY DREDGED TO 23.0 FEET UPSTREAM OF BRIDGE NO. 1 TO JUNCTION WITH OLD RIVER.

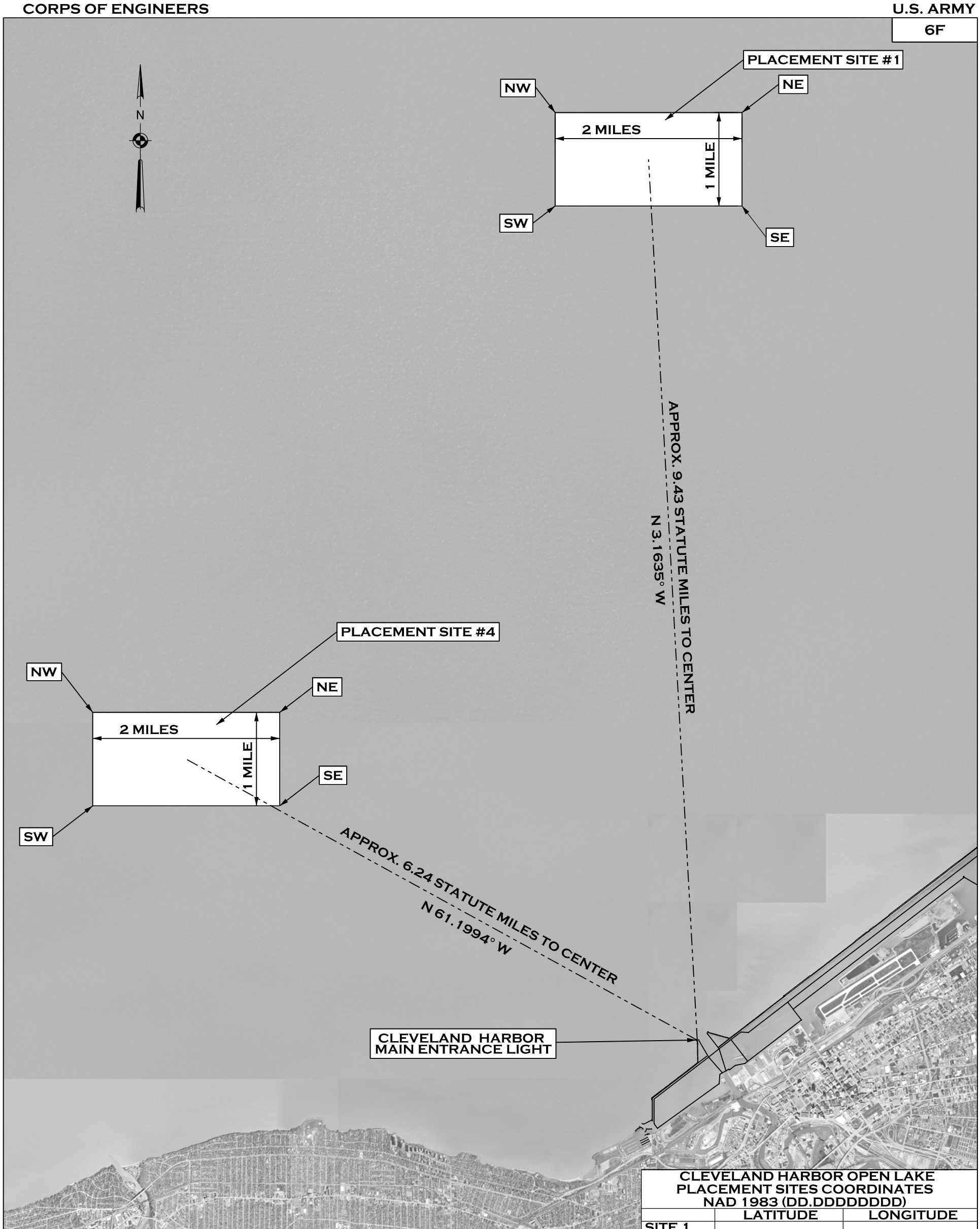
OLD RIVER PARTIALLY DREDGED TO 23.0 FEET FROM JUNCTION WITH CUYAHOGA RIVER TO OPPOSITE SAND PRODUCTS CORP. DOCK, REMAINDER DREDGED TO 21.0 FEET

FIGURE 2

CLEVELAND HARBOR OHIO

SCALE OF FEET
1000 0 1000 2000

U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 2000



CLEVELAND HARBOR OPEN LAKE PLACEMENT SITES COORDINATES NAD 1983 (DD.DDDDDDDD)		
	LATITUDE	LONGITUDE
SITE 1		
CENTER	41.645504988	81.726066535
NE	41.652619543	81.706661473
SE	41.638130041	81.706837175
SW	41.638387177	81.745467376
NW	41.652876734	81.745300230
SITE 4		
CENTER	41.553171131	81.822554593
NE	41.560302010	81.803187373
SE	41.545811921	81.803341480
SW	41.546037006	81.841917596
NW	41.560527144	81.841772022

LOCATION OF PLACEMENT AREAS WERE CALCULATED AS FOLLOWS:

1. THE LAT/LON COORDINATES WERE PROVDIED TO TD-DS IN A EMAIL FROM PM-EA ON 17 OCT. 2013.
2. THE COORDINATES WERE CONVERTED TO STATE PLANE COORDINATES USING CORPSCON AND PLOTTED IN A CADD FILE.
3. THE SOUTHWEST CORNER WAS HELD AS THE STARTING POINT WITH LINES DRAWN DUE EAST AT 2 MILES AND DUE NORTH AT 1 MILE, THEN COPIED PARALLEL TO FORM THE 2 MILE X I MILE SITE.
4. THE XY STATE PLANE COORDINATES OF THE CORNERS FROM THE DRAWN PLACEMENT SITE WERE THEN CONVERTED TO LAT/LON FOR INCLUSION ON THIS MAP.
5. THE BEARING AND DISTANCE TO THE CENTERS WAS CALCULATED BY DRAWING A LINE FROM THE CENTER OF THE PLACEMENT SITE TO THE LIGHTHOUSE SHOWN ON A GEOREFERENCED SID FILE OBTAINED FROM THE OHIO GRAPHICALLY REFERENCED INFORMATION PROGRAM.

CLEVELAND HARBOR
OHIO
OPEN LAKE PLACEMENT SITE LOCATION
SCALE OF MILES
1 ½ 0 1
U.S. ARMY ENGINEER DISTRICT BUFFALO
NOVEMBER 2013

FIGURE 3

FIGURE 4: Cleveland Harbor Upper River Reach Discrete Sample Locations and DMMU Boundaries

TABLES

TABLE 1. Results of standard 10-day *Hyalella azteca* and *Chironomus dilutus* solid phase bioassays (±1 standard deviation [SD] from the mean) on Cleveland Harbor Federal navigation channel sediments (*Management Units 1, 2a and 2b)* and open-lake placement areas sediments (CLA-1 and CLA-4) (USACE 2013a).

Test Species	Measurement Endpoint	Harbor			Lake		Control
		DMMU-1	DMMU-2a	DMMU-2b	CLA-1	CLA-4	
H. azteca	Survival (%)	94±6	94±6	82±25	84±15	92±11	90±7
C. dilutus	Survival (%)	80±7	86±13	90±10	90±10	88±5	94±6
	Growth (mass, mg DW)	3.513±0.116	2.311±0.282	2.171±0.299	1.699±0.142	1.720±0.156	2.069±0.237

TABLE 2. Results of 28-day *L. variegatus* PCB bioaccumulation experiments on Cleveland Harbor Federal navigation channel, and Lake Erie vicinity sediments (highlighted values are non-detectable concentrations valued at one-half the MDL) (USACE 2013a).

PCB Congener (ug/kg)	Lake Area									Harbor Management Unit														
	CLA 1 Comp replicate					CLA 4 Comp replicate				DMMU 1 replicate					DMMU 2a replicate					DMMU 2b replicate				
	1	2	3	4	5	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
44	0.64	0.69	0.82	0.74	1.00	0.16	0.15	0.16	0.15	2.81	2.21	2.05	2.02	2.90	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15
52	1.76	1.65	1.72	1.55	1.99	0.16	0.15	0.16	0.15	4.05	4.66	3.20	2.41	3.74	1.38	0.95	1.34	2.14	1.20	1.36	1.33	1.71	1.24	1.21
64	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	1.29	1.05	0.94	0.92	1.14	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.90	0.14	0.15
66	0.72	0.62	0.91	0.71	1.08	1.00	1.63	1.03	0.76	1.66	1.82	2.26	1.96	1.72	2.19	3.12	3.63	2.96	2.31	3.27	2.36	2.06	2.70	0.83
70	1.36	1.05	1.38	1.61	1.82	0.16	0.15	0.16	0.15	3.26	3.48	3.20	3.01	3.52	1.15	1.39	1.36	1.55	1.34	1.23	1.05	1.10	1.23	0.94
75	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	2.13	2.29	2.09	2.24	2.41	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15
81/87	3.09	2.71	3.22	3.22	3.78	0.16	0.15	0.16	0.53	9.16	4.79	4.78	4.53	8.68	3.76	4.51	4.83	6.18	5.02	5.92	4.80	5.77	5.82	4.77
90/101	3.52	3.91	4.23	3.71	4.36	2.83	1.90	2.31	1.33	4.88	4.76	5.45	5.12	5.36	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15
95	5.56	5.18	6.12	4.83	5.69	1.70	1.41	1.21	1.01	5.00	5.03	5.13	5.02	5.65	1.59	2.14	2.43	3.71	2.69	2.39	1.98	2.07	2.15	1.71
97	1.06	0.98	1.10	1.40	1.61	0.16	0.15	0.16	0.15	1.78	2.11	3.53	2.18	2.29	0.60	0.76	0.85	1.00	1.01	0.77	0.76	0.82	0.81	0.94
105	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.72	0.71	0.77	0.73	0.78	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15
107	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	1.11	0.75	0.61	0.64	0.54	0.63	2.04	0.63	0.70	0.88	2.70	1.10	0.95	0.65	0.48
110	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.17	0.17	0.17	0.16	0.15	0.17	0.16	0.16	0.14	0.15	1.61	2.80	3.19	4.11	3.14
118	2.26	2.12	2.57	2.45	3.01	0.16	0.15	0.16	0.15	3.45	3.37	3.51	3.37	3.67	1.16	1.30	1.41	1.73	1.50	1.25	1.32	1.27	1.29	1.17
122	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.17	0.99	0.17	0.17	1.15	0.61	0.72	0.78	1.13	0.89	0.94	0.85	1.02	0.96	0.82
138	3.20	3.61	3.94	3.22	3.88	1.80	2.33	1.97	1.73	3.95	4.00	5.83	4.60	4.93	1.56	1.85	1.93	2.45	2.08	2.20	2.00	2.18	2.70	1.90
149	0.14	0.13	0.16	0.15	0.16	1.52	2.28	1.94	1.62	2.65	2.35	2.86	2.73	2.70	1.00	1.33	1.40	1.55	1.46	1.50	1.49	1.56	1.65	1.45
151	1.18	1.22	1.75	1.52	1.60	0.16	0.15	0.16	0.15	1.18	1.07	1.70	1.55	0.15	0.50	0.16	0.16	0.71	0.15	0.17	0.65	0.16	0.14	0.15
153	2.39	2.35	2.78	2.41	2.96	1.41	1.20	1.20	1.05	2.26	1.99	2.50	2.33	2.30	0.80	0.95	1.07	1.36	1.14	1.20	1.20	1.28	1.30	1.08
163/164	0.14	0.13	2.13	0.15	2.14	0.16	0.15	0.16	0.59	1.68	1.39	1.90	1.76	1.67	0.84	0.65	0.89	0.85	0.87	0.92	0.90	0.95	1.04	0.88
170	0.14	0.13	3.85	2.83	0.16	0.16	0.15	0.16	0.15	0.17	0.17	0.17	4.78	5.15	7.00	7.28	9.51	8.08	8.05	4.64	9.86	8.38	8.81	8.59
187	0.14	0.13	0.16	0.15	0.16	0.79	1.13	0.99	0.75	2.17	1.74	2.04	1.78	2.00	1.52	1.62	1.90	1.73	1.95	2.14	2.13	2.18	2.31	2.09
ΣPCBs	28.14	27.39	37.76	31.51	36.36	13.38	14.13	12.98	11.26	55.69	50.89	54.85	54.00	62.60	27.28	31.70	35.05	38.67	33.44	35.03	37.36	38.17	39.61	32.90
Mean ΣPCBs	32.2					12.9				55.6					33.2					36.6				
Mean lipid	1.6					1.3				1.2					1.2					1.2				

TABLE 3. Results of 28-day *L. variegatus* ΣDDT bioaccumulation experiments on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (highlighted values are non-detectable concentrations valued at one-half the MDL) (USACE 2013a).

DDT Isomer (ug/kg)	Lake Area										Harbor Management Unit														
	CLA 1 Comp replicate					CLA 4 Comp replicate					DMMU 1 replicate					DMMU 2a replicate					DMMU 2b replicate				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
4,4'-DDD	1.990	2.300	2.500	3.090	2.540	0.748	0.679	2.420	0.587	0.693	1.390	1.810	1.200	1.200	1.330	0.894	0.873	0.934	0.993	0.950	1.340	1.580	1.380	1.560	1.390
4,4'-DDE	2.580	2.790	3.312	2.670	3.210	1.190	0.934	4.190	0.994	0.824	4.290	3.850	3.870	4.010	3.530	2.170	2.210	2.680	2.340	3.020	4.290	3.430	3.880	5.180	4.170
4,4'-DDT	0.048	0.051	0.053	0.051	0.055	0.054	0.052	0.051	0.053	0.051	0.057	0.056	0.057	0.052	0.051	0.056	0.053	0.054	0.047	0.051	0.056	0.051	0.056	0.049	0.051
2,4'-DDD	0.085	0.089	0.093	0.089	0.50*	0.094	0.092	0.090	0.092	0.089	0.100	0.099	0.099	0.092	0.089	0.098	0.093	0.094	0.083	0.090	0.097	0.089	0.097	0.086	0.089
2,4'-DDE	0.085	0.089	0.093	0.089	0.097	0.094	0.092	0.090	0.092	0.089	0.100	0.099	0.099	0.092	0.089	0.098	0.093	0.094	0.083	0.090	0.097	0.089	0.097	0.086	0.089
2,4'-DDT	0.085	0.089	0.093	0.089	0.097	0.094	0.092	0.090	0.092	0.089	0.100	0.099	0.099	0.092	0.089	0.098	0.093	0.094	0.083	0.090	0.097	0.089	0.097	0.086	0.089
ΣDDT	4.570	5.090	5.812	5.760	5.750	1.938	1.613	6.610	1.581	1.517	5.680	5.660	5.070	5.210	4.860	3.064	3.083	3.614	3.333	3.970	5.630	5.010	5.260	6.740	5.560
Mean ΣDDT	**5.396**					**2.652**					**5.296**					**3.413**					**5.640**				
Mean lipid	**1.6**					**1.3**					**1.2**					**1.2**					**1.2**				

*J-flagged concentration not included in summation.

TABLE 4. Results of 48-hour *Ceriodaphnia dubia* and 96-hour *Pimephales promelas* elutriate bioassays on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013a).

		Species							
		C. dubia				*P. promelas*			
		Measurement Endpoint				Measurement Endpoint			
Sample	Elutriate concentration (%)	Survival (%)	NOEC (%)	LOEC (%)	LC50 (%)	Survival (%)	NOEC (%)	LOEC (%)	LC50 (%)
DMMU-1	6	100	100	N/A	N/A	98±4	100	N/A	N/A
	13	96±9				98±4			
	25	92±18				100			
	50	100				96±9			
	100	100				98±4			
DMMU-2a	6	100	100	N/A	NC	100	50	100	67 (63-71)
	13	96±9				96±5			
	25	92±18				100			
	50	84±17				96±5			
	100	84±17				**0**			
DMMU-2b	6	92±18	100	N/A	NC	100	50	100	67 (63-71)
	13	100				100			
	25	100				96±5			
	50	92±11				96±5			
	100	76±17				**0**			
CDF	6	84±17	100	N/A	N/A	100	100	N/A	N/A
	13	96±9				100			
	25	92±11				100			
	50	92±11				100			
	100	88±18				100			
Control	N/A	92±18	N/A	N/A	N/A	100	N/A	N/A	N/A
Lake Site Water	0	80±28	N/A	N/A	N/A	100	N/A	N/A	N/A

TABLE 5. Maximum metal and inorganic standard elutriate test (SET) results on Cleveland Harbor DMMU-1, DMMU-2a and DMMU-2b sediments (USACE 2013a). Notes: water hardness-dependent metal standards based on measured lake water hardness of 120 mg/L $CaCO_3$.

Metals	Site with maximum concentration	SET Concentration (µg/L)	Aquatic life WQS (µg/L) (IMZM)	Human health WQS, drink (µg/L) (chronic)
Aluminum	All	20		970
Antimony	DMMU-1	1.8	1800	9.7
Arsenic	DMMU-2b	12.4	680	
Barium	DMMU-2b	71.2	4000	2000
Beryllium	All	0.5U*	250 TR	17
Cadmium	All	0.5U	10.5	14 TR**
Calcium	All	70400		
Chromium	DMMU-2b	1.3	1323	140 TR
Cobalt	DMMU-2a	0.7J***	440	
Copper	DMMU-1	4.9	31.9	790 TR
Iron	DMMU-2b	71.4		300 S
Lead	All	0.5	243	
Magnesium	DMMU-2b	15.4		
Manganese	DMMU-2a	1210		50
Mercury	DMMU-2a	0.075	2.9	0.0031 TR
Nickel	DMMU-2a	6.9	1092	470 TR
Potassium	DMMU-2b	8730		
Selenium	DMMU-2b	2.3	4.6#	130 TR
Silver	All	0.5	3.7	
Sodium	DMMU-2b	32800		
Thallium	All	0.5	160	
Vanadium	DMMU-1	0.9J	300	
Zinc	DMMU-1	7.6	274	5000 TR

Miscellanious	Site with maximum concentration	SET Concentration (mg/L)	Aquatic life WQS (mg/L) (IMZM)	Human health WQS, drink (mg/L) (chronic)
Ammonia, N	DMMU-2a	**16.8**	2.4##	
Cyanide	All	0.01	0.044	0.6
Phosphorus	DMMU-2b	0.124		

*Non-detectable at the specified detection limit.

**Total recoverable.

***Estimated value between the minimum detection limit and reporting limit.

#Outside mixing zone average.

##OMZA WQS Based on a water temperature of 20°C and pH of 8.4.

TABLE 6. Maximum pesticide SET results on Cleveland Harbor DMMU-1, DMMU-2a and DMMU-2b sediments (USACE 2013a).

Pesticide	Site with maximum concentration	SET Concentration (µg/L)	Aquatic life (µg/L) (OMZA)	Federal freshwater CMC (µg/L) (acute)	Human health WQS, drink (µg/L) (chronic)
Aldrin	All	0.001U			
BHC, alpha-	All	0.001U			
BHC, beta-	All	0.001U			
BHC, delta-	All	0.001R			
BHC, gamma- (Lindane)	All	0.001U			
Chlordane, alpha-	All	0.001U			
Chlordane, gamma-	All	0.001U			
DDD, 4,4'-	All	0.001U			
DDE, 4,4'-	All	0.001U	0.000011[#]	1.1[##]	0.00015
DDT, 4,4'-	All	0.001U			
Dieldrin	All	0.001U			
Endosulfan-I	All	0.001U			
Endosulfan-II	All	0.001U			
Endosulfan-Sulfate	All	0.001U			
Endrin	All	0.001U			
Endrin Aldehyde	All	0.001U			
Endrin Ketone	All	0.001R			
Heptachlor	All	0.001U			
Heptachlor Epoxide	All	0.001U			
Methoxychlor	All	0.001U			
Toxaphene	All	0.001U			

*Non-detectable at the specified detection limit.
**Rejected.
***Estimated value between the method detection limit and reporting limit.
[#]Wildlife WQS for DDT, OMZA.
[##]National recommended water quality criterion for DDT and its metabolites (Federal, USEPA); freshwater criterion maximum concentration (CMC) (acute).

TABLE 7. Maximum PCB SET results on Cleveland Harbor DMMU-1, DMMU-2a and DMMU-2b sediments (USACE 20131). Note: all WQSs are chronic.

Aroclor	Site with maximum concentration	SET Concentration (µg/L)	Wildlife WQS (µg/L) (OMZA)	Federal freshwater CCC* (µg/L) (chronic)	Human health WQS, drink (µg/L) (OMZA)
1016	All	0.03U	0.00012	0.014	0.000026
1221	All	0.03U	0.00012	0.014	0.000026
1232	All	0.03U	0.00012	0.014	0.000026
1242	All	0.03U	0.00012	0.014	0.000026
1248	All	0.03U	0.00012	0.014	0.000026
1254	All	0.03U	0.00012	0.014	0.000026
1260	All	0.03U	0.00012	0.014	0.000026

*National recommended water quality criterion (Federal, USEPA); freshwater criterion continuous concentration (CCC) (chronic).
**Non-detectable at the specified detection limit.

TABLE 8. Maximum PAH compound SET results on Cleveland Harbor DMMU-1, DMMU-2a and DMMU-2b sediments (USACE 2013a).

PAH compound	Site with maximum concentration	SET Concentration (µg/L)	Aquatic life (µg/L) (IMZM)	Human health WQS, drink (µg/L) (chronic)
1-Methylnaphthalene	DMMU-1	1.6U		
2-Methylnaphthalene	DMMU-1	1.6U		
Acenaphthene	DMMU-1	0.04U	38	570
Acenaphthylene	DMMU-1	0.04U	240	850
Anthracene	DMMU-1	0.04U	0.35	590
Benzo(a)anthracene	DMMU-1	0.04J	85	
Benzo(a)pyrene	DMMU-1	0.08J	1.1	0.00002
Benzo(b)fluoranthene	DMMU-1	0.12J	47	
Benzo(g,h,i)perylene	DMMU-1	0.08J		
Benzo(k)fluoranthene	DMMU-1	0.08J		
Chrysene	DMMU-1	0.08J	85	
Dibenz(a,h)anthracene	DMMU-1	0.04U		
Fluoranthene	DMMU-1	0.16J	7.4	9.4
Fluorene	DMMU-1	0.04U	220	250
Indeno(1,2,3-cd)pyrene	DMMU-1	0.08J		
Naphthalene	DMMU-1	0.04U	340	540
Phenanthrene	DMMU-1	0.04J	61	
Pyrene	DMMU-1	0.12J	83	15

*Non-detectable at the specified detection limit.

**Estimated value between the method detection limit and reporting limit.

OPERATIONS AND MAINTENANCE

OPEN-LAKE PLACEMENT OF MATERIAL DREDGED FROM CLEVELAND HARBOR FEDERAL NAVIGATION CHANNELS IN THE UPPER CUYAHOGA RIVER

CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

• 2014 SECTION 401 STATE WATER QUALITY CERTIFICATION APPLICATION (INCLUDES CLEVELAND HARBOR DREDGED MATERIAL EVALUATIONS)

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207-3199

November 27, 2013

REPLY TO
ATTENTION OF

Environmental Analysis Team

SUBJECT: Cleveland Harbor, Cuyahoga County, Ohio - Request for Section 401 Water Quality Certification for Scheduled 2014 Maintenance Dredging Project

Mr. Scott J. Nally
Director
Ohio Environmental Protection Agency
ATTN: Ric Queen
Division of Surface Water
P.O. Box 1049
Columbus, Ohio 43216-1049

Dear Mr. Nally:

This letter transmits the Section 404(a) Public Notice and Section 401 State Water Quality Certification (WQC) application for our scheduled 2014 maintenance dredging project at Cleveland Harbor, Ohio. This project entails the maintenance dredging of authorized Federal navigation channels and management of the associated dredged material. Material dredged from the upper Cuyahoga River Channel between Station 799+00 (upstream Federal navigation channel limit) and Station 736+00 (Upper Turning Basin) will be discharged at either of two proposed open-lake areas in Lake Erie. Material dredged from the remaining portions of the harbor's Federal navigation channels will be placed in existing dredged material confined disposal facilities (CDFs) in Cleveland Harbor. The Public Notice has been prepared in conformance with U.S. Army Corps of Engineers (USACE) regulation, "Practice and Procedure: Final Rule for Operation and Maintenance of Army Corps of Engineers Civil Works Projects Involving the Discharge of Dredged Materials into Waters of the United States or Ocean Waters," 33 Code of Federal Regulations (CFR) 337.1.

The USACE is requesting Ohio Environmental Protection Agency (OEPA) WQC for the scheduled 2014 maintenance dredging project at Cleveland Harbor, or waiver thereof, under Section 401 of the Clean Water Act.

The following items are included with this request:

a. Section 404(a) Public Notice (Enclosure 1).
b. Section 401 WQC application (Enclosure 2).

SUBJECT: Cleveland Harbor, Cuyahoga County, Ohio - Request for Section 401 Water Quality Certification for Scheduled 2014 Maintenance Dredging Project

c. Aerial photograph of Cleveland Harbor (Enclosure 3).
d. Contract drawings depicting the preferred and minimum degradation design alternatives (Enclosures 4 and 5, respectively).
e. Cleveland Harbor, Cuyahoga County, Ohio – Evaluation of Federal Navigation Channel Sediments with Respect to their Suitability for Open-lake Placement (2007) (Enclosure 6).
f. Evaluation of Cleveland Harbor Federal Navigation Channel (Upper Cuyahoga River Channel) Dredged Material with Respect to Suitability for Open-lake Placement (2013) (Enclosure 7).
g. Preliminary Information toward USACE Response to OEPA Comments in October 4, 2013 letter and from November 4, 2013 Meeting (Enclosure 8).

The National Environmental Policy Act (NEPA) documents (Environmental Impact Statements and Environmental Assessments [EAs]) for CDF disposal of Cleveland Harbor dredged material were previously furnished to your office. Much of the information requested in Item 10 of the WQC application is contained in these documents in further detail. In addition, an EA and Section 404(b)(1) Evaluation for the open-lake placement of material dredged from the upper Cuyahoga River Channel are pending and will be provided to your office for comment at a later date.

The USACE conducted large scale sediment sampling and analyses of sediments within the Cleveland Harbor Federal navigation channels in 2012. The OEPA, Port of Cleveland, and Ohio Department of Natural Resources reviewed in advance the associated sediment sampling and analysis plan (SAP) and provided comments in March and April 2012. This effort applied standard biological and other advanced testing procedures to sediments within the upper Cuyahoga River Channel because this is the reach of the harbor where the majority of dredging takes place each year (about 80 percent of the material or approximately 180,000 cubic yards). The USACE completed a comprehensive evaluation of these data in 2013 in accordance with the protocols and guidelines contained in the U.S. Environmental Protection Agency (USEPA)/USACE Great Lakes Dredged Material Testing and Evaluation Manual (1998) and Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.—Testing Manual (1998) (Enclosure 7). The evaluation concludes that discharge of the dredged material into the open-lake would not result in contaminant-related, unacceptable adverse impacts to the aquatic ecosystem. Therefore, it has been determined that this dredged material meets Federal "contaminant determination" guidelines (40 CFR 210.11[d]) for open-lake placement.

In an effort to facilitate the forthcoming WQC application process, USACE provided a draft of the 2013 evaluation of the upper Cuyahoga River Channel material to OEPA for a pre-application review on August 1, 2013 and comments were provided to USACE in a letter from OEPA dated October 4, 2013. On November 4, 2013, OEPA and USACE met to discuss and further clarify your significant concerns regarding open-lake placement of this dredged material.

SUBJECT: Cleveland Harbor, Cuyahoga County, Ohio - Request for Section 401 Water Quality Certification for Scheduled 2014 Maintenance Dredging Project

We expect to provide a comprehensive technical response to those comments within the next few weeks which will be submitted to OEPA as a supplement to the 2013 dredged material evaluation. In the mean time we have enclosed preliminary information to address many of the points raised in the October 4 OEPA letter and November 4 meeting which will be incorporated into our forthcoming formal response to your concerns (Enclosure 8).

As you know, we require WQC in order to accept contract bids on this project. The bid opening date has been scheduled for April 1, 2014 and our goal is to secure the WQC by March 27, 2014. Therefore, we are requesting for an administratively complete determination on the application as soon as possible, and that the Public Hearing is scheduled at your earliest possible convenience. Please advise us regarding the status of the enclosed application by December 13, 2013. We appreciate your cooperation in this matter.

A copy of the Public Notice will be sent to U.S. Fish and Wildlife Service (Ecological Services, Columbus, Ohio) and ODNR (Division of Wildlife, Ohio Biodiversity Database, Columbus, Ohio) on December 2, 2013 to coordinate comments with respect to Threatened and Endangered species, including the presence or absence of Critical Habitat. Further, we will e-mail these two entities on December 2, 2013 to request their comments in this regard with copy furnished to OEPA.

If you have any questions pertaining to this matter please contact Mr. Scott W. Pickard of the Buffalo District at (716) 879-4404, by writing to the following address: U.S. Army Corps of Engineers, 1776 Niagara Street, Buffalo, New York, 14207-3199, or by e-mail at: Scott.W.Pickard@usace.army.mil .

Sincerely,

Martin P. Wargo, PWS
Supervisory Biologist
Environmental Analysis Team

Enclosures

Enclosure 1

Section 404 (a) Public Notice

US Army Corps of Engineers

Public Notice

Issuing Office: CELRB-PM-EA **Published: 2 DEC 2013**
Notice No: CLEVELAND-14 **Expires: 2 JAN 2014**

OPERATION AND MAINTENANCE
DREDGING AND DREDGED MATERIAL PLACEMENT

CLEVELAND HARBOR

CUYAHOGA COUNTY, OHIO

This Public Notice has been prepared and distributed in conformance with U.S. Army Corps of Engineers (USACE) regulation, "Practice and Procedure: Final Rule for Operation and Maintenance of Army Corps of Engineers Civil Works Projects involving the Discharge of Dredged Materials into Waters of the United States or Ocean Waters," 33 Code of Federal Regulations (CFR) 337.1. Its purpose is to specify what dredged/fill materials would be discharged into waters of the United States by implementation of the proposed action, and advise all interested parties of the proposed project and provide an opportunity to submit comments or request a public hearing.

The USACE anticipates the need to dredge and place material excavated from the Federal navigation channels of the Cleveland Harbor, including the Cuyahoga River, Old River, Lake Approach Channel, and Outer Harbor Channel, in order to maintain sufficient depth for deep-draft commercial vessels. The attached maps (Figure 1a and 1b) show the authorized limits and depths of the Federal navigation channels. To insure that the minimum authorized depth in the Harbor is maintained throughout the navigation season, an additional four feet of shoal may be removed, including one foot of overdepth and three feet of advance maintenance dredging. Approximately 225,000 cubic yards of material will be dredged from Cleveland Harbor Federal navigation channels during the 2014 dredging operation.

The 2014 dredging operation at Cleveland Harbor is tentatively scheduled to be performed between April 1 and December 31.

Sediments will be removed from the channel bottom by mechanical dredge and placed aboard scows for transport to the placement areas. In previous years, clamshell and hopper dredges have been used to complete this dredging. A contractor of the Federal government will accomplish this work.

The material to be dredged from the Cleveland Harbor Federal navigation channels consists primarily of silts and clays, with some sands and gravels. In the Spring of 2012, a

comprehensive sediment testing effort was conducted on sediments sampled from the upper reach of the Cuyahoga River Channel, between Stations 799+00 (upstream Federal navigation channel limit) and 736+00 (Turning Basin), to evaluate suitability of the dredged material for open-lake placement (Figure 2). The subsequent evaluation of sediment sampling data completed in 2013 was conducted in accordance with the protocols and guidelines contained in the U.S. Environmental Protection Agency (USEPA)/USACE Great Lakes Dredged Material Testing and Evaluation Manual (1998) and Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.—Testing Manual (1998). The sediments analyzed represent approximately 80 percent of the material dredged from Cleveland Harbor on an annual basis. The evaluation concludes that discharge of this dredged material into the open-lake would not culminate in contaminant-related, unacceptable adverse impacts to the aquatic ecosystem. Therefore, it has been determined that it meets Federal "contaminant determination" guidelines (40 CFR 210.11[d]) for open-lake placement. Placement of this dredged material is proposed at open-lake areas 1 and 4 shown in Figure 3. The remaining material to be dredged from the harbor has not been determined to meet Federal guidelines for open-lake placement at this time and will therefore be placed in either confined disposal facility (CDF) No. 9 and/or 10B which are located in the Cleveland Outer Harbor (Figure 4).

In addition to showing that the dredged material met Federal guidelines for open-lake placement, the 2013 evaluation evidenced a significant net improvement in the overall quality of upper Cuyahoga River Channel sediments between 2007 and 2012. Further, the potential impacts from open-lake placement of this dredged material to the quality of water at the Crown, Morgan, Baldwin and Nottingham potable water intakes (PWIs) was investigated by the U.S. Army Engineer Research and Development Center (USAERDC). Conservative modeling showed that no meaningful contribution of any suspended solids or contaminants from dredged material placement operations at open-lake areas #1 or #4 would be expected at any of these PWIs.

Water Quality Certification (WQC) from the Ohio Environmental Protection Agency (OEPA) is required for this action, pursuant to Section 401 of the Clean Water Act. Therefore, a copy of this Public Notice has been provided to OEPA requesting WQC (or waiver thereof) for the associated discharge of dredged material at the open-lake placement areas and resultant overflow effluent from CDF Nos. 9 and/or 10B.

The environmental effects of the dredging operation are documented in the ***Final Environmental Impact Statement (FEIS), Operation and Maintenance, Cleveland Harbor, Ohio (1974); and FEIS, Harbor Maintenance and Confined Disposal Facility Site 10B, Cleveland Harbor, Ohio (1994).*** These documents, and supplemental documentation, have been submitted to USEPA and copies are available for examination at the Buffalo District office. An Environmental Assessment and Clean Water Act Section 404(b)(1) Evaluation for discharge of the dredged material at the proposed open-lake lake areas are forthcoming and will be available for public review and comment.

There are no listed historic properties or properties determined as being eligible for listing in the National Register of Historic Places that will be affected by this project. By this notice, the National Park Service is advised that currently unknown archaeological, scientific, prehistorical

or historical data may be lost or destroyed by the work to be accomplished.

The USACE has determined that the proposed project will have No Effect upon any species proposed or designated by the U.S. Department of the Interior as threatened or endangered, nor will the proposed work result in an Adverse Modification of designated critical habitat for any such species. Therefore, unless new information indicates otherwise, no further consultation pursuant to Section 7 of the Endangered Species Act Amendments of 1978 will be undertaken with the U.S. Fish and Wildlife Service.

This work will be undertaken in a manner consistent, to the maximum extent practicable, with the State of Ohio Coastal Management Program. A Coastal Management Program Federal Consistency Determination will be submitted to the Ohio Department of Natural Resources (ODNR) documenting this determination.

The decision whether to perform dredging has been based on an evaluation of the probable impact, including cumulative impacts of the proposed activity on the public interest. That decision reflects the national concern for both protection and utilization of important resources. The benefit which is reasonably expected to accrue from the proposal has been balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal have been considered including the cumulative factors thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership and, in general, the needs and welfare of the people.

This activity is being coordinated with the following agencies, as well as other appropriate Federal, State and local agencies and organizations:

Ohio Department of Natural Resources
Ohio Environmental Protection Agency
Ohio Historic Preservation Office
U.S. Coast Guard
U.S. Department of the Interior, Fish and Wildlife Service
U.S. Environmental Protection Agency

Any interested parties and/or agencies desiring to express their views concerning these proposed discharges of dredged material may do so by filing their comments, in writing, no later than 30 days from the date of this notice. Any person who has an interest which may be affected by the discharge of this dredged material may request a public hearing. The request must be submitted in writing to the undersigned within 30 days of the date of this Public Notice. The request must clearly set forth the interest which may be affected, and the manner in which the interest may be affected, by this activity.

Interested parties are encouraged to contact the USACE with their comments regarding the proposed discharge of this Cleveland Harbor dredged material. Please review this Public Notice and send your comments in writing within 30 days to the following e-mail address:

ClevelandOpenLake@usace.army.mil

or via mail to:

U.S. Army Corps of Engineers, Buffalo District
Environmental Analysis Team
1776 Niagara Street
Buffalo, NY 14207-3199
ATTN: Environmental Analysis – Cuyahoga River Dredging

This Public Notice is published in conformance with 33 CFR 337.1. All dredging and dredged material discharge will be performed in conformance with Sections 313 and 404 of the Clean Water Act (33 USC 1323 and 1344, respectively).

Martin P. Wargo, PWS
Supervisory Biologist
Environmental Analysis Team

Attachments

NOTICE TO THE POSTMASTER: It is requested that the above notice be conspicuously displayed for 30 days from the date of issuance.

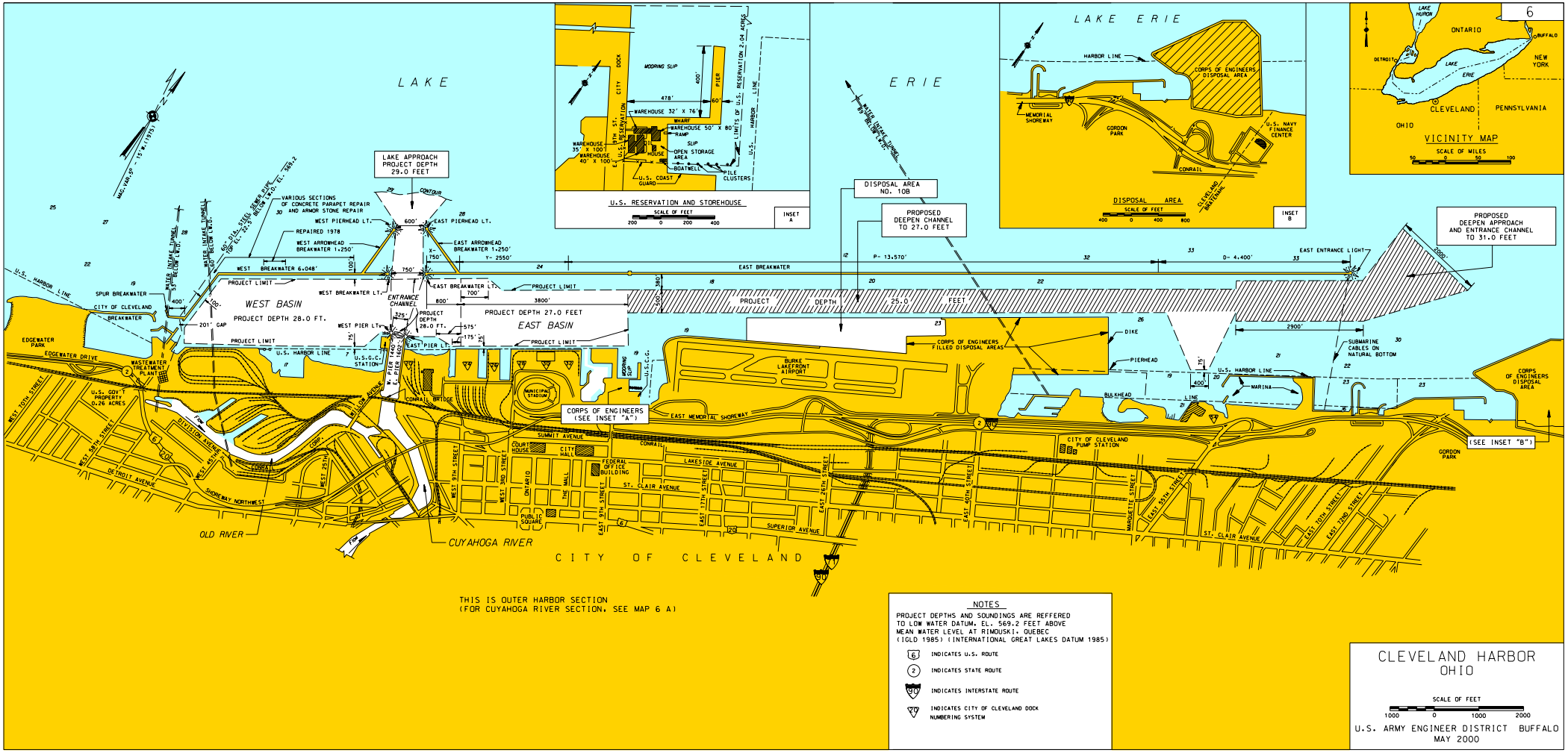
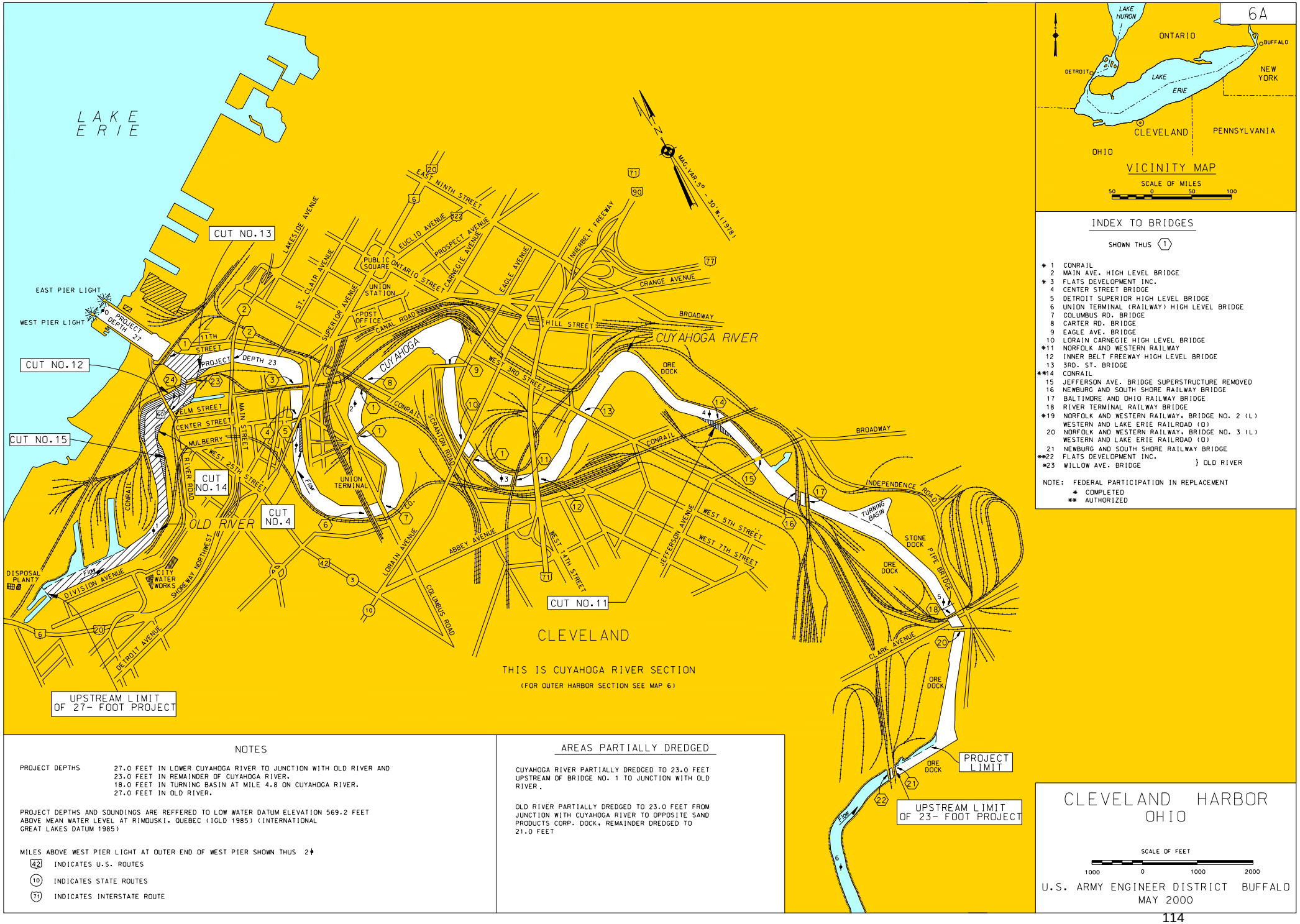


Figure 1a. Cleveland Harbor (Cuyahoga River), Cuyahoga County, Ohio (Outer Harbor)



INDEX TO BRIDGES

SHOWN THUS (1)

* 1	CONRAIL	
2	MAIN AVE. HIGH LEVEL BRIDGE	
* 3	FLATS DEVELOPMENT INC.	
4	CENTER STREET BRIDGE	
5	DETROIT SUPERIOR HIGH LEVEL BRIDGE	
6	UNION TERMINAL (RAILWAY) HIGH LEVEL BRIDGE	
7	COLUMBUS RD. BRIDGE	
8	CARTER RD. BRIDGE	
9	EAGLE AVE. BRIDGE	
10	LORAIN CARNEGIE HIGH LEVEL BRIDGE	
*11	NORFOLK AND WESTERN RAILWAY	
12	INNER BELT FREEWAY HIGH LEVEL BRIDGE	
13	3RD. ST. BRIDGE	
**14	CONRAIL	
15	JEFFERSON AVE. BRIDGE SUPERSTRUCTURE REMOVED	
16	NEWBURG AND SOUTH SHORE RAILWAY BRIDGE	
17	BALTIMORE AND OHIO RAILWAY BRIDGE	
18	RIVER TERMINAL RAILWAY BRIDGE	
*19	NORFOLK AND WESTERN RAILWAY, BRIDGE NO. 2 (L)	
	WESTERN AND LAKE ERIE RAILROAD (O)	
20	NORFOLK AND WESTERN RAILWAY, BRIDGE NO. 3 (L)	
	WESTERN AND LAKE ERIE RAILROAD (O)	
21	NEWBURG AND SOUTH SHORE RAILWAY BRIDGE	
**22	FLATS DEVELOPMENT INC.	} OLD RIVER
*23	WILLOW AVE. BRIDGE	

NOTE: FEDERAL PARTICIPATION IN REPLACEMENT
* COMPLETED
** AUTHORIZED

NOTES

PROJECT DEPTHS
27.0 FEET IN LOWER CUYAHOGA RIVER TO JUNCTION WITH OLD RIVER AND
23.0 FEET IN REMAINDER OF CUYAHOGA RIVER.
18.0 FEET IN TURNING BASIN AT MILE 4.8 ON CUYAHOGA RIVER.
27.0 FEET IN OLD RIVER.

PROJECT DEPTHS AND SOUNDINGS ARE REFFERED TO LOW WATER DATUM ELEVATION 569.2 FEET ABOVE MEAN WATER LEVEL AT RIMOUSKI, QUEBEC (IGLD 1985) (INTERNATIONAL GREAT LAKES DATUM 1985)

MILES ABOVE WEST PIER LIGHT AT OUTER END OF WEST PIER SHOWN THUS 2

(42) INDICATES U.S. ROUTES

(10) INDICATES STATE ROUTES

(71) INDICATES INTERSTATE ROUTE

AREAS PARTIALLY DREDGED

CUYAHOGA RIVER PARTIALLY DREDGED TO 23.0 FEET UPSTREAM OF BRIDGE NO. 1 TO JUNCTION WITH OLD RIVER.

OLD RIVER PARTIALLY DREDGED TO 23.0 FEET FROM JUNCTION WITH CUYAHOGA RIVER TO OPPOSITE SAND PRODUCTS CORP. DOCK, REMAINDER DREDGED TO 21.0 FEET

CLEVELAND HARBOR OHIO

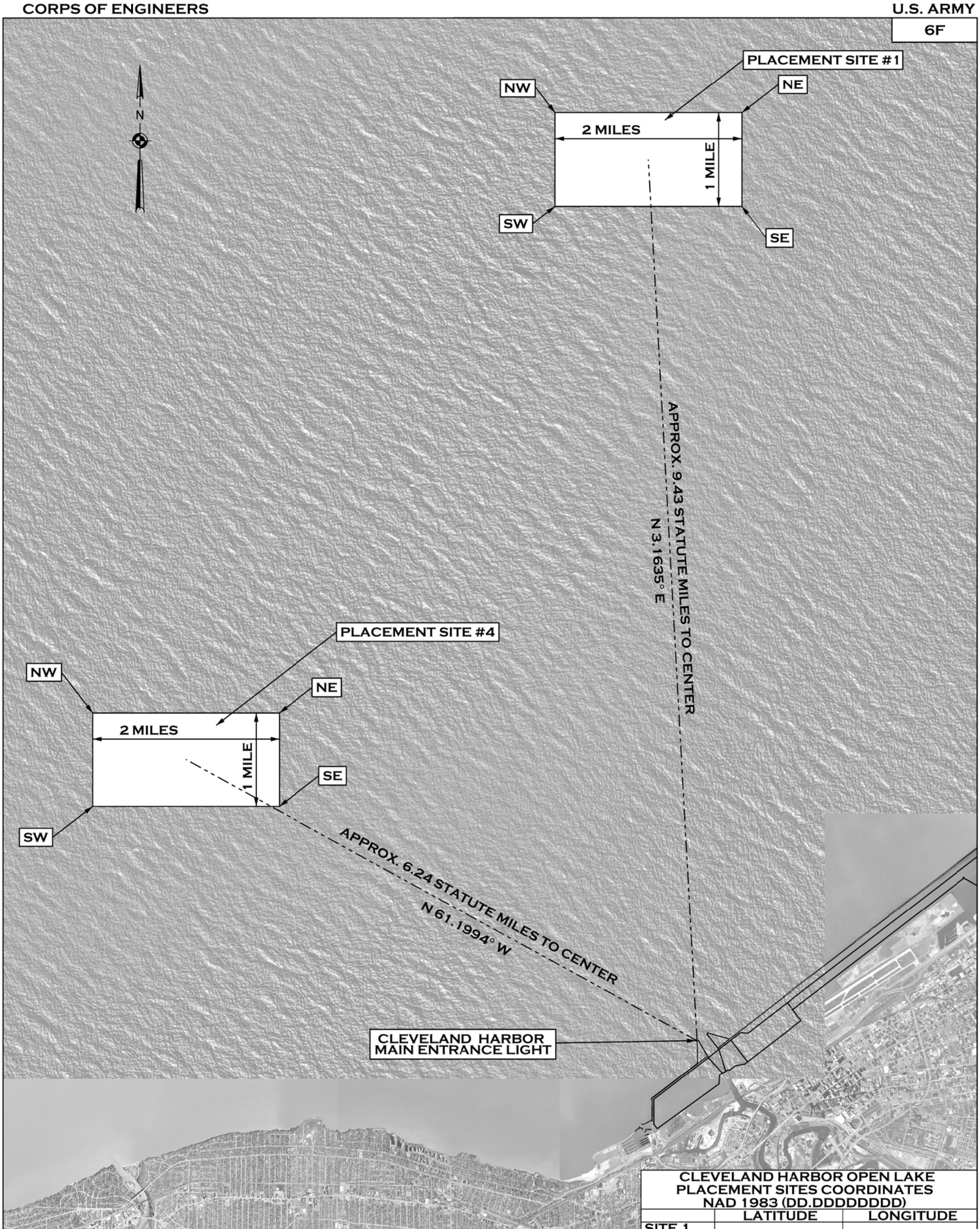
SCALE OF FEET
1000 0 1000 2000

U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 2000

Figure 1b. Cleveland Harbor (Cuyahoga River), Cuyahoga County, Ohio (River)

Figure 2:Upper Cuyahoga River Sample Locations and DMMU Boundaries

Figure 3: Open Lake Placement Site Locations in Lake Erie, Cleveland, Ohio



CLEVELAND HARBOR OPEN LAKE PLACEMENT SITES COORDINATES NAD 1983 (DD.DDDDDDDD)		
	LATITUDE	LONGITUDE
SITE 1		
CENTER	41.645504988	81.726066535
NE	41.652619543	81.706661473
SE	41.638130041	81.706837175
SW	41.638387177	81.745467376
NW	41.652876734	81.745300230
SITE 4		
CENTER	41.553171131	81.822554593
NE	41.560302010	81.803187373
SE	41.545811921	81.803341480
SW	41.546037006	81.841917596
NW	41.560527144	81.841772022

LOCATION OF PLACEMENT AREAS WERE CALCULATED AS FOLLOWS:

1. THE LAT/LON COORDINATES WERE PROVDIED TO TD-DS IN A EMAIL FROM PM-EA ON 17 OCT. 2013.
2. THE COORDINATES WERE CONVERTED TO STATE PLANE COORDINATES USING CORPSCON AND PLOTTED IN A CADD FILE.
3. THE SOUTHWEST CORNER WAS HELD AS THE STARTING POINT WITH LINES DRAWN DUE EAST AT 2 MILES AND DUE NORTH AT 1 MILE, THEN COPIED PARALLEL TO FORM THE 2 MILE X 1 MILE SITE.
4. THE XY STATE PLANE COORDINATES OF THE CORNERS FROM THE DRAWN PLACEMENT SITE WERE THEN CONVERTED TO LAT/LON FOR INCLUSION ON THIS MAP.
5. THE BEARING AND DISTANCE TO THE CENTERS WAS CALCULATED BY DRAWING A LINE FROM THE CENTER OF THE PLACEMENT SITE TO THE LIGHTHOUSE SHOWN ON A GEOREFERENCED SID FILE OBTAINED FROM THE OHIO GRAPHICALLY REFERENCED INFORMATION PROGRAM.

CLEVELAND HARBOR
OHIO

OPEN LAKE PLACEMENT SITE LOCATION

SCALE OF MILES

1 ½ 0 1

U.S. ARMY ENGINEER DISTRICT BUFFALO
NOVEMBER 2013

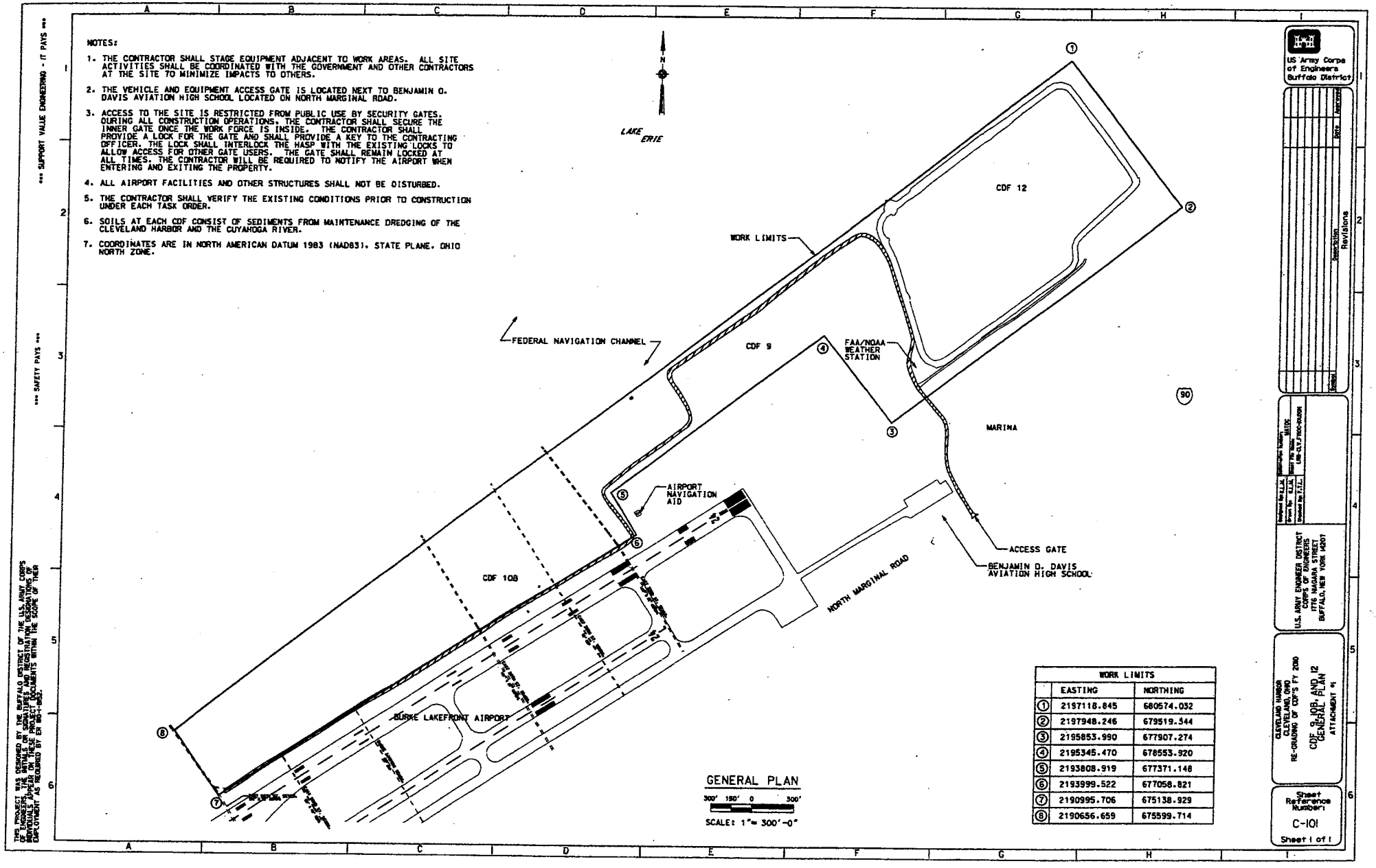


Figure 4 - Cleveland Harbor Confined Disposal Facility (CDF)

Enclosure 2

401 WQC Application

APPLICATION FOR OHIO EPA SECTION 401 WATER QUALITY CERTIFICATION

Effective October 1, 1996
Revised August, 1998

This application must be completed whenever a proposed activity requires an individual Clean Water Act Section 401 Water Quality Certification (Section 401 certification) from Ohio EPA. A Section 401 certification from the State is required to obtain a federal Clean Water Act Section 404 permit from the U.S. Army Corps Engineers, or any other federal permits or licenses for projects that will result in a discharge of dredged or fill material to any waters of the State. To determine whether you need to submit this application to Ohio EPA, contact the U.S. Army Corps of Engineers District Office with jurisdiction over your project, or other federal agencies reviewing your application for a federal permit to discharge dredged or fill material to waters of the State, or an Ohio EPA Section 401 Coordinator at (614) 644-2001.

The Ohio EPA Section 401 Water Quality Certification Program is authorized by Section 401 of the Clean Water Act (33 U.S.C. 1251) and the Ohio Revised Code Section 6111.03(P). Ohio Administrative Code (OAC) Chapter 3745-32 outlines the application process and criteria for decision by the Director of Ohio EPA. In order for Ohio EPA to issue a Section 401 certification, the project must comply with Ohio's Water Quality Standards (OAC 3745-1) and not potentially result in an adverse long-term or short-term impact on water quality. Included in the Water Quality Standards is the Antidegradation Rule (OAC Rule 3745-1-05), effective October 1, 1996, revised October, 1997 and May, 1998. The Rule includes additional application requirements and public participation procedures. **Because there is a lowering of water quality associated with every project being reviewed for Section 401 certification, every Section 401 certification applicant must provide the information required in Part 10 (pages 3 and 4) of this application.** In addition, applications for projects that will result in discharges of dredged or fill material to wetlands must include a wetland delineation report approved by the Corps of Engineers, a wetland assessment with a proposed assignment of wetland category (ies), official documentation on evaluation of the wetland for threatened or endangered species, and appropriate avoidance, minimization, and mitigation as prescribed in OAC 3745-1-50 to 3745-1-54. Ohio EPA will evaluate the applicant's proposed wetland category assignment and make the final assignment.

Information provided with the application will be used to evaluate the project for certification and is a matter of public record. If the Director determines that the application lacks information necessary to determine whether the applicant has demonstrated the criteria set forth in OAC Rule 3745-32-05(A) and OAC Chapter 3745-1, Ohio EPA will inform the applicant in writing of the additional information that must be submitted. The application will not be accepted until the application is considered complete by the Section 401 Coordinator. An Ohio EPA Section 401 Coordinator will inform you in writing when your application is determined to be complete.

Please submit the following to "Section 401 Supervisor, Ohio EPA/DSW, P.O. Box 1049, Columbus, Ohio 43216-1049:

- Four (4) sets of the completed application form, including the location of the project (preferably on a USGS quadrangle) and 8-1/2 x 11" scaled plan drawings and sections.
- One (1) set of original scaled plan drawings and cross-sections (or good reproducible copies).

(See Application Primer for detailed instructions)

1. The federal permitting agency has determined this project: (check appropriate box and fill in blanks)

   a. X requires an individual 404 permit/401 certification- Public Notice # (if known) CLEVELAND-14

   b.____ requires a Section 401 certification to be anthorized by Nationwide Permit #_____

   c.____ requires a modified 404 permit/401 certification for original Public Notice #_____

   d.____ requires a federal permit under _____ jurisdiction identified by #_____

   e.____ requires a modified federal permit under _____ jurisdiction identified by #_____

2. Application number (to be assigned by Ohio EPA):

3. Name and address of applicant:

Martin P. Wargo
U.S. Army Corps of Engineers, Buffalo District
1776 Niagara Street
Buffalo, NY 14207-3199

Telephone number during business hours:

(_____)_____(Residence)

(716) 879-4116 (Office)

3a. Signature of Applicant: Martin P. Wargo Date: 11/26/13

4. Name, address and title of authorized agent:

Scott W. Pickard
U.S. Army Corps of Engineers, Buffalo District
1776 Niagara Street
Buffalo, NY 14207-3199

Telephone number during business hours:

(_____)_____(Residence)

(716) 879-4404 (Office)

4a. Statement of Authorization: I hereby designate and authorize the above-named agent to act in my behalf in the processing of this permit application, and to furnish, upon request, supplemental information in support of the application.

Signature of Applicant: Martin P. Wargo Date: 11/26/13

5. Location on land where activity exists or is proposed. Indicate coordinates of a fixed reference point at the impact site (if known) and the coordinate system and datum used.

Address:

SEE ATTACHED CONTINUATION SHEET

Street, Road, Route, and Coordinates, or other descriptive location

Watershed	County	Township	City	State	Zip Code

6. Is any portion of the activity for which authorization is sought complete? _____ Yes __X__ No
If answer is "yes," give reasons, month and year activity was completed. Indicate the existing work on the drawings.

7. List all approvals or certifications and denials received from other federal, interstate, state or local agencies for any structures, construction, discharge or other activities described in this application.

Issuing Agency	Type of Approval	Identification No.	Date of Application	Date of Approval	Date of Denial

SEE ATTACHED CONTINUATION SHEET

8. **DESCRIPTION OF THE ACTIVITY (fill in information in the following four blocks - 8a, 8b, 8c & 9)**

8a. Activity: Describe the Overall Activity:

SEE ATTACHED CONTINUATION SHEET

8b. Purpose: Describe the purpose, need and intended use of the activity:

SEE ATTACHED CONTINUATION SHEET

8c. Discharge of dredged or fill material: Describe type, quantity of dredged material (in cubic yards), and quantity of fill material (in cubic yards). **(OAC 3745-1-05(B)(2)(a))**

SEE ATTACHED CONTINUATION SHEET

9. Waterbody and location of waterbody or upland where activity exists or is proposed, or location in relation to a stream, lake, wetland, wellhead or water intake (if known). Indicate the distance to, and the name of any receiving stream, if appropriate.

SEE ATTACHED CONTINUATION SHEET

10. To address the requirements of the Antidegradation Rule, your application must include a report evaluating the:

- Preferred Design (your project) and Mitigative Techniques
- Minimal Degradation Alternative(s) (scaled-down version(s) of your project) and Mitigative Techniques
- Non-Degradation Alternative(s) (project resulting in avoidance of all waters of the state)

At a minimum, item a) below must be completed for the Preferred Design, the Minimal Degradation Alternative(s), and the Non-Degradation Alternative(s), followed by completion of item b) for each alternative, and so on, until all items have been discussed for each alternative (see Primer for specific instructions). (Application and review requirements appear at **OAC 3745-1-05(B)(2), OAC 3745-1-05(C)(6), OAC 3745-1-05(C)(1) and OAC 3745-1-54)**.

10a) Provide a detailed description of any construction work, fill or other structures to occur or to be placed in or near the surface water. Identify all substances to be discharged, including the cubic yardage of dredged or fill material to be discharged to the surface water. **(OAC 3745-1-05(B)(2)(b))**

10b) Describe the magnitude of the proposed lowering of water quality. Include the anticipated impact of the proposed lowering of water quality on aquatic life and wildlife, including threatened and endangered species (include written comments from Ohio Department of Natural Resources and U.S. Fish and Wildlife Service), important commercial or recreational sport fish species, other individual species, and the overall aquatic community structure and function. Include a Corps of Engineers approved wetland delineation. **(OAC 3745-1-05(C)(6)(a, b) and OAC 3745-1-54)**

10c) Include a discussion of the technical feasibility, cost effectiveness, and availability. In addition, the reliability of each alternative shall be addressed (including potential recurring operational and maintenance difficulties that could lead to increased surface water degradation.) **(OAC 3745-1-05(C)(6)(h, j-k) and OAC 3745-1-54)**

10d) For regional sewage collection and treatment facilities, include a discussion of the technical feasibility, cost effectiveness and availability, and long-range plans outlined in state or local water quality management planning documents and applicable facility planning documents. **(OAC 3745-1-05(C)(6)(i))**

10e) To the extent that information is available, list and describe any government and/or privately sponsored conservation projects that exist or may have been formed to specifically target improvement of water quality or enhancement of recreational opportunities on the affected water resource. **(OAC 3745-1-05(B)(2)(g))**

10f) Provide an outline of the costs of water pollution controls associated with the proposed activity. This may include the cost of best management practices to be used during construction and operation of the project. **(OAC 3745-01-05(C)(6)(g))**

10g) Describe any impacts on human health and the overall quality and value of the water resource. **(OAC 3745-1-05(C)(6)(c) and OAC 3745-1-54)**

10h) Describe and provide an estimate of the important social and economic benefits to be realized through this project. Include the number and types of jobs created and tax revenues generated and a brief discussion on the condition of the local economy. **(OAC 3745-1-5(B)(2)(e), and OAC 3745-1-05(C)(6)(i))**

10i) Describe aud provide an estimate of the important social and economic benefits that may be lost as a result of this project. Include the effect on commercial and recreational use of the water resource, including effects of lower water quality on recreation, tourism, aesthetics, or other use and enjoyment by humans. **(OAC 3745-1-05(B)(2)(e,f), and OAC 3745-1-05(C)(6)(e))**

10j) Describe environmental benefits, including water quality, lost and gained as a result of this project. Include the effects on the aquatic life, wildlife, threatened or endangered species. **(OAC 3745-1-05 (B)(2)(e,f), OAC 3745-1-05 (C)(6)(b) and OAC 3745-1-54)**

10k) Describe mitigation techniques proposed (except for the Non-Degradation Alternative):

- Describe proposed Wetland Mitigation (see **OAC 3745-1-54** and Primer)
- Describe proposed Stream, Lake, Pond Mitigation (see Primer)

11. Application is hereby made for a Section 401 Water Quality Certification. I certify that I am familiar with the information contained in this application and, to the best of my knowledge and belief, such information is true, complete and accurate. I further certify that I possess the authority to undertake the proposed activities or I am acting as the duly authorized agent of the applicant.

Signature of Applicant	Date	Signature of Agent
	11/26/13	

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in Block 3 has been filled out and signed.

Do not send a certification processing fee with this application. The appropriate fee will be assessed when a certification is issued.

401\401appl.898

CONTINUATION SHEET

Application for Ohio Environmental Protection Agency (OEPA) Section 401 State Water Quality Certification

CLEVELAND HARBOR
2014 MAINTENANCE DREDGING PROJECT

5. The project is located in Cleveland Harbor, Cuyahoga County, Ohio. The latitude/longitude of the dredging activity (near the head of navigation in the upper river) is 41˚27'54"N/81˚40'27"W. The latitude/longitude of the center of each confined disposal facility (CDF) is: CDF No. 9: 41˚31'36"N/81˚40'22”W; CDF No. 10B: 41˚31'14"N/81˚40'57”W; and CDF No. 12: 41˚31'44"N/81˚39'58”W. The latitude/longitude of the center of each open-lake placement area is: #1: 41.645504988/81.726066535; #4: 41.553171131/81.822554593

7. Final Environmental Impact Statement (FEIS), Operation and Maintenance, Cleveland Harbor, Ohio for CDF disposal

< Issuing Agency - U.S. Army Corps of Engineers
< Type of Approval - Record of Decision (ROD) and Section 404(b)(1) Evaluation
< Date of Application - January 1972
< Date of Approval - April 1974

FEIS and Section 404(b)(1) Evaluation for Confined Disposal Facility No. 10B, Cleveland Harbor, Ohio

< Issuing Agency - U.S. Army Corps of Engineers
< Type of Approval - Record of Decision (ROD) and Section 404(b)(1) Evaluation
< Date of Application - January 1993
< Date of Approval - March 1994

8a. The project will entail the maintenance dredging of sediments from the authorized Federal navigation channels of Cleveland Harbor, Cuyahoga County, Ohio. The channels will be dredged to the authorized depth (See Figures 1a and 1b in the Public Notice). To ensure that the minimum depth in the Harbor is maintained throughout the navigation season, an additional four feet of shoal may be removed including one foot of overdepth and three feet of advance maintenance dredging. Approximately 225,000 cubic yards of sediments will be dredged from the harbor in 2014 (minimum degradation alternative). Dredged material placement will occur in the open lake and confined disposal facilities (CDFs) (See Figures 3 and 4 in the Public Notice). In the Spring of 2012, a comprehensive sediment testing effort was conducted on sediments sampled from the upper reach of the Cuyahoga River Channel, between Stations 799+00 (upstream Federal navigation channel limit) and 736+00 (Turning Basin), to evaluate suitability of the dredged material for open-lake placement. This reach of the upper Cuyahoga River Channel was subdivided into dredged material management units (DMMUs) DMMU-1, DMMU-2a and DMMU-2b (see Figure 2 in the Public Notice). The sediments analyzed represent approximately 80% of the material dredged from Cleveland Harbor on an annual basis. The subsequent evaluation completed in 2013 was conducted in accordance with the protocols

and guidelines contained in the U.S. Environmental Protection Agency (USEPA)/USACE Great Lakes Dredged Material Testing and Evaluation Manual (1998) and Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.—Testing Manual (1998). The evaluation concludes that discharge of the material in the open-lake would not culminate in contaminant-related, unacceptable adverse impacts to the aquatic ecosystem. Therefore, it has been determined that this dredged material meets Federal “contaminant determination” guidelines (40 CFR 210.11[d]) for open-lake placement. Placement of the dredged material is proposed at open-lake areas #1 and #4 (see Figure 3 in the Public Notice). The remaining material to be dredged from the harbor has not yet been determined to meet Federal guidelines for open-lake placement, and will therefore be placed in either confined disposal facility (CDF) No. 9 and 10B both of which are located in the Cleveland Outer Harbor (Figure 4 in the Public Notice). The dredging is scheduled to occur between 1 April and 31 December 2014. The project will be accomplished by a contractor of the Federal government.

8b. The purpose of the project is to maintain sufficient water depths for commercial navigation in Cleveland Harbor. This project was congressionally authorized by the 1875, 1886, 1888, 1896, 1899, 1902, 1907, 1910, 1916, 1917, 1935, 1937, 1945, 1958, 1960 and 1962 River and Harbor Acts, 1976 and 1986 Water Resources Development Acts, 1985 Supplemental Appropriations Act and 1988 Energy and Water Appropriations Act. If the Federal navigation channels are not dredged to authorized depth, commercial navigation will eventually be adversely affected.

8c. The material to be dredged from Cleveland Harbor Federal navigation channels consists primarily of silts and clays, with some sands and gravels. Approximately 225,000 cubic yards of sediments will be dredged from the harbor in 2014 (minimum degradation alternative). All of this dredged material will be subsequently discharged as described in Item 8a of this application.

9. The dredging portion of the project is located in Cleveland Harbor, which is located at the mouth of the Cuyahoga River (a major tributary to Lake Erie) and within the Cuyahoga River. The Cuyahoga River and Lake Erie are the receiving water for dredging activities, and Lake Erie is the receiving water for dredged material placement activities (via open-lake placement and CDF weir discharges).

10. Information relating to placement of the dredged material in CDFs as pertinent under this item is included in the above noted FEISs and Section 404(b)(1) Evaluations prepared for the project, and previously furnished to OEPA. The Environmental Assessment (EA) and Section 404(b)(1) Evaluation to be completed for open-lake placement of this dredged material is forthcoming. Relevant information is provided in the items below:

10a) Descriptions.

(1) *Preferred Design Alternative*: See Enclosure 4 (Figure 5). This alternative would entail the dredging of an estimated 475,000 cubic yards of material in 2014, with the placement of 295,000 cubic yards of the dredged material at the existing Cleveland Harbor CDFs and 180,000 cubic yards at open-lake areas #1 and #4, as depicted in Figure 5. A contractor of the Federal government would accomplish the project. Mechanical equipment (e.g., clamshell bucket dredges with scow) would be used to complete the maintenance dredging operation. The project would take about 120 to 150 days to complete.

(2) *Non-Degradation Alternative*: This is the "No Action" alternative. No dredging or filling of

surface waters would occur as a result of this alternative.

(3) *Minimum Degradation Alternative*: See Enclosure 5 (Figure 6). This alternative would entail the dredging of an estimated 225,000 cubic yards of dredged material from the Federal navigation channels in 2013, with the placement of 45,000 cubic yards dredged material at the existing Cleveland Harbor CDFs and 180,000 cubic yards at open-lake areas #1 and #4, as depicted in Figure 6. A contractor of the Federal government would accomplish the project. Mechanical equipment (e.g., clamshell bucket dredges with scow) would be used to complete the maintenance dredging operation. This project would take about 90 to 120 days to complete.

Note that the Minimum Degradation Alternative estimates dredging 250,000 cubic yards less than the Preferred Design Alternative. It is estimated that dredging activities specified in the Minimum Degradation Alternative will impact an estimated 40 acres less of channel bottom/habitat than what would be impacted under the Preferred Design Alternative. The estimated length of stream to be dredged under the Preferred Design and Minimum Degradation Alternatives are 25,340 and 10,291 linear feet, respectively. Note that the actual shoal thickness cannot be determined until just before the dredging begins. In addition, shoal thickness will vary throughout the harbor and greatly depend on weather conditions. Therefore, the above quantities are merely estimates regarding the acreage of Federal navigation channel to be dredged/impacted under either alternative.

10b) Water Quality Impacts.

(1) *Preferred Design Alternative*: The material that would be dredged under this alternative consists of sediments that have been deposited in the Federal navigation channels since the last maintenance dredging effort.

The dredged material to be placed in the CDFs is described in Enclosure 6 to the WQC application. With respect to the placement of dredged material in the CDFs and associated return water, the sediments to be dredged are homogenous and residually contaminated with pollutants that are ubiquitous throughout the Great Lakes. As such, these sediments, although not virgin material with high levels of pollutants, contain levels of contaminants that may be elevated or are more bioavailable in relation to Lake Erie background contaminants, and should be confined from the aquatic environment after dredging. This alternative would result in a short-term, localized, and negligible lowering of ambient water quality. The main water quality impact would be negligible turbidity associated with CDF return water. Dredging and open-lake placement activities would result in excavation, smothering, and mortality of benthic macroinvertebrates, and the temporary avoidance of work areas during the dredging operation by fish and wildlife species (i.e., mostly waterfowl). Following dredging and placement activities, benthic communities are expected to recolonize the impacted areas, and fish and wildlife would return. The dredging area is industrialized, so benthic, fish and wildlife use of the water resource is limited; therefore, impacts in this regard would be minor. No impacts to any listed Threatened or Endangered Species would occur from dredging or the placement of dredged material.

For a comprehensive examination of sediment and water quality (contaminant) related impacts associated with open-lake placement of material dredged from the upper Cuyahoga River Channel, see Enclosure 7 to the WQC transmittal letter. Note that Section 3.2.5 of Enclosure 7 addresses the water quality impacts in terms of the discharge of this dredged material in the

open-lake and compliance with applicable, numeric Ohio water quality standards (WQSs). The sediments to be dredged are homogenous and residually contaminated with pollutants that are ubiquitous throughout the Great Lakes. The dredged material was sampled and testing generally included bulk sediment physical and chemical analyses, cationic metal simultaneously extracted metal/acid volatile sulfide (SEM/AVS) analysis, elutriate testing, standard sediment and elutriate bioassays, and sediment bioaccumulation testing for polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE). Data generated from this effort were used to evaluate whether this material meets Federal (USEPA/USACE) guidelines for open-lake placement, which includes compliance with applicable WQSs or water quality criteria (WQC). The evaluation showed that the placement of dredged material at open-lake areas #1 and #4 would not result in significant benthic sediment toxicity, unacceptable adverse impacts with respect to the bioaccumulation of PCBs and sum (Σ) DDT, significant water column toxicity, and would not exceed applicable, numeric WQSs after consideration of mixing and dilution. Accordingly, the evaluation indicates that the discharge of material dredged from DMMU-1, DMMU-2a and DMMU-2b at open-lake areas #1 and #4 would not result in contaminant-related, unacceptable adverse impacts to the aquatic ecosystem. Therefore, it is concluded that this dredged material meets Federal guidelines for open-lake placement.

To ensure that any increase in the bioaccumulation of total PCBs and ΣDDT in yellow perch and walleye remains within the range of analytical variability (less than what is biologically significant), the following controls would be implemented: (1) use of mechanical equipment to dredge and discharge the dredged material; (2) spatially limiting the placement of material dredged from DMMU-2a and DMMU-2b to a one-square mile area within open-lake area #1 and #4; and (3) spatially limiting the placement of material dredged from DMMU-1 to a one mile square area within open-lake area #1 and two-third square mile area within open-lake area #4. With respect to the potential of open-lake placement of dredged material to influence harmful algal blooms (HABs), modeling completed by the U.S. Army Engineer Research and Development Center showed that the extent and duration of total phosphorus plumes predicted to result from the placement of this dredged material at open-lake areas #1 and #4 at concentrations potentially sufficient to stimulate a HAB are very small and short-lived. These phosphorus plumes would be inadequate to trigger or pose an effect on the occurrence of HABs and/or to significantly impact water quality in the Central Basin of Lake Erie.

(2) *Non-Degradation Alternative*: Since this alternative involves no construction or filling of surface waters, no lowering of water quality would result.

(3) *Minimum Degradation Alternative*: The water quality impacts under this alternative, although similar in nature to those of the Preferred Design Alternative, would be less due to the duration of the project, the reduction in the quantity of material dredged and the reduction in the linear feet of harbor impacted.

10c) Feasibility.

(1) *Preferred Design Alternative*: This alternative is technically feasible, as it involves routine maintenance dredging and dredged material placement procedures. Equipment is readily available to accomplish this type of work. The Benefit/Cost (B/C) ratio for this alternative with respect to commercial navigation in the harbor is greater than or equal to 1.0. Costs of this project are currently estimated as $20.15 per cubic yard of dredged material disposed in the CDF

and costs for open-lake placement are currently estimated as $10.00 per cubic yard.

(2) *Non-Degradation Alternative*: Since this alternative involves no construction or filling of surface waters, this alternative is technically feasible and available, but would not be cost effective from a commercial navigation standpoint. Under this alternative, the Federal navigation channels would progressively shoal in and impede commercial navigation, which would result in an increased cost of commodities to the local community. Deep-draft commercial navigation in the harbor would become economically nonviable and gradually cease. This would negatively impact the annual $305 million in direct revenue, over 2,000 jobs, and $112 million in personal income generated by the continued viability of the Harbor. Losses of between one and two feet of channel depth would result in increased transportation costs of between $2.3 million and $5.2 million annually.

(3) *Minimum Degradation Alternative*: This alternative is technically feasible, as it involves routine maintenance dredging and dredged material placement procedures. Equipment is readily available to accomplish this type of work. The Benefit/Cost (B/C) ratio for this alternative with respect to commercial navigation in the harbor is greater than or equal to 1.0. Costs of this project are currently estimated as $20.15 per cubic yard of dredged material disposed in the CDF and costs for open-lake placement are currently estimated as $10.00 per cubic yard.

10d) Regional Sewage Collection/Treatment Facilities. N/A.

10e) Water Quality Improvement/Recreation Projects. N/A.

10f) Water Pollution Control Costs.

(1) *Preferred Design Alternative*: Not dredging or placing material during storm events constitutes "blow days," which cost about $5,000 to $10,000 per day of lost work. The decision not to dredge based on weather conditions would be due to safety concerns.

(2) *Non-Degradation Alternative*: Since this alternative involves no construction or filling of surface waters, no costs result from water pollution controls.

(3) *Minimum Degradation Alternative*: Not dredging or placing material during storm events constitutes "blow days," which cost about $5,000 to $10,000 per day of lost work. The decision not to dredge based on weather conditions would be due to safety concerns.

10g) Human Health Impacts.

(1) *Preferred Design Alternative*: The human health impacts associated with this alternative would be indiscernible and would not significantly impact the overall quality and value of the water resource. The generation of turbidity and low dissolved oxygen in the water column would be the most common effects associated with dredging and dredged material placement activities. Such impacts would be minor, localized and short-term. The dredging area is within an industrialized water resource designed for commercial navigation. This alternative would result in short-term, minor, negative impacts to the quality and value of the receiving waters. Areas with sediment not suitable for open lake placement would be removed from the Federal navigation channels and contained in a CDF, which would serve to improve water quality in the

harbor in the long-term, and remove sediment contaminants and reduce their availability to aquatic life and wildlife. With respect to open-lake placement, modeling was completed by the U.S. Army Engineer Research and Development Center in 2013 to address the potential transport of total suspended solids (TSS) to the Crown, Morgan, Baldwin and Nottingham potable water intake (PWI) structures following the placement of Cleveland Harbor dredged material at open-lake areas #1 and #4. Solids losses resulting from dredged material placement at these two areas are not expected to have any significant impact on water column TSS concentrations at these PWIs. Under the worst-case scenario modeled, TSS contributions of up to 1 mg/L from dredged material placement at open-lake area #4 would occur at the Morgan PWI only about 1% of the time. During this time period, water column TSS would increase 20% from 5 mg/L (background) to 6 mg/L. No measurable TSS contributions are expected to occur at any of the other PWIs. Similarly, no measureable TSS contributions are expected to occur at any of the PWIs from dredged material placement operations at open-lake area #1.

The hydrodynamic data used for modeling represents currents that could potentially occur in May. Stronger currents tend to occur in April and could occur in May as well. It is estimated that stronger currents typical in April might increase background concentrations by approximately 30%. Nevertheless, TSS contributions from dredged material placement would still be expected to be around 20% above background and would occur with similar frequency. Additional modeling was employed to ascertain dissolved contaminant contributions at the PWIs from fine-grained and organic matter attributable to the open-lake placement of dredged material. As a worst-case scenario, this effort used the maximum increased water column TSS concentration that may occur at the Morgan PWI from placement of dredged material at open-lake area #4, along with the highest measured, normalized bulk contaminant concentrations associated with fine-grained and organic matter. All calculated dissolved phase contaminant concentrations were below Ohio and Federal drinking water quality standards/criteria. The very conservative approach used in these modeling efforts indicate that no meaningful contribution of suspended solids or contaminants from dredged material placement operations at open-lake areas #1 or #4 would be expected at any PWI.

(2) *Non-Degradation Alternative*: Since this alternative involves no construction or filling of surface waters, no effects to human health would occur.

(3) *Minimum Degradation Alternative*: This alternative involves a reduction in the volume of dredged material and the associated human health impacts would be similar to those described for the Preferred Design Alternative.

10h) Social/Economic Benefits Gained.

(1) *Preferred Design Alternative*: This alternative would restore navigable depths in the harbor channels for commercial vessel traffic. A large industrial base depends on the harbor to receive commercial goods and ship them off-site for a reasonable cost. As such, it would allow for the cost-effective transport of commodities through the local community. Cleveland Harbor is the 48th leading port in the United States and is ranked 5th among Great Lakes Ports (1st on Lake Erie) with 10.8 million tons of material shipped or received in 2010. Commodities shipped or received include iron ore, limestone, sand and gravel, salt, cement and concrete, general cargo and liquid bulk. This commerce has a substantial positive impact on the local economy by providing jobs that support the transportation, processing and production of these commodities,

as well as by maintaining competitive price levels on commercial goods. The harbor contains a major iron ore transshipment facility that provides iron ore to inland steel mills at lower delivery costs when compared to truck or direct rail delivery, and also ships more than one million tons of salt annually that is used by local municipalities for road deicing. Bulk commodities that pass through the harbor generate approximately $1.7 billion dollars annually in direct revenue which supports over 15,000 jobs. These jobs generate more than $1.07 billion dollars in annual personal income. The estimated annual rate savings provided by Cleveland Harbor (savings compared to the costs of alternative modes of transportation, such as rail or truck) is $195.7 million dollars. The harbor's industrial base generates $103.6 million dollars in tax revenues for state and local governments. Construction of the project itself would support jobs for a period of about 3 to 6 months. In addition, social and economic benefits associated with recreational navigation would accrue with harbor maintenance.

(2) *Non-Degradation Alternative*: This alternative would involve the cessation of maintenance of harbor Federal navigation channels. However, benefits would accrue to recreational navigation until the channels shoal into a degree at which they would no longer be usable for shallow-draft vessels. Recreational benefits in this regard would include primarily those associated with local marinas and the leisure craft they support.

(3) *Minimum Degradation Alternative*: This alternative would restore navigable depths in the harbor channels for commercial vessel traffic. A large industrial base depends on the harbor to receive commercial goods and ship them off-site for a reasonable cost. As such, it would allow for the cost-effective transport of commodities through the local community. Cleveland Harbor is the 48th leading port in the United States and is ranked 5th among Great Lakes Ports (1st on Lake Erie) with 10.8 million tons of material shipped or received in 2010. Commodities shipped or received include iron ore, limestone, sand and gravel, salt, cement and concrete, general cargo and liquid bulk. This commerce has a substantial positive impact on the local economy by providing jobs that support the transportation, processing and production of these commodities, as well as by maintaining competitive price levels on commercial goods. The harbor contains a major iron ore transshipment facility that provides iron ore to inland steel mills at lower delivery costs when compared to truck or direct rail delivery, and also ships more than one million tons of salt annually that is used by local municipalities for road deicing. Bulk commodities that pass through the harbor generate approximately $1.7 billion dollars annually in direct revenue which supports over 15,000 jobs. These jobs generate more than $1.07 billion dollars in annual personal income. The estimated annual rate savings provided by Cleveland Harbor (savings compared to the costs of alternative modes of transportation, such as rail or truck) is $195.7 million dollars. The harbor's industrial base generates $103.6 million dollars in tax revenues for state and local governments. Construction of the project itself would support jobs for a period of about 3 to 6 months. In addition, social and economic benefits associated with recreational navigation would accrue with harbor maintenance.

10i) Social/Economic Benefits Lost.

(1) *Preferred Design Alternative*: This alternative would not result in any significant reduction in the economic value of the lake through use for recreation, tourism and enjoyment by humans. Negligible to minor, short-term degradations in water quality associated with this alternative, such as that associated with turbidity in the water column, would be aesthetically displeasing and may not be attractive to recreational boaters in the area. Recreational and commercial fishing

activities in the vicinity may be temporarily negatively affected by temporary degradations in water quality and the presence of dredging equipment. Except for commercial industries such as restaurants and other riparian retail establishments, the temporary degradation in water quality and the presences of dredging equipment would have minimal negative effects on commercial activities. Modeling showed that turbidity (e.g., TSS) plume impacts associated with open-lake placement of the dredged material would be short-term, spatially limited and negligible.

(2) *Non-Degradation Alternative*: Since this alternative involves no construction or filling of surface waters, no lowering of water quality would occur. Therefore, negative effects on the recreational use of the harbor would not occur. However, substantial effects on commercial navigation and associated industries would occur as a result of this alternative. The overall value of the harbor as a water resource to commercial navigation would progressively deteriorate to a point at which deep-draft commercial vessels would no longer be able to navigate the harbor due to inadequate depths. The large industrial base that depends on the harbor to transport commodities would no longer be able to do so cost-effectively. The harbor would no longer be a viable alternative for the transportation of goods. This would negatively impact the annual $305 million in direct revenue, over 2,000 jobs, and $112 million in personal income generated by the continued viability of the Harbor. Losses of between one and two feet of channel depth would result in increased transportation costs of between $2.3 million and $5.2 million annually.

(3) *Minimum Degradation Alternative*: This alternative would not result in any significant reduction in the economic value of the Basin through use for recreation, tourism and enjoyment by humans. Negligible to minor, short-term degradations in water quality associated with this alternative, such as that associated with turbidity in the water column, would be aesthetically displeasing and may not be attractive to recreational boaters in the area. Recreational and commercial fishing activities in the vicinity may be temporarily negatively affected by temporary degradations in water quality and the presence of dredging equipment. Except for commercial industries such as restaurants and other riparian retail establishments, the temporary degradation in water quality and the presences of dredging equipment would have minimal negative effects on commercial activities. Modeling showed that turbidity (e.g., TSS) plume impacts associated with open-lake placement of the dredged material would be short-term, spatially limited and negligible.

10j) Environmental Benefits Lost/Gained.

(1) *Preferred Design Alternative*: Refer to water quality impacts evaluation for “Preferred Design Alternative,” relative to Question 10(b) of this application.

With respect to CDF placement, this alternative would result in a short-term, minor reduction of water quality in the receiving waters, as mainly associated with turbidity resulting from return water. Sediments not suitable for open lake placement would be removed from the Federal navigation channels and contained in a CDF, which would serve to improve water quality in the harbor in the long-term, remove sediment contaminants, and reduce their availability to aquatic life and wildlife. No effects to any listed Threatened or Endangered Species would occur.

With respect to open-lake placement of dredged material, this alternative would result in a short-term, minor reduction of water quality in the receiving waters. Testing and evaluation indicates that placement of the dredged material at open-lake areas #1 and #4 would not significantly impact aquatic life. The main water quality impacts would be the generation of turbidity and

variation of dissolved oxygen levels in the water column. These impacts would be short-term and spatially limited. Turbidity would not increase to an extent that it would result in any significant reduction of light penetration into the water column, or adversely affect phytoplankton and aquatic plant production, and fish. Discharge of the dredged material at open-lake areas #1 and #4 would have insignificant potential to influence HABs. Dredging and dredged material placement activities would result in the excavation, smothering and mortality of benthic macroinvertebrates. Following dredging operations, benthic communities are expected to recolonize the impacted areas. The open-lake placement areas are located to avoid any significant fish spawning areas. The fish community is generally adapted to natural levels of turbidity in the lake and open-lake placement of the dredged material would not significantly increase ambient turbidity levels over the long-term. Fishes may avoid or be attracted to open-lake placement events, or may not show any noticeable effect, and would return following the completion of dredging operations. The aquatic ecosystems at the open-lake placement areas are resilient. The periodic disturbance created by open-lake placement of dredged material is absorbed or accommodated by the ecosystem because its structure and function would not fundamentally change to a different state. Wildlife species (i.e., mostly gulls and waterfowl) would temporary avoid work areas and would return following the completion of dredging operations. No effects to any listed Threatened or Endangered species would occur.

(2) *Non-Degradation Alternative*: Since this alternative involves no construction or filling of surface waters, associated environmental benefits would include no degradation of water quality in receiving waters, and no physical disturbances to benthos, or fish and wildlife. Regarding environmental losses, polluted sediments would not be removed from the Federal navigation channels and contained in a CDF, which would leave sediment contaminants in-place and available to aquatic life and wildlife, and serve to degrade water quality in the harbor on the long-term. No effects to endangered or threatened species would occur.

(3) *Minimum Degradation Alternative*: This alternative involves a reduction in the volume of dredged material and the associated environmental benefits lost/gained would be similar to those described for the Preferred Design Alternative.

10k) Mitigative Techniques.

(1) *Preferred Design Alternative:* Mechanical equipment would be used to dredge and discharge the upper Cuyahoga River Channel material at open-lake areas #1 and #4. The placement of this dredged material would be spatially limited to a one-square mile area within open-lake areas #1 and #4. The placement of material dredged from DMMU-1 would be spatially limited to a two-third square mile area within open-lake area #4. Dredging would not be performed during Lake Erie storm events. Care would be employed throughout the course of the dredging/placement operations to avoid the creation of unnecessary turbidity that may degrade water quality or adversely affect aquatic life outside the project area.

(2) *Non-Degradation Alternative:* N/A.

(3) *Minimum Degradation Alternative:* Mechanical equipment would be used to dredge and discharge the upper Cuyahoga River Channel material at open-lake areas #1 and #4. The placement of material dredged from DMMU-2a and DMMU-2b would be spatially limited to a one-square mile area within open-lake areas #1 and #4. The placement of material dredged from DMMU-1 would be spatially limited to a one square mile area within open-lake area #1 and two-

third square mile area within open-lake area #4. Dredging would not be performed during Lake Erie storm events. Care would be employed throughout the course of the dredging/placement operations to avoid the creation of unnecessary turbidity that may degrade water quality or adversely affect aquatic life outside the project area.

Enclosure 3

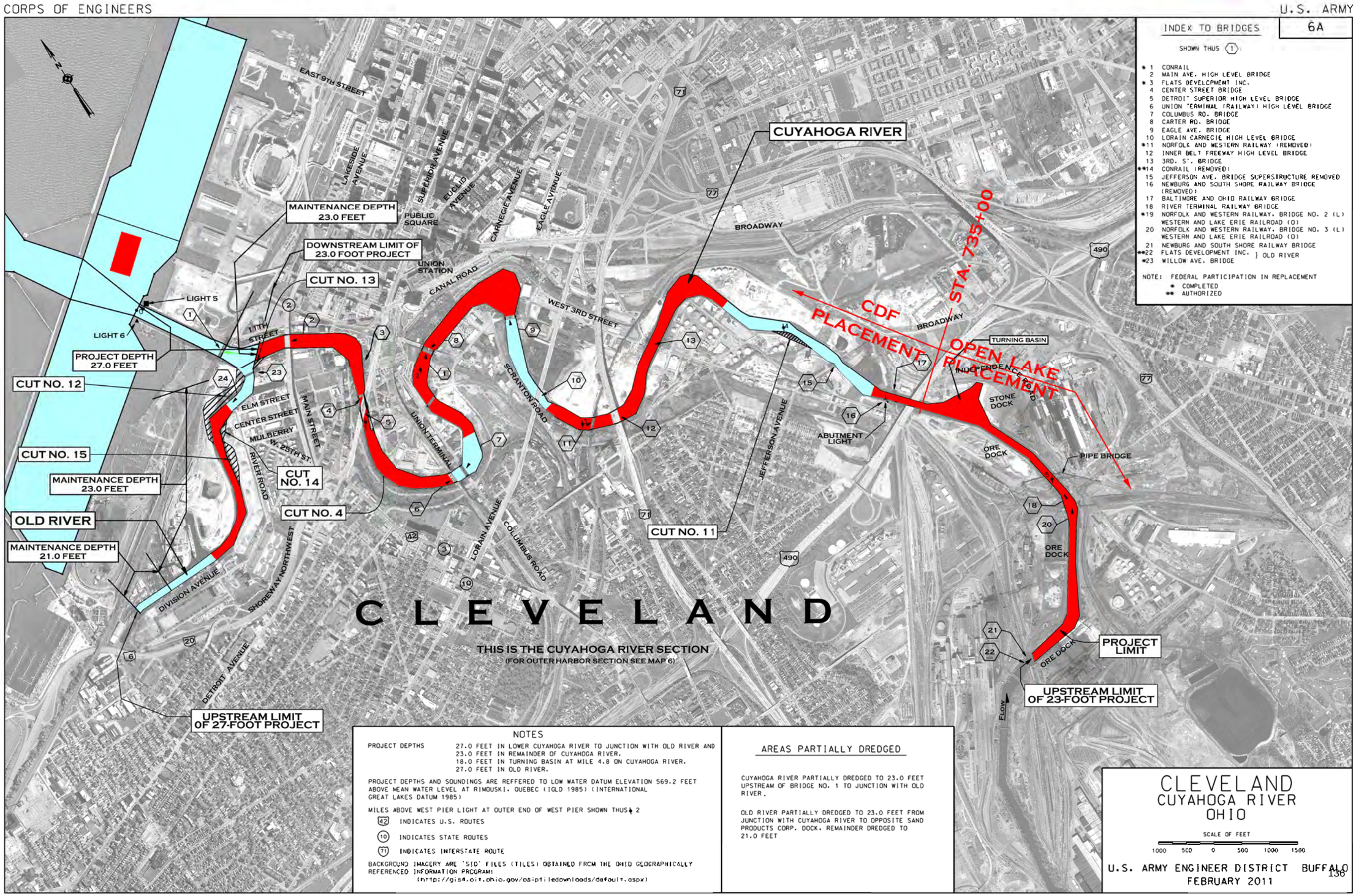
Aerial photograph of Cleveland Harbor

Enclosure 3 - Aerial Photo of Cleveland Harbor

Enclosure 4

Contract drawing depicting the Preferred Alternative

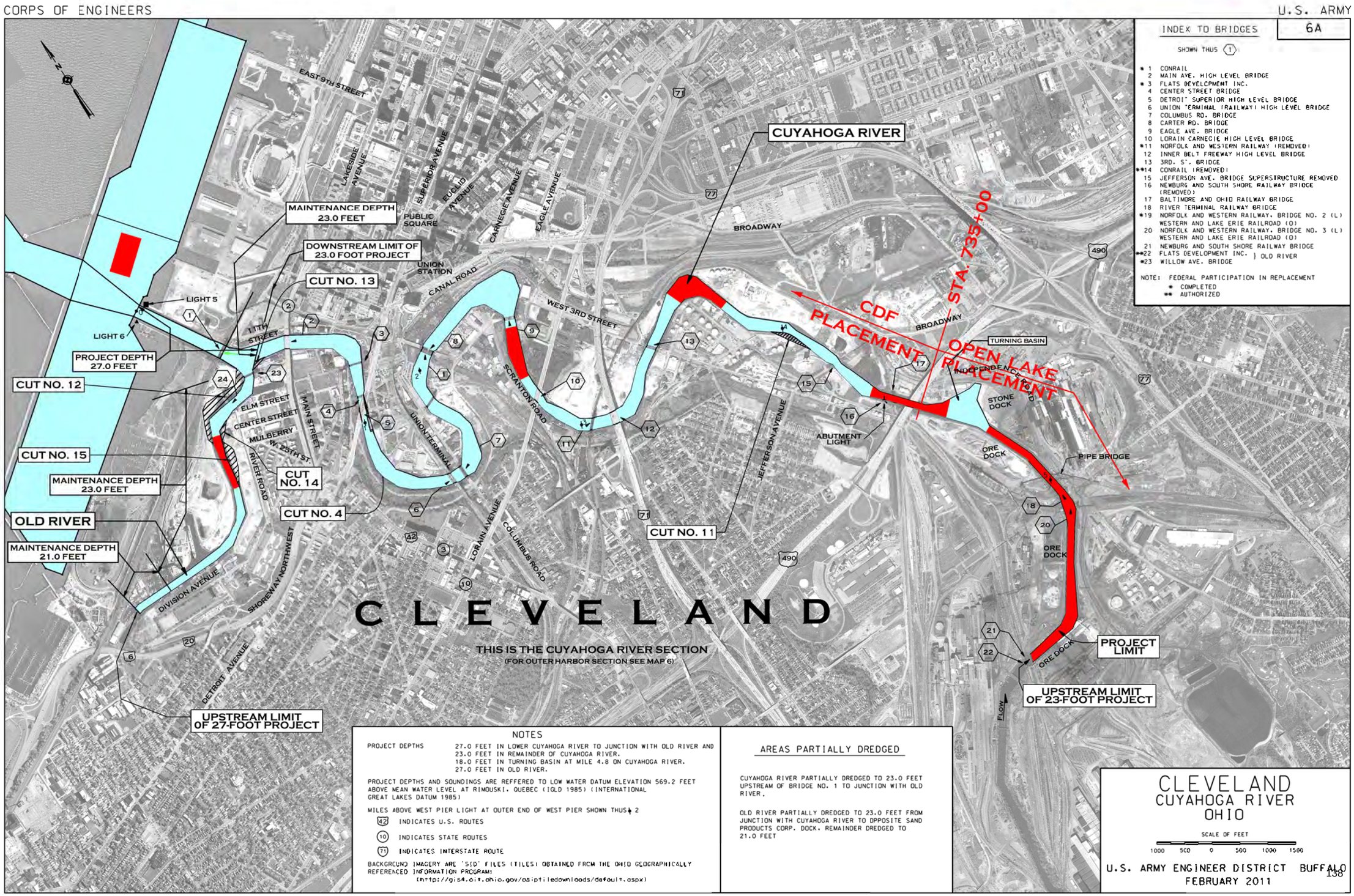
Figure 5: PREFERRED DESIGN ALTERNATIVE
(DREDGE 148 ACRES, 25,340 LINEAL FEET, LOCATIONS AND EXTENTS WILL BE ADJUSTED, BASED ON ACTUAL SHOALING LOCATIONS AND DEPTHS [redacted])



Enclosure 5

Contract drawing depicting the Minimum degradation Alternative

Figure 6: MINIMUM DEGRADATION ALTERNATIVE (DREDGE 42 ACRES, 10,291 LINEAL FEET, LOCATIONS AND EXTENTS WILL BE ADJUSTED, BASED ON ACTUAL SHOALING LOCATIONS AND DEPTHS [redacted])



Enclosure 6

Cleveland Harbor, Cuyahoga County, Ohio

Evaluation of Federal Navigation Channel Sediments with Respect to their Suitability for Open-Lake Placement – 2007

US Army Corps of Engineers
Buffalo District

CLEVELAND HARBOR, CUYAHOGA COUNTY, OHIO

EVALUATION OF FEDERAL NAVIGATION CHANNEL SEDIMENTS WITH RESPECT TO THEIR SUITABILITY FOR OPEN-LAKE PLACEMENT

I. Introduction

This preliminary Tiered Evaluation on Cleveland Harbor Federal navigation channel sediments has been performed in accordance with guidelines contained in the 1998 U.S. Environmental Protection Agency (USEPA)/U.S. Army Corps of Engineers (USACE) Great Lakes Dredged Material Testing and Evaluation Manual (USEPA/USACE 1998). It is based on 2007 data on the Federal navigation channel sediments (Engineering and Environment, Inc. [EEI] 2007).

II. Sediment Quality Assessment

Background and Potential Sources of Sediment Contamination

Traditional chemical contaminants in Cleveland Harbor Federal navigation channel sediments include heavy metals, nutrients, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and pesticides. Cleveland Harbor is located within the Cuyahoga River Area of Concern (AOC), which includes the lower 45 miles of the river between the Ohio Edison Dam and mouth, and approximately 10 miles of Lake Erie shoreline, between Edgewater Park eastward to Wildwood Park (http://www.epa.gov/glnpo/aoc/cuyahoga.html). Major sources of contamination to bottom sediments in the harbor's Cuyahoga River, Old River and Outer Harbor Channels include (1) point source municipal and industrial wastewater discharges; (2) bank erosion; (3) commercial/recreational development; (4) atmospheric deposition; (5) leachate from hazardous waste disposal sites; (6) urban storm water runoff; (7) combined sewer overflows (CSOs); and (8) wastewater treatment plant bypasses.

Evaluation Based on Existing Sediment Data

In 2007, 30 surface grab samples were collected from the River Channel (Sites CH-1 through CH-19), Old River Channel (Sites CH-20 through CH-22) and Outer

Harbor Channels (Sites CH-23 through CH-30) (Figure 1). The reach of River Channel, referred to as the "Upper End" located at the upstream limit between approximate Stations 799+92 and 788, was sampled more rigorously relative to other areas of the harbor, and was represented by Sites CH-1 through CH-5. In addition, four surface grab sediment samples were collected from the open-lake reference area in Lake Erie (Sites CL-1 through CL-4) (Figure 2). All sediment samples were subjected to bulk particle size analyses, and analyzed for the following: Inorganics—heavy metals, total cyanide, ammonia and total organic carbon (TOC); and organics—PAHs, PCBs and pesticides (EEI 2007). A modified elutriate test (MET) for the same inorganic and organic contaminants was performed on five composited sediment samples used to represent management units (MUs) within the Federal navigation channels: CH-UEMU (CH-1 through CH-5); CH-URMU (CH-6 through CH-11); CH-LRMU (CH-12 through CH-19); CH-ORMU (CH-20 through CH-22); and CH-OHMU (CH-23 through CH-30). In addition, two solid phase acute toxicity tests (bioassays) were applied to the Cuyahoga River Upper End MU sediments (EEI 2007) to verify that the material dredged from this reach, which is traditionally comprised of an appreciable fraction of coarse-grain sediment, does not meet Federal guidelines for open-lake (and/or nearshore) placement.

Based on the 2007 data, our toxicological assessment of these sediments is summarized as follows:

a. Bulk sediment analyses.

1. **Physical testing:** Table 1 presents the results of the sieve analyses performed on the sediment samples. The River Channel material was comprised of between 35.7% (Site CH-1) and 98.3 % (Site CH-13) silts and clays, with the remainder sands. The Upper End material within the River Channel was comprised of between 49.8% (Site CH-4) and 64.3% (Site CH-1) sands, with the remainder silts and clays. The Old River Channel material was composed of between 39.8% (Site CH-22) and 63.4% (Site CH-21) sands, with the remainder silts and clays. With respect to the Outer Harbor Channel material, it was comprised of between 90.9% (Site CH-30) and 99.1% (Site CH-27) silts and clays, with the remainder sands. Sediments at the open-lake reference area were comprised predominantly of silts and clays (98.3% [Site CL-4] to 98.9% [Site CL-2]), with a very small fraction of sands.

2. **Chemical testing:** The open-lake reference area was (Figure 2) was used to represent the Lake Erie environs. As such, contaminant concentrations in the Federal navigation channel sediment samples were compared to these areas to determine if they significantly exceeded lake sediment concentrations.

(a) *Inorganic analyses*—Table 2 presents the results of inorganic analyses on the sediment samples.

(1) Heavy metals—Relative to open-lake reference area levels, heavy metal concentrations in the Federal navigation channel sediments were generally comparable. Some sediment samples within the Federal navigation channel showed significantly elevated heavy metals concentrations in comparison when compared to those at the open-lake reference area. Arsenic concentrations at Sites CH-9, CH-12, CH-13, CH-14, CH-25 and CH-29, which range from 17.4 mg/kg to 20.3 mg/kg, may be of toxicological concern. At Site CH-6, the mercury concentration of 2.88 mg/kg could be acutely toxic. The lead concentration of 127 mg/kg at Site CH-22 would appear to be acutely toxic. Zinc concentrations at Sites CH-9, CH-13 and CH-17, which ranged from 379 mg/kg to 428 mg/kg, may be of toxicological concern. Based on these data, the following heavy metal COCs were identified: mercury at Site CH-6; arsenic and zinc at Site Ch-9; arsenic at Site CH-12; arsenic and zinc at Site CH-13; arsenic at Site CH-14; zinc at Site CH-17; lead at Site CH-22; arsenic at Site CH-25; and arsenic at Site CH-29.

(2) TOC and other inorganic parameters—TOC levels in the Federal navigation channel sediment samples ranged from 0.68% (Site CH-22) to 4.0% (Site CH-30). At the open-lake reference area, TOC concentrations ranged from 2.7% (Site CL-4) to 3.06% (Site CL-2). With respect to other inorganic contaminants, ammonia levels at Sites CH-3, CH-10 and CH-25 (range 190 mg/kg to 201 mg/kg) may be toxicologically significant. With respect to cyanide, concentrations at Sites CH-21 and CH-22 (range 2.62 mg/kg to 3.63 mg/kg) could be of toxicological concern. Based on these data, ammonia was identified as a COC at Sites CH-3, CH-10 and CH-25, and cyanide was identified as a COC at Sites CH-21 and CH-22.

(b) *Organic analyses*

(1) PAHs—Table 3 presents the results of these analyses. Total PAH concentrations in the Federal navigation channel sediments ranged from 1.13 mg/kg (Site CH-11) to 7.18 mg/kg (Site CH-6). Total PAH levels at the open-lake reference area were quite low, ranging from 0.03 mg/kg (Site CL-1) to 0.69 mg/kg (Site CL-4). While total PAH concentrations at all of the Federal navigation channel sites exceeded those at the open-lake reference area, many may not be of significant toxicological concern. Nevertheless, given the relatively low level of TOC throughout the Federal navigation channel sediments and an assumed low fraction of black carbon, some PAH compounds may be more bioavailable and therefore capable of exerting acute toxicity. For example, TOC levels at all sites, except for Sites CH-6, CH-7, CH-9, CH-10, CH-13, Ch-23 and CH-30, were significantly below the lowest open-lake reference area TOC level of

2.7%.

In order to ascertain whether total PAHs would bioaccumulate from harbor sediments at levels higher than those of the open-lake reference area, a Tier 2 theoretical bioaccumulation potential (TBP) model was employed. TBP is an equilibrium theory-based algorithm used to predict the potential bioaccumulation of neutral, organic compounds, such as PCBs, in sediments (McFarland 1984). This model is expressed as:

$$TBP = BSAF\ (L)\ (C_s/TOC)$$

Where:

TBP = Predicted whole body tissue concentration of the neutral organic compound (µg/kg wet weight)
BSAF = Biota-sediment accumulation factor, a measure of bioavailability
L = Concentration of lipid in target animals (percent of wet weight)
C_s = Concentration of neutral organic compound in sediment (µg/kg dry weight)
TOC = Total organic carbon concentration in sediment (percent of dry weight)

The target animal used in this case is an oligochaete worm. In this model, a 1% lipid content in oligochaete worms, an average that is characteristically representative (e.g., Ankley *et al.* 1992, Pickard *et al.* 2001), a BSAF of 1.0 (Pickard *et al*. 2006) and TOC data from Table 2 were used. The total PAH TBP for open-lake reference area sediments (Site CL-4) was 0.26 mg/kg. The total PAH TBP predictions for the Federal navigation channel sediments are summarized in Table 4. Predicted TBP values for total PAHs at individual harbor sites ranged from 0.41 mg/kg (Site CH-10) to 3.76 mg/kg (Site CH-22), and were 1.6 to 14.6 times that of the open-lake reference area sediments.

Great Lakes harbor and lake reference sediments with total PAH levels on the order of up to about 7 mg/kg have been shown to not exhibit acute toxicity. However, in this case, generally lower TOC levels and other factors (coarse-grain fraction of sediment, origin of organic carbon, etc.) could be factors that contribute to lower total PAH levels potentially being acutely toxic. For example, in the Upper End of the River Channel, sediments were one-half or greater coarse-grain and had TOC levels (1.42% to 2.19%) that were below those of the open-lake reference area. As a result, it is possible that some total PAH concentrations in this reach, which ranged from 1.55 mg/kg to 5.85 mg/kg (mean = 3.03 mg/kg), could potentially exert some acute toxicity.

Preliminary calculations were performed on selected Cleveland Harbor sites to derive concentrations of PAH mixtures in sediments that may be toxic to benthic organisms. The equilibrium partitioning (EqP) approach was applied to calculate

EqP sediment benchmarks (EBS) for PAH mixtures, termed an EqP Sediment Benchmark Toxic Unit ($\sum ESBTU_{FCV}$) (USEPA 2003). Using this approach, freshwater sediments containing $\sum ESBTU_{FCV} \leq 1.0$ of a mixture of 34 or more PAH compounds are acceptable for the protection of aquatic organisms. In this case, an uncertainty factor had to be applied because the analyses covered only 16 PAHs. These calculations suggested that most of the concentrations of most of the PAH mixtures in Cleveland Harbor sediments probably cause chronic toxicity. In addition, it suggested that the total PAH concentrations at Sites CH-9, CH-11, CH-25 and CH-28 are not chronically or acutely toxic. It should be noted that ESBs do not consider the antagonistic, additive or synergistic effects of other sediment contaminants in combination with PAH mixtures or the potential for bioaccumulation and trophic transfer of PAH mixtures to aquatic life, wildlife or humans. The weight-of-the-evidence suggests that total PAHs are COCs at all sites, excluding Sites CH-9, CH-11, CH-25 and CH-28.

(2) PCBs—Table 5 presents the results of these analyses. PCBs were measured at all of the Federal navigation channel sites, with Aroclors 1242, 1254 and 1260 being the mixtures that were predominantly detected. Individual Aroclor mixtures that were detected ranged from 22.2 μg/kg of Aroclor 1254 at Site CH-8 to 260 μg/kg of Aroclor 1254 at Site CH-27_{QC}. "Total PCB" concentrations (the sum of the three predominant Aroclors, valuing non-detectable concentrations at the laboratory reporting limit [LRL]) in the Federal navigation channel sediments ranged from 96.6 μg/kg to 504 μg/kg at Sites CH-14 to CH-27_{QC}, respectively. Aroclor 1254 was the only PCB mixture detected in the open-lake reference area sediments, ranging in concentration from 35.4 μg/kg (Site CL-3) to 42.8 μg/kg (Site CL-2). Since Aroclor 1254 was the only detected PCB mixture, the measured level was assumed to represent the "total PCB" concentration. Total PCB concentrations at all of the Federal navigation channel sites exceeded those at the open-lake reference area sediments.

The TBP model was employed to ascertain whether total PCBs would bioaccumulate from Federal navigation channel sediments at levels higher than the open-lake reference area. The model used an oligochaete worm as the target animal with a 1% lipid content, PCB BSAF of 1.2 (unpublished Lake Erie data) and TOC data from Table 2. The open-lake reference area PCB TBP was calculated to be 16.8 μg/kg, and the total PCB TBP predictions for the Federal navigation channel sediments are summarized in Table 6. The TBP for total PCBs ranged from 44.2 μg/kg (Site CH-10) to 388 μg/kg (Site CH-27), all of which exceeded the open-lake reference area total PCB TBP. The predicted total PCB TBP values were over 2.6 to 23-fold that of the open-lake reference area. Relative to the open-lake reference area sediments, it is possible that PCBs may not bioaccumulate to statistically significant higher levels at Sites CH-6 through CH-17 (TBP range = 44.2 μg/kg to 84.4 μg/kg). Nevertheless, based on these

TBP predictions and existing information, total PCBs were retained as a COC at all of the Federal navigation channel sites.

(3) Pesticides—Table 7 presents the results of these analyses. Most pesticides in the Federal navigation channel sediment samples were non-detectable at LRLs ranging from 1.02 μg/kg to 623 μg/kg. With the exception of dieldrin at Site CH-10 (11.6 μg/kg), 4,4'-dichlorodiphenyltrichloroethane (DDT) and its metabolites/breakdown products 4,4'-dichlorodiphenyldichloroethylene (DDE) and 4,4'-dichlorodiphenyldichloroethane (DDD) were detected at most of the Federal navigation channel sites. DDD was the only pesticide detected in the open-lake reference area sediments, ranging in concentration from 7.89 μg/kg to 8.95 μg/kg at Sites CL-1 and CL-2, respectively. The sum of DDT, DDE and DDD (ΣDDT) was used to interpret the data and for comparison purposes, based on the following rationale:

1—4,4'-DDT, 4,4'-DDE and 4,4'-DDD are considered highly hydrophobic, having Log K_{ow}s of 6.91, 6.51 and 6.02 respectively (ATSDR 2002). Hydrophobicities tend to reduce the bioavailability of sediment-associated neutral organic contaminants;

2—BSAFs in the literature for sediment-processing benthic organisms show that the bioavailability of DDT, DDE and DDD is similar (Ingersoll *et al.* 2003), or that DDT (Mulsow and Landrum 1995) can be less bioavailable than DDE (Ferraro *et al.* 1990); and

3—The sediment samples were processed through gas chromatographic analysis. This method has been shown to cause a breakdown of DDT into DDE and DDD, which would tend to make the analytical differentiation of the three compounds based on these sediment data obscure (Forman and Gates 1997).

Concentrations of ΣDDT in the Federal navigation channel sediments ranged from 6.09 μg/kg (Site CH-21) to 105 μg/kg (Site CH-4) (see Table 8). The open-lake reference area ΣDDT concentration was 41.4 μg/kg. Concentrations of ΣDDT at Sites CH-4, CH-5 and CH-8 (range 59.4 to 105 μg/kg) significantly exceeded that of the open-lake reference area. Tier 2 TBP predictions using an oligochaete worm as the target animal, 1% lipid content, BSAF of 2.5 (Ingersoll *et al.* 2003) and TOC data from Table 2 are summarized in Table 8. Projected ΣDDT bioaccumulation levels at these sites ranged from 85.8 μg/kg (Site CH-8) to 120 μg/kg (Site CH-4), and were 2.5 to 3.6 times the open-lake reference area ΣDDT TBP of 33.8 μg/kg. Therefore, ΣDDT was determined to be a COC at Sites CH-4, CH-5 and CH-8.

(c) *Elutriate testing*—Tables 9 through 12 present the results of

the MET performed on the Federal navigation channel sediments. The results showed releases of some heavy metals, ammonia and cyanide from the sediments (Table 9). Evidenced heavy metal releases from the harbor sediments were low, and maximum releases (dissolved) generally occurred from MUs CH-URMU and CH-LRMU sediments. The highest releases of copper and mercury (dissolved) were 1.5 μg/L and 0.0024 μg/L from MU CH-URMU sediments, respectively. Maximum ammonia-nitrogen (total) releases ranged from 5.22 μg/L (MU CH-ORMU) to 11 μg/L (MU CH-URMU). At a water pH of 8.1 and temperature of 21°C, and after consideration of mixing in the water column, ammonia concentrations would not appear to contravene applicable State Water Quality Standards. Releases of PAH compounds (dissolved) were indicated at several of the Federal navigation channels sites (Table 10). Maximum benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, chrysene, fluoranthene and pyrene releases (dissolved) were 0.156 μg/L, 0.181 μg/L, 0.405 μg/L, 0.143 μg/L, 0.172 μg/L, 0.254 μg/L and 0.386 μg/L at MU CH-LRMU in the Lower River channel reach, respectively. With respect to PCBs, no releases (dissolved) were shown at LRLs ranging from 0.0102 μg/L to 0.104 μg/L (Table 11). Pesticide releases (dissolved) from the sediments were non-detectable at LRLs ranging from 0.0222 μg/L to 2.78 μg/L (Table 12).

b. Biological testing. Tier 3, 10-day solid phase bioassays applied to MU CH-UEMU sediments employed the test species *Hyalella azteca* (amphipod) and *Chironomus tentans* (mayfly nymph) (USEPA/USACE 1998). The biological measurement endpoints for the *H. azteca* and *C. tentans* bioassays were survival, and survival and growth, respectively. The results are presented in Table 13 and are summarized as follows:

1. ***H. azteca***: The mean survival of this species was 0.52±0.02% and statistically lower than the survival associated with open-lake reference area sediments (0.88%).

2. ***C. tentans***: The mean survival of this species was 0.72±0.03% and statistically lower than the survival associated with the open-lake reference area sediments (0.94%). The mean growth of this species was 1.06±0.09 mg/org and not statistically different from that associated with open-lake reference area sediments (1.01mg/org).

These combined bioassay results indicate that the MU CH-UEMU sediments are acutely toxic. Based on the bulk chemistry data on these sediments, this toxicity may be attributable to total PAHs and/or ∑DDT.

c. Final COC List. COCs identified in Cleveland Harbor Federal navigation channel sediments are summarized as follows:

1. Arsenic at Sites CH-9, CH-12, CH-13, CH-14, CH-25 and CH-29 in the River and Outer Harbor channels.

2. Lead at Site CH-22 in the River Channel.

3. Mercury at Site CH-6 in the River Channel.

4. Zinc at Sites CH-9, CH-13 and CH-17 in the River Channel.

5. Ammonia-nitrogen at Sites CH-3, CH-10 and CH-25 in the River and Outer Harbor channels.

6. Cyanide at Sites CH-21 and CH-22 in the River Channel.

7. Total PAHs at all River, Old River and Outer Harbor Channel sites, except Sites CH-9, CH-11, CH-25 and CH-28.

8. Total PCBs at Sites CH-1 through CH-30 in the River, Old River and Outer Harbor Channels.

11. ΣDDT at Sites CH-4, CH-5 and CH-8 in the River Channel.

Based on the data considered in this evaluation, it is possible that PCBs may not bioaccumulate to statistically significant higher levels from sediments at Sites CH-6 through CH-17. If that were shown to be the case, and if the sediments were also shown to not exhibit acute toxicity through the prescribed bioassays, dredged material at Sites CH-7, CH-11, CH-15 and CH-16 would meet Federal guidelines for open-lake placement. All three solid-phases tests would be required on these sediments to make such a determination.

d. Quality Assurance (QA)/Quality Control (QC) Documentation. QA/QC information and records on the data contained in this evaluation are available in EEI (2007).

Conclusion

This evaluation has determined that sediments dredged from all Cleveland Harbor Federal navigation channels, as represented by Sites CH-1 through CH-30 (Figure 1), do not meet Federal guidelines for open-lake placement based on existing information.

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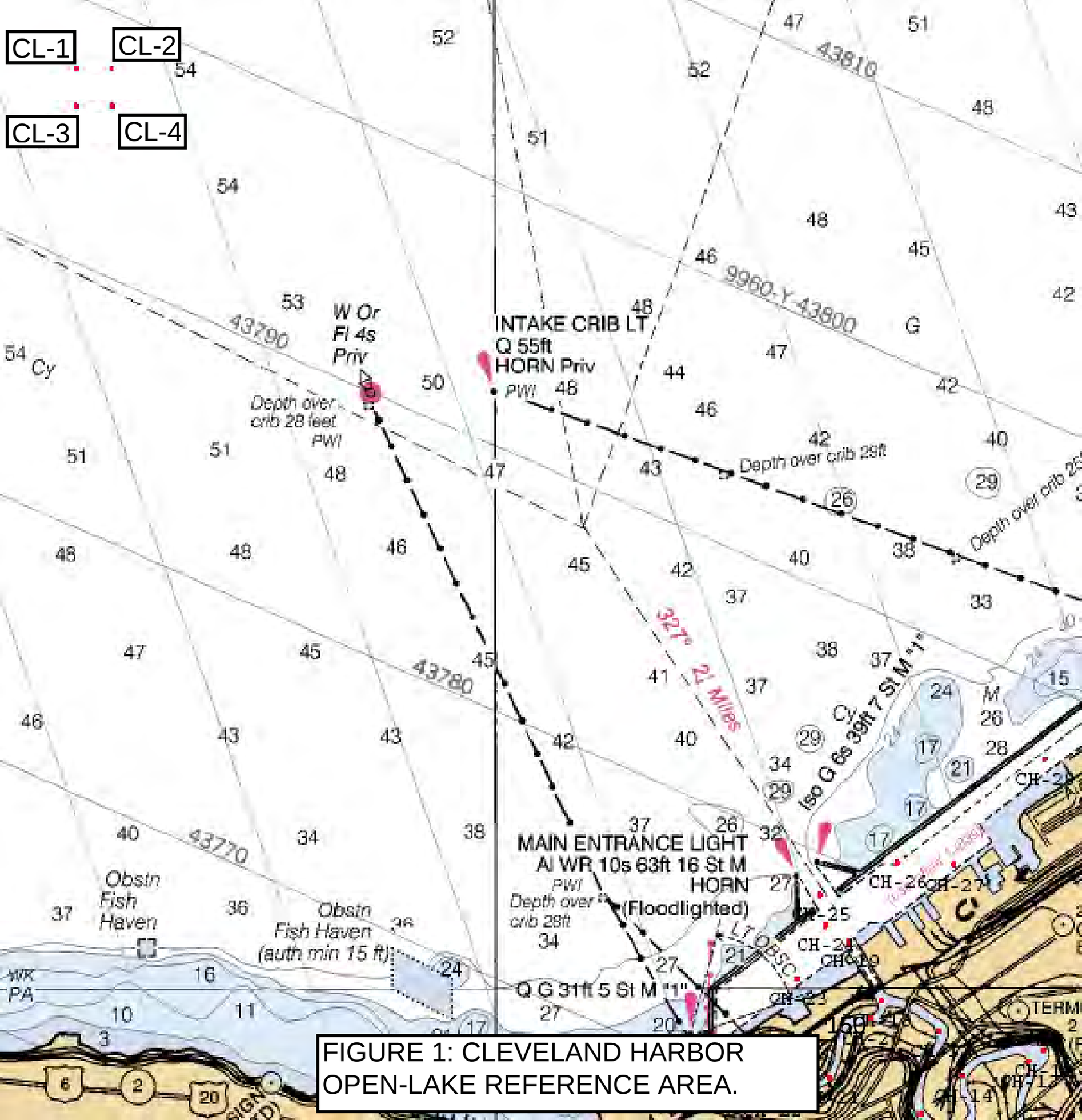

FIGURE 1: CLEVELAND HARBOR OPEN-LAKE REFERENCE AREA.

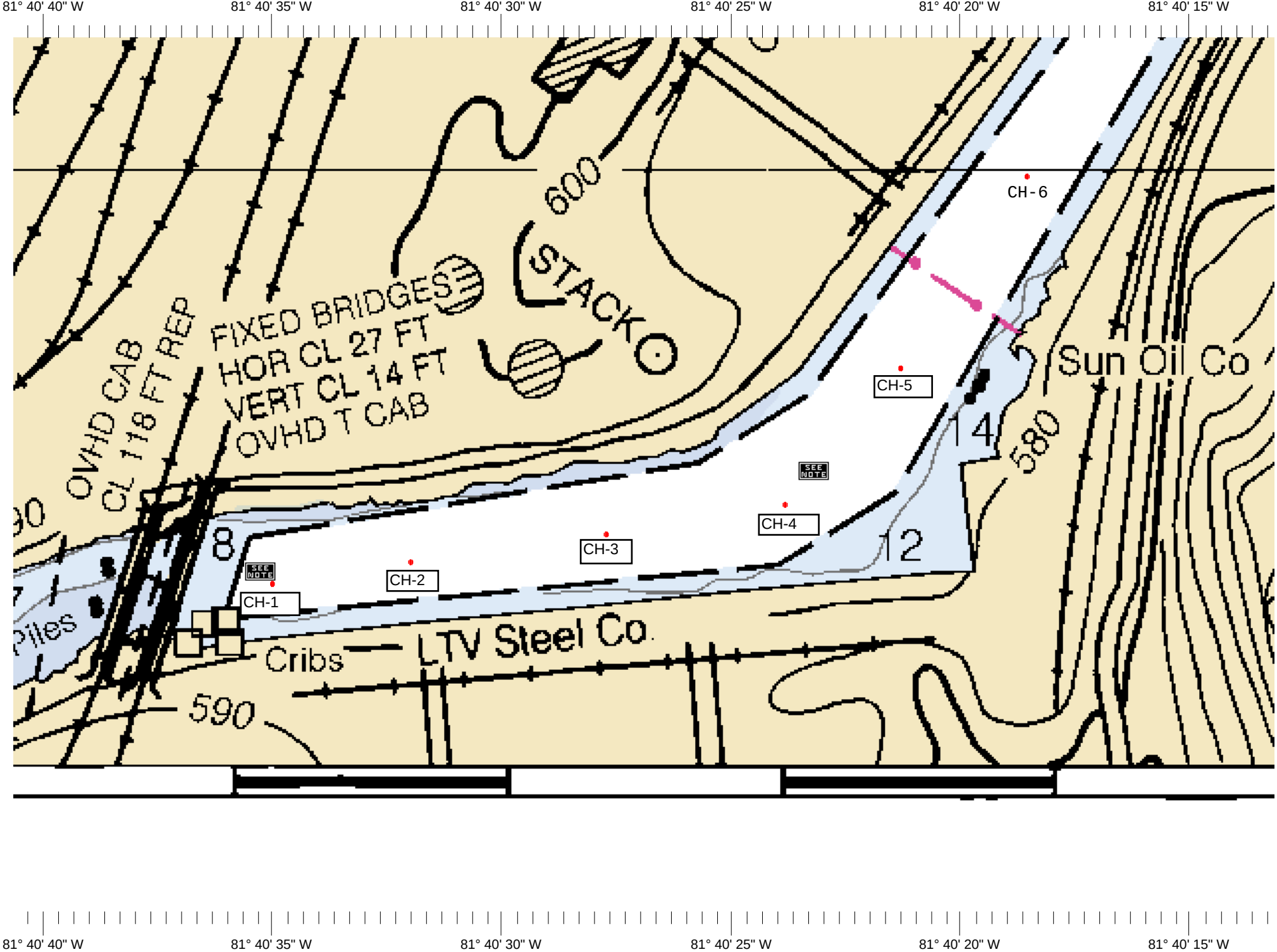

FIGURE 2: CLEVELAND HARBOR (CUYAHOGA RIVER) UPPER END MANAGEMENT UNIT

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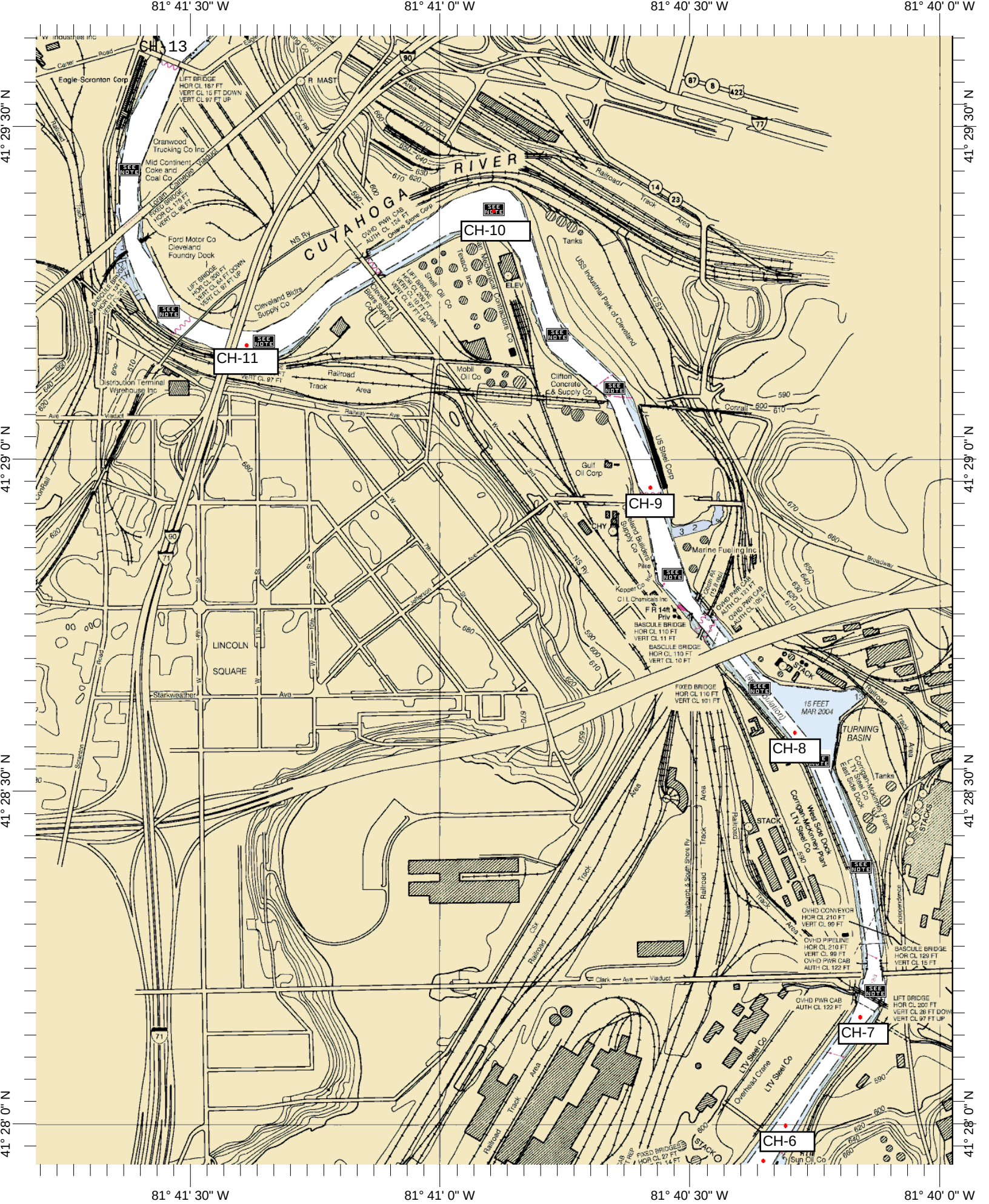

FIGURE 3: CLEVELAND HARBOR (CUYAHOGA RIVER) UPPER RIVER MANAGEMENT UNIT

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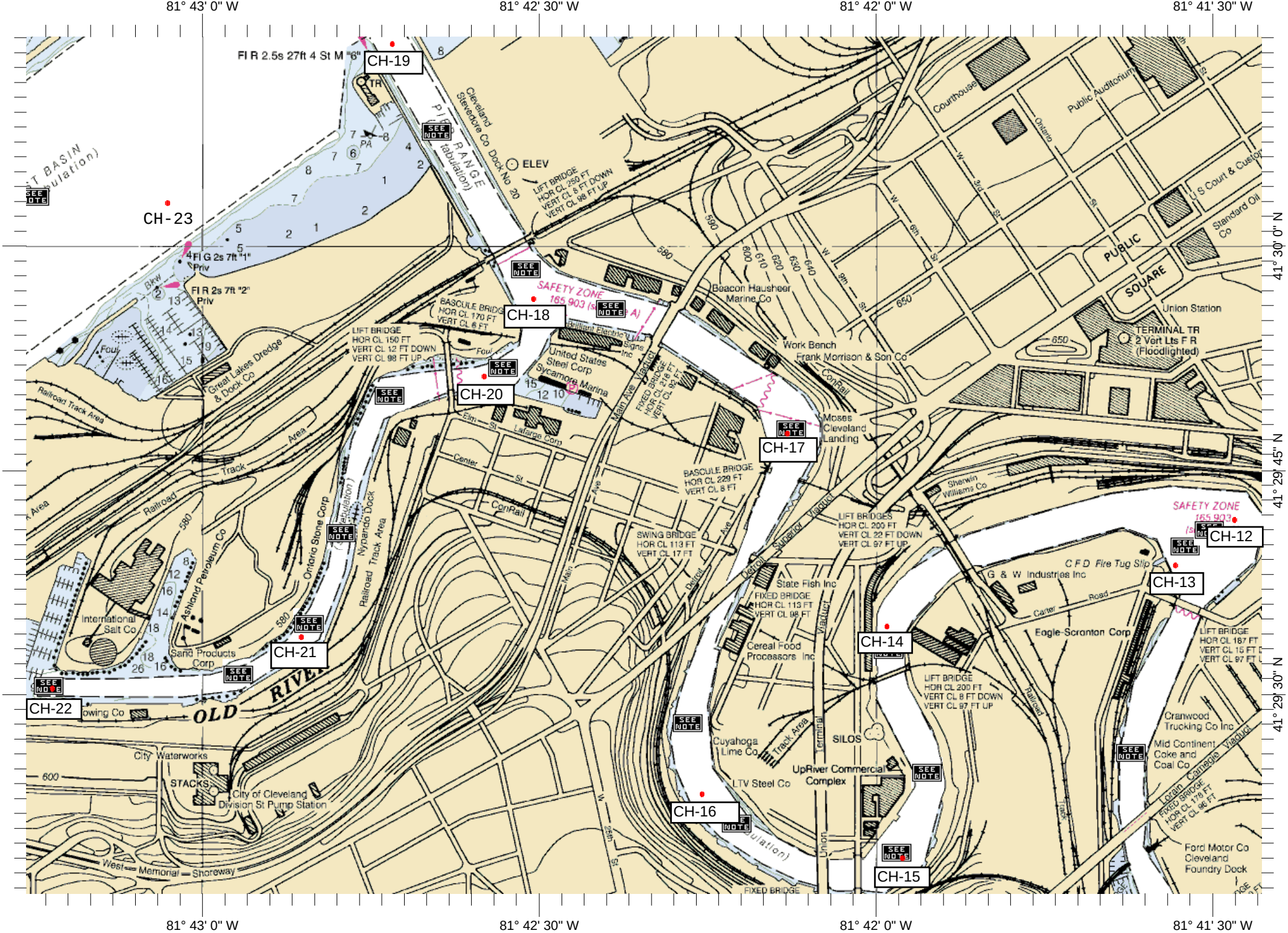

FIGURE 4: CLEVELAND HARBOR (CUYAHOGA RIVER) LOWER RIVER AND OLD RIVER CHANNEL MANAGEMENT UNITS.

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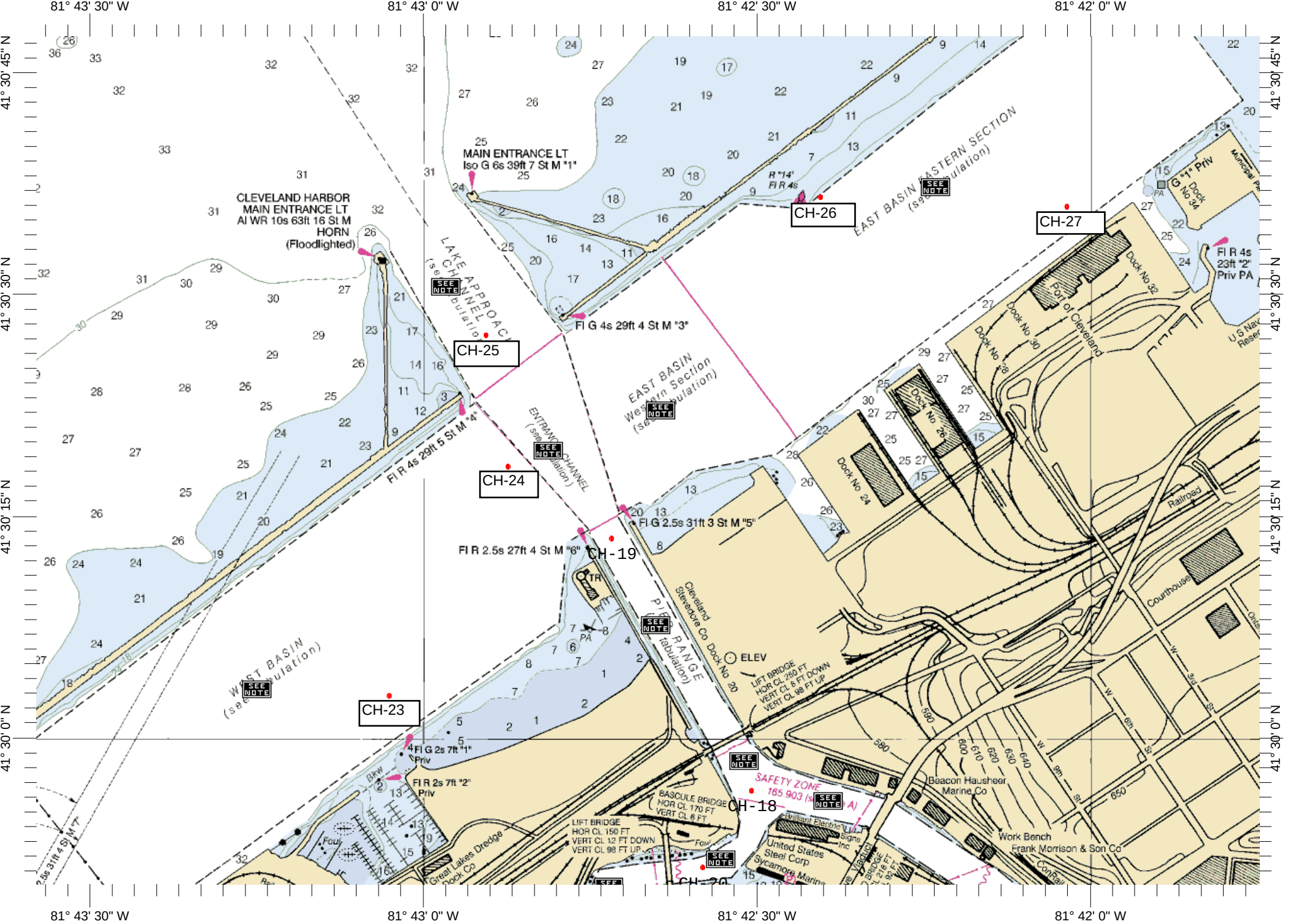

FIGURE 5: CLEVELAND HARBOR OUTER HARBOR MANAGEMENT UNIT (SITES CH-23 - CH-27)

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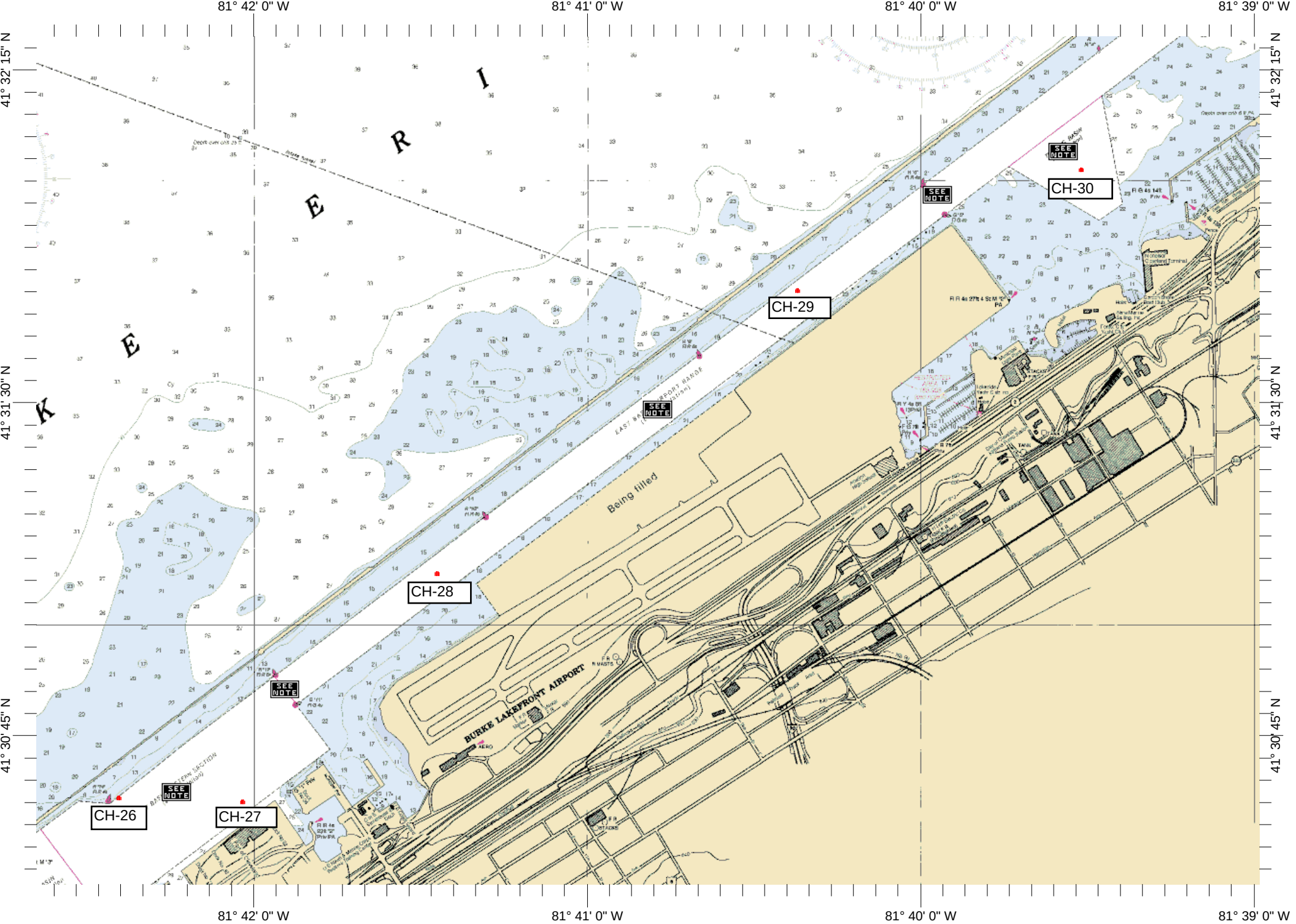

FIGURE 6: CLEVELAND HARBOR OUTER HARBOR MANAGEMENT UNIT (SITES CH-26 - CH-30)

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TABLE 1. Particle size distribution of Cleveland Harbor Federal navigation channel sediments (from EEI 2007).

Particle Size Distribution	Harbor Sediments																
	Sampling Sites																
	CH-1	CH-2	CH-3	CH-4	CH-5	CH-6	CH-7	CH-8	CH-9	CH-10	CH-11	CH-12	CH-13	CH-14	CH-15	CH-16	CH-17
Clay	8.1	11.2	12.6	10.6	8.4	15.1	15.3	11.2	25.4	25.2	31.1	25.8	33.1	23.4	28.7	26.9	32.9
Silt	27.6	34.1	35.4	39.6	36.6	56.2	55.2	68.4	71.3	68.3	62	71.2	65.2	72.1	66.8	67.8	53.5
Sand	64.3	54.7	52	49.8	55	28.7	29.5	20.4	3.3	6.5	6.9	3	1.7	4.5	4.5	5.3	13.6
Gravel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Particle Size Distribution	Harbor Sediments													Open-Lake Reference Area Sediments			
	Sampling Sites													Sampling Sites			
	CH-18	CH-19	CH-20	CH-21	CH-22	CH-23	CH-24	CH-25	CH-26	CH-27	CH-28	CH-29	CH-30	CL-1	CL-2	CL-3	CL-4
Clay	24.1	18.6	12.6	14.3	28.2	38	26.3	25	36.9	48.9	46.3	45	30.3	33.8	28	38	33.7
Silt	69.4	73.6	29.2	22.3	32	53.5	70.6	72.2	58.3	50.2	51.1	53.5	60.6	64.7	70.9	60.7	64.6
Sand	6.5	2.8	56.5	63.4	39.8	8.5	3.1	2.8	4.8	0.9	2.6	1.5	9.1	1.5	1.1	1.3	1.7
Gravel	0	0	1.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 2. Bulk inorganic analyses on Cleveland Harbor Federal navigation channel sediments. Boldface/shaded values indicate a concentration that is greater in comparison to the open-lake reference area (from EEI 2007).

	Harbor Sediments																
	Sampling Sites																
Metal (mg/kg)	CH-1	CH-2	CH-3	CH-4	CH-5	CH-6	CH-7	CH-8	CH-9	CH-10	CH-11	CH-12	CH-13	CH-14	CH-15	CH-16	CH-17
Aluminum	6850	5860	6910	7720	7180	9040	8690	7950	11400	9130	10900	12800	13800	10300	9030	9560	10700
Antimony	0.895J*	0.782J	0.786J	0.849J	1.47U**	0.523J	1.55U	0.508J	**11**	1.31J	0.179U	0.157U	0.169U	0.146U	0.86	0.157U	0.180U
Arsenic	10.4	9.33	**11.1**	**14.1**	**12.5**	**14.5**	**16.8**	**12.8**	**17.4**	**13.7**	**16.1**	**20.3**	**20.2**	**19.4**	**14.5**	**14.3**	**14.4**
Barium	52.7	41.6	60	56.8	55.1	66.6	67.2	58.1	87.7	69.2	72.9	84	91.5	74.6	62.2	65.5	82.7
Beryllium	0.438J	0.387J	0.456J	0.553J	0.476J	0.561J	0.555U	0.515J	0.719J	0.571J	0.67	0.76	0.82	0.62	0.55	0.59	0.65
Cadmium	0.664J	0.456J	0.8	0.687J	0.577J	0.593J	0.311U	0.633J	1.31J	0.619J	0.99	0.96	1.6	1	0.37	0.47	1.2
Calcium	10400	10400	**13200**	**13700**	**14000**	**15100**	**14700**	**12500**	**18200**	**14200**	**15500**	**16300**	**19800**	**14200**	**13700**	**14500**	**16400**
Chromium	19.9	14.8	20.7	22.2	19.4	23.4	21.3	22.6	36	24.2	31	30.7	37.4	23.2	22.3	23	35.1
Cobalt	7.77	6.46	8.11	9.35	8.36	10.1	10.1	9.19	12.5	10.2	11.1	11.8	**14.2**	10.4	10	10.1	10.8
Copper	43.2	**55.5**	**56**	48.2	46.2	50.6	43.3	52.8	**67.8**	49.2	48.5	50.1	**67.6**	42.3	40.8	43.2	52
Iron	21000	18900	22800	27700	26000	30200	30300	27600	34100	29800	33100	35500	**42000**	33600	30600	32000	32100
Lead	36	26.1	41.6	39.8	36.7	41.8	38.9	38.2	**66.3**	41.3	45.4	43.9	62.3	37.9	36.4	41.7	45.9
Magnesium	4100	3370	4620	5090	4870	5700	5710	5070	6990	5640	7430	7780	8000	6590	5720	6170	6450
Manganese	455	397	485	498	517	661	576	462	580	525	528	585	580	512	443	434	486
Mercury	0.0855	0.0733	0.0708	0.0759	0.0702	**2.88**	0.0624	0.081	0.105	0.128	0.0793	0.0884	0.126	0.104	0.0766	0.0835	0.123
Nickel	25	34.7	28	31.7	31.2	31.4	29.7	27.7	39.1	30.9	34.1	34.4	41.4	29.4	28.5	28.7	31.2
Potassium	912	703	859	1000	926	1160	1070	988	1370	1230	1360	1560	1720	1180	1120	1180	1340
Selenium	0.752J	2.25U	1.46J	2.40U	1.5J	1.52J	2.34	1.72J	**13.9U**	1.62J	0.894U	0.785U	0.843U	0.729U	2	1.4	1.3
Silver	0.182J	0.155J	0.764U	0.802U	0.4J	0.198J	0.776U	0.194J	0.927U	0.192J	0.200J	0.26	0.33	0.250J	0.250J	0.2	0.33
Sodium	**232**	**207**	**224**	**222**	**198**	**254**	**216**	**214**	**304**	**247**	**269**	**236**	**328**	**232**	**255**	**252**	**269**
Thallium	2.91U	1.26J	1.36J	3.21U	1.03J	3.26U	1.14	1.07J	**18.5U**	3.31U	0.300J	0.42	0.49	0.37	1.9	1.8	0.360J
Vanadium	14.3	12.6	14.6	17.8	15.9	18.4	18.5	16.5	23.1	19.5	21	22.9	26.6	19.9	18.1	18.8	20.3
Zinc	156	130	137	193	170	189	167	**296**	**428**	**226**	**323**	243	**417**	194	216	**236**	**379**

	Harbor Sediments																
	Sampling Sites																
Misc. (mg/kg)	CH-1	CH-2	CH-3	CH-4	CH-5	CH-6	CH-7	CH-8	CH-9	CH-10	CH-11	CH-12	CH-13	CH-14	CH-15	CH-16	CH-17
Ammonia	48	98.7	**201**	69.4	66.9	101	90.6	68.7	116	**195**	89.9	101	105	99.7	91.1	98.3	153
Total cyanide	0.117J	0.104J	0.355J	0.197J	0.101J	0.469	0.116J	0.492	0.531	0.430U	0.195J	0.190J	0.499	0.3J	0.548	**1.03**	**1.08**
TOC	14200	20500	21200	21900	20100	25200	24100	17300	26500	27400	22900	20300	28000	14000	14500	14500	22300

*Estimated value between the detection limit and reporting limit.
**Not detected at or above the specified reporting limit.

TABLE 2 (continued). Bulk inorganic analyses on Cleveland Harbor Federal navigation channel sediments. Boldface/shaded values indicate a concentration that is greater in comparison to the open-lake reference area (from EEI 2007).

	Harbor Sediments													Open-Lake Reference Area			
	Sampling Sites													Sampling Sites			
Metal (mg/kg)	**CH-18**	**CH-19**	**CH-20**	**CH-21**	**CH-22**	**CH-23**	**CH-24**	**CH-25**	**CH-26**	**CH-27**	**CH-28**	**CH-29**	**CH-30**	**CL-1**	**CL-2**	**CL-3**	**CL-4**
Aluminum	9680	10600	5420	6460	10400	10800	9080	11700	9630	9490	11900	17200	11700	16600	19700	18600	17500
Antimony	**6.7**	0.190J	0.84	0.56	0.7	0.193U	1.2	**4.8**	1	0.197U	0.198U	0.239U	1.5	3.77U	3.87U	3.76U	3.74U
Arsenic	**16.3**	**16.5**	7.3	8.5	**15**	**12.8**	**15.9**	**20.2**	**12.8**	10	**13.8**	**17.5**	**12.9**	11	9.75	9.35	8.54
Barium	79.5	79.2	36.2	51.9	78.2	64.5	70.1	85.6	60.5	56.7	78	108	78.9	108	123	115	110
Beryllium	0.63	0.77	0.37	0.42	0.65	0.67	0.58	0.72	0.59	0.56	0.74	1.1	0.89	1.02J	1.22J	1.1J	1.07J
Cadmium	**3.4**	0.99	0.41	0.92	1.2	1	0.71	0.94	0.8	0.64	1.2	1.4	1.4	1.77J	1.97	1.78J	1.77J
Calcium	**14100**	**19500**	**22800**	**17400**	379	10300	11300	**13700**	9820	7130	11000	12000	9560	11900	12100	11300	10700
Chromium	41.5	26.1	14.8	21.2	38.3	27.2	23.8	26.9	24.4	22.1	31.3	44.5	36.2	46.6	55.7	49.6	49.9
Cobalt	11.5	10.8	6.1	5.6	9.7	11.1	10.2	12.2	10.3	9.3	12.2	**15.3**	11.4	12.8	14.1	13.7	12.8
Copper	**58.8**	47	24	32.5	**69.6**	38	48	47.1	40	32	49.8	**56.6**	53	46.6	53.4	49.2	47.1
Iron	30000	34400	18100	17700	34100	30100	28900	35900	29400	25000	33100	**45600**	**39800**	34100	39500	36800	35100
Lead	**71.5**	41.4	27.9	37.1	**127**	38.5	41	40.1	37.9	30.2	50.3	62.2	61.4	53.3	65.9	57.5	59.3
Magnesium	6160	9120	9350	6000	**12600**	5870	5320	6750	5590	4740	6740	9010	6580	10700	11500	10700	10100
Manganese	502	551	251	238	471	538	507	758	479	420	561	832	512	833	650	584	618
Mercury	0.151	0.0663	0.0352	0.0626	0.0177	0.0128	0.0763	0.0942	0.0118	0.0109	0.0122	0.0164	0.0211	0.253	0.294	0.286	0.345
Nickel	40.9	32.9	18.1	18.2	33.3	32.2	30.7	35.3	29.4	26.3	36.4	46.2	35.6	51	57.6	54.2	53.5
Potassium	1190	1250	710	808	1220	1540	1150	1450	1260	1360	154	2230	1560	2420	2790	2660	2490
Selenium	0.772U	0.744U	0.91	0.734U	1.5	2	1.7	0.792U	0.915U	1.4	1.1	1.19U	3.6	5.66U	3.94J	2.14J	5.60U
Silver	0.45	0.19	0.120J	0.170J	0.270J	0.330J	0.260J	0.280J	0.300J	0.43	0.31	0.53	0.75	1.89U	1.93U	1.88U	1.87U
Sodium	**252**	159	174	**445**	**306**	**203**	179	180	138	170	151	188	174	189	196	181	184
Thallium	0.49	6.2	0.240J	0.230J	0.47	0.6	0.46	0.42	0.38	0.58	0.57	0.51	0.82	7.55U	7.74U	7.52U	7.47U
Vanadium	21.2	21.7	12.2	11.7	19.8	22.1	19.4	23.4	19.3	18	23.5	33.5	25	36.7	43	40.6	38.5
Zinc	**339**	207	132	211	**307**	205	208	193	203	173	**259**	**299**	**238**	185	217	199	196

	Harbor Sediments													Open-Lake Reference Area			
	Sampling Sites													Sampling Sites			
Misc. (mg/kg)	**CH-18**	**CH-19**	**CH-20**	**CH-21**	**CH-22**	**CH-23**	**CH-24**	**CH-25**	**CH-26**	**CH-27**	**CH-28**	**CH-29**	**CH-30**	**CL-1**	**CL-2**	**CL-3**	**CL-4**
Ammonia	133	108	51.5	102	120	152	140	**190**	139	**165**	126	127	82	158	142	132	118
Total cyanide	**1.05**	0.111U	0.481	**2.62**	**3.63**	0.131U	0.189J	0.289J	0.121U	0.144U	0.148U	0.161U	0.153U	0.997U	1.01U	0.979U	0.965U
TOC	19900	17500	12500	6850	6780	26300	20700	20400	19400	15600	20400	15600	40000	30100	30600	29600	27000

*Estimated value between the detection limit and reporting limit.

**Not detected at or above the specified reporting limit.

TABLE 3. Bulk Polycyclic Aromatic Hydrocarbon (PAH) analyses on Cleveland Harbor Federal navigation channel sediments. Boldface/shaded values indicate a concentration that is greater in comparison to the open-lake reference area (from EEI 2007).

PAH Compound (ug/kg)	Harbor Sediments																
	Sampling Sites																
	CH-1	CH-2	CH-3	CH-4	CH-5	CH-6	CH-7	CH-8	CH-9	CH-10	CH-11	CH-12	CH-13	CH-14	CH-15	CH-16	CH-17
Acenaphthene	16.9	10.6	9.89	31.8	32.1	46.6	24.3	18.3	6.86	14.2	9.36	25.8	14.6	29.4	14.5	21.8	17.4
Acenaphthylene	16.2	11.4	8.24	32	30.3	42	14.4	15.2	5.88	12.1	6.84	20.5	11.7	24.7	12.7	18.5	18.4
Anthracene	61.3	27.6	31.3	117	134	137	74.8	64	20.8	39.5	19.7	65.5	32.9	83.5	36.1	44.1	50.9
Benzo(a)Anthracene	213	112	142	449	424	558	270	216	102	170	84.9	224	123	355	154	168	167
Benzo(a)Pyrene	262	136	163	495	426	628	268	227	122	196	99.1	266	148	401	191	205	190
Benzo(b)Flouranthene	352	203	260	814	719	948	391	356	204	340	166	449	272	695	338	347	291
Benzo(ghi)Perylene	141	77.6	91.9	273	242	340	144	116	72.6	117	56.7	160	98.4	248	117	113	96.1
Benzo(k)Fluoranthene	131	67.1	72.3	204	165	340	135	96.5	63.5	95.8	49.2	136	79.1	202	97.3	116	97.3
Chrysene	274	149	171	594	509	657	301	246	129	225	100	312	168	497	219	231	203
Dibenz(a,h)Anthracene	38.9	21	28.7	79.2	71.8	102	39.9	33.1	21.6	31.7	16.4	43.9	26.4	69.1	32.1	36.9	30.1
Fluoranthene	534	287	334	1020	991	1310	612	487	254	419	210	548	306	863	390	400	355
Fluorene	26.9	15.2	15.3	48.8	47.4	71.6	32.7	28.7	10.2	22.2	13.2	39.9	21.3	45.2	21.8	30.2	23.1
Indeno(1,2,3-cd)Pyrene	126	70.6	84.6	257	224	314	135	106	65.9	103	51.2	144	87.4	231	109	102	91.1
Naphthalene	4.08U*	3.94U	4.47U	4.61U	6.82U	22.1U	4.79U	4.39U	5.45U	5.06U	5.03U	17.2U	5.28U	25U	5U	5.13U	5.2U
Phenanthrene	258	138	154	522	488	618	327	269	106	199	89.4	290	135	429	176	187	155
Pyrene	452	223	271	909	825	1070	508	414	202	352	159	453	240	734	317	340	296
Total PAHs	**2903**	**1549**	**1837**	**5846**	**5329**	**7182**	**3277**	**2693**	**1386**	**2337**	**1131**	**3178**	**1764**	**4907**	**2226**	**2361**	**2081**

*Not detected at or above the specified reoprting limit.

TABLE 3 (continued). Bulk Polycyclic Aromatic Hydrocarbon (PAH) analyses on Cleveland Harbor Federal navigation channel sediments. Boldface/shaded values indicate a concentration that is greater in comparison to the open-lake reference area (from EEI 2007).

PAH compound (ug/kg)	Harbor Sediments													Open-Lake Reference Area			
	Sampling Sites													Sampling Sites			
	CH-18	CH-19	CH-20	CH-21	CH-22	CH-23	CH-24	CH-25	CH-26	CH-27	CH-28	CH-29	CH-30	CL-1	CL-2	CL-3	CL-4
Acenaphthene	54.8	11.5	38.2	12.5	23.1	14.8	22	8.07	14.5	15.5	19.4	13	46.4	10.7U*	11.9U	12U	6.48
Acenaphthylene	47	12.9	20.3	12.4	22.7	12.5	20.7	9	25.1	16.9	23.8	30.8	50.4	10.7U	6.12	12U	13.5
Anthracene	122	33.4	59.1	31.8	70.7	41.9	63.9	24.6	40.6	42.3	38.4	41.3	145	10.7U	8.61	12U	18.4
Benzo(a)Anthracene	379	131	182	127	236	136	283	102	138	165	107	131	510	16.8	45.2	39.6	57.2
Benzo(a)Pyrene	417	159	205	142	222	141	327	112	165	192	126	152	478	10.7U	15.5	10.5	75.5
Benzo(b)Fluoranthene	677	253	315	242	338	239	586	202	242	346	187	232	818	10.7U	17.9	11.5	103
Benzo(ghi)Perylene	249	86.2	107	75.7	114	74.9	206	64.3	83.5	117	68.2	80.2	224	10.7U	6.38	12U	46.3
Benzo(k)Fluoranthene	193	86.1	106	58.1	91.9	60.9	156	51.4	60.7	94.6	69.2	66.4	221	10.7U	9.83	10.5	44.2
Chrysene	466	168	221	143	244	136	375	113	127	202	114	122	593	10.7U	11.9U	12U	40.1
Dibenz(a,h)Anthracene	75.5	26.4	33	21.8	38.6	23.1	60.2	19	26.2	33.3	22.9	25.8	74.5	10.7U	11.9U	12U	11.6
Fluoranthene	815	318	387	256	404	283	662	247	237	367	214	237	1040	13.2	34.3	25.5	122
Fluorene	84.4	17.7	39.7	18.4	37.1	23.1	35.3	12.3	21	26.7	25.9	22.8	73.9	10.7U	11.9U	12U	11.1
Indeno(1,2,3-cd)Pyrene	227	83	99.1	67.5	105	69.1	194	59.3	79.4	106	65.9	78.7	212	10.7U	11.9U	12U	41.7
Naphthalene	38	4.86U	77.4	4.06U	3.25	6.26U	4.81U	5.31U	5.42U	6.45U	6.26U	7.6U	39.2	10.7U	11.9U	12U	11.5U
Phenanthrene	465	143	220	114	206	141	324	103	120	156	78	97.3	515	10.7U	11.9U	12U	14.8
Pyrene	714	260	357	248	393	227	563	193	197	292	167	185	1020	10.7U	7.19	12U	87.2
Total PAHs	**5024**	**1789**	**2467**	**1570**	**2549**	**1623**	**3878**	**1320**	**1577**	**2172**	**1327**	**1515**	**6060**	30	151	97.6	693.08

*Not detected at or above the specified reporting limit.

TABLE 4. Theoretical bioaccumulation potential (TBP) for total PAH concentrations in Cleveland Harbor Federal navigation channel sediments (based on data from EEI 2007). TBP Boldface/shaded values indicate a TBP that is greater than the calculated open-lake reference area total PAH TBP of 257 μg/kg.

Site	Total PAH concentration (μg/kg)	TOC concentration (%)	BSAF	Lipid level (%)	TBP (μg/kg)
CH-1	2903	0.0142	1	0.01	**2044.3662**
CH-2	1549	0.0205	1	0.01	**755.60976**
CH-3	1837	0.0212	1	0.01	**2757.5472**
CH-4	5846	0.0219	1	0.01	**2433.3333**
CH-5	5329	0.0201	1	0.01	**3573.1343**
CH-6	7182	0.0252	1	0.01	**1300.3968**
CH-7	3277	0.0241	1	0.01	**1117.4274**
CH-8	2693	0.0173	1	0.01	**801.15607**
CH-9	1386	0.0265	1	0.01	**881.88679**
CH-10	2337	0.0274	1	0.01	**412.77372**
CH-11	1131	0.0229	1	0.01	**1387.7729**
CH-12	3178	0.0203	1	0.01	**868.96552**
CH-13	1764	0.028	1	0.01	**1752.5**
CH-14	4907	0.014	1	0.01	**1590**
CH-15	2226	0.0145	1	0.01	**1628.2759**
CH-16	2361	0.0145	1	0.01	**1435.1724**
CH-17	2081	0.0223	1	0.01	**2252.9148**
CH-18	5024	0.0199	1	0.01	**2524.6231**
CH-19	1789	0.0175	1	0.01	**1022.2857**
CH-20	2467	0.0125	1	0.01	**1973.6**
CH-21	1570	0.00685	1	0.01	**2291.9708**
CH-22	2549	0.00678	1	0.01	**3759.587**
CH-23	1623	0.0263	1	0.01	**617.11027**
CH-24	3878	0.0207	1	0.01	**1873.43**
CH-25	1320	0.0204	1	0.01	**647.05882**
CH-26	1577	0.0194	1	0.01	**812.8866**
CH-27	2172	0.0156	1	0.01	**1392.3077**
CH-28	1327	0.0204	1	0.01	**650.4902**
CH-29	1515	0.0156	1	0.01	**971.15385**
CH-30	6060	0.04	1	0.01	**1515**

TABLE 5. Bulk Polychlorinated Biphenyl (PCB) analyses on Cleveland Harbor Federal navigation channel sediments. Boldface/shaded values indicate a concentration that is greater in comparison to the open-lake reference area (from EEI 2007).

	Harbor Sediments																
	Sampling Sites																
Aroclor (ug/kg)	CH-1	CH-2	CH-3	CH-4	CH-5QC	CH-6	CH-7	CH-8	CH-9	CH-10	CH-11	CH-12	CH-13	CH-14	CH-15	CH-16	CH-17
1016	58.1U*	60.7U	63.8U	67.3U	63.8U	66.8U	63.9U	29.3U	36.9U	34.5U	35.9U	32.9U	38.0U	32.2U	32.5U	34.0U	36.0U
1221	58.1U	60.7U	63.8U	67.3U	63.8U	66.8U	63.9U	29.3U	36.9U	34.5U	35.9U	32.9U	38.0U	32.2U	32.5U	34.0U	36.0U
1232	58.1U	60.7U	63.8U	67.3U	63.8U	66.8U	63.9U	29.3U	36.9U	34.5U	35.9U	32.9U	38.0U	32.2U	32.5U	34.0U	36.0U
1242	58.8	56.2J**	61.6J	56.3J	**111**	51.6J	53.2J	29.3U	36.9U	34.5U	35.9U	32.9U	38.0U	32.2U	32.5U	34.0U	36.0U
1248	58.1U	60.7U	63.8U	67.3U	63.8U	66.8U	63.9U	29.3U	36.9U	34.5U	35.9U	32.9U	38.0U	32.2U	32.5U	34.0U	36.0U
1254	**163**	**75**	**63.2J**	**68**	**126**	**48.2J**	42.8J	22.2J	28.1J	30.1J	33.8J	32.9U	38.0U	32.2U	32.5U	34.0U	**46.7**
1260	29.1J	60.7U	63.8U	67.3U	32.4J	66.8U	63.9U	29.3U	36.9U	34.5U	35.9U	32.9U	38.0U	32.2U	32.5U	34.0U	27.1J
"Total"***	**251**	**192**	**189**	**192**	**269**	**167**	**160**	**80.8**	**102**	**101**	**106**	**98.7**	**114**	**96.6**	**97.5**	**102**	**110**

	Harbor Sediments													Open-Lake Reference Area Sediments			
	Sampling Sites													Sampling Sites			
Aroclor (ug/kg)	CH-18	CH-19	CH-20	CH-21	CH-22	CH-23	CH-24	CH-25	CH-26	CH-27QC	CH-28	CH-29	CH-30	CL-1	CL-2	CL-3	CL-4
1016	68.3U	65.3U	55.1U	60.9U	71.9U	77.8U	66.6U	76.4U	75.5U	90.3U	86.7U	48.8U	91.7U	78.6U	81.1U	77.1U	77.7U
1221	68.3U	65.3U	55.1U	60.9U	71.9U	77.8U	66.6U	76.4U	75.5U	90.3U	86.7U	48.8U	91.7U	78.6U	81.1U	77.1U	77.7U
1232	68.3U	65.3U	55.1U	60.9U	71.9U	77.8U	66.6U	76.4U	75.5U	90.3U	86.7U	48.8U	91.7U	78.6U	81.1U	77.1U	77.7U
1242	53.4J	43.7J	79.5	55.7J	47.7J	68.9J	60.8J	46.6J	**99.7**	**163**	**147**	48.8U	**83.0J**	78.6U	81.1U	77.1U	77.7U
1248	68.3U	65.3U	55.1U	60.9U	71.9U	77.8U	66.6U	76.4U	75.5U	90.3U	86.7U	48.8U	91.7U	78.6U	81.1U	77.1U	77.7U
1254	**56.6J**	65.3U	**73.5**	**80.9**	**75.5**	**85.3**	**64.4J**	38.7J	**138**	**260**	**221**	**62.1**	**102**	36.6J	42.8J	35.4J	37.9J
1260	68.3U	65.3U	55.1U	34.4J	30.5J	77.8U	66.6U	76.4U	44.9J	81J	62.6J	31.0J	44.4J	78.6U	81.1U	77.1U	77.7U
"Total"	**179**	**174**	**208**	**171**	**153**	**232**	**192**	**162**	**283**	**504**	**431**	**142**	**230**	36.6	42.8	35.4	37.9

*Not detected at or above the specified reporting limit.
**Estimated value between the detection limit and reporting limit.
***Sum of aroclor(s) evidenced in harbor or lake sediments, with non-detectable concentrations valued at the reporting limit.

TABLE 6. TBP for total PCB concentrations in Cleveland Harbor Federal navigation channel sediments (based on data from EEI 2007). TBP Boldface/shaded values indicate a TBP that is greater than the calculated open-lake reference area total PCB TBP of 16.8 μg/kg.

Site	Total PCB concentration (μg/kg)	TOC concentration (%)	BSAF	Lipid level (%)	TBP (μg/kg)
CH-1	251	0.0142	1.2	0.01	**212.1127**
CH-2	192	0.0205	1.2	0.01	**112.3902**
CH-3	189	0.0212	1.2	0.01	**106.9811**
CH-4	192	0.0219	1.2	0.01	**105.2055**
CH-5	269	0.0201	1.2	0.01	**160.597**
CH-6	167	0.0252	1.2	0.01	**79.52381**
CH-7	160	0.0241	1.2	0.01	**79.66805**
CH-8	80.8	0.0173	1.2	0.01	**56.04624**
CH-9	102	0.0265	1.2	0.01	**46.18868**
CH-10	101	0.0274	1.2	0.01	**44.23358**
CH-11	106	0.0229	1.2	0.01	**55.54585**
CH-12	98.7	0.0203	1.2	0.01	**58.34483**
CH-13	114	0.028	1.2	0.01	**48.85714**
CH-14	96.6	0.014	1.2	0.01	**82.8**
CH-15	97.5	0.0145	1.2	0.01	**80.68966**
CH-16	102	0.0145	1.2	0.01	**84.41379**
CH-17	110	0.0223	1.2	0.01	**59.19283**
CH-18	179	0.0199	1.2	0.01	**107.9397**
CH-19	174	0.0175	1.2	0.01	**119.3143**
CH-20	208	0.0125	1.2	0.01	**199.68**
CH-21	171	0.00685	1.2	0.01	**299.562**
CH-22	153	0.00678	1.2	0.01	**270.7965**
CH-23	232	0.0263	1.2	0.01	**105.8555**
CH-24	192	0.0207	1.2	0.01	**111.3043**
CH-25	162	0.0204	1.2	0.01	**95.29412**
CH-26	283	0.0194	1.2	0.01	**175.0515**
CH-27	504	0.0156	1.2	0.01	**387.6923**
CH-28	431	0.0204	1.2	0.01	**253.5294**
CH-29	142	0.0156	1.2	0.01	**109.2308**
CH-30	230	0.04	1.2	0.01	**69**

TABLE 7. Bulk pesticide analyses on Cleveland Harbor Federal navigation channel sediments. Boldface/shaded values indicate a concentration that is greater in comparison to the open-lake reference area (from EEI 2007).

	Harbor Sediments																
	Sampling Sites																
Pesticide (ug/kg)	**CH-1**	**CH-2**	**CH-3**	**CH-4**	**CH-5**	**CH-6**	**CH-7**	**CH-8**	**CH-9**	**CH-10**	**CH-11**	**CH-12**	**CH-13**	**CH-14**	**CH-15**	**CH-16**	**CH-17**
4,4-DDD	4.70J*	6.07U**	6.38U	22.4U	20.0U	4.95J	2.13U	19.8U	8.16J	14.9J	2.38J	2.21J	2.58U	3.05	2.20U	2.06J	2.42U
4,4-DDE	5.81U	6.07U	6.38U	22.4U	20.0U	6.68U	2.13U	19.8U	24.9U	11.1J	7.19U	5.54	2.58U	2.18U	2.20U	2.28U	4.36
4,4-DDT	5.81U	6.07U	6.38U	**60.6**	**55.7**	10.2	11.3	19.8U	10.7J	11.7J	7.19U	9.52	11.6	9.9	10.3	13.1	2.42U
Aldrin	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.14U	1.21U
Alpha-BHC	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.14U	1.21U
Beta-BHC	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.31	2.07
Chlordane	36.3U	37.9U	39.9U	140U	125U	41.8U	13.3U	124U	156U	145U	44.9U	16.8U	16.1U	13.7U	13.7U	14.3U	15.1U
Delta-BHC	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.14U	1.21U
Dieldrin	5.81U	6.07U	6.38U	22.4U	20.0U	6.68U	2.13U	19.8U	24.9U	**11.6**	7.19U	2.21U	2.58U	1.09U	2.20U	2.28U	2.42U
Endosulfan I	2.91U	6.07U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	2.28U	1.21U
Endosulfan II	2.91U	3.03U	6.38U	22.4U	20.0U	6.68U	2.13U	19.8U	24.9U	11.2J	7.19U	2.21U	2.58U	2.18U	2.20U	1.14U	2.42U
Endosulfan Sulfate	5.81U	6.07U	6.38U	22.4U	20.0U	6.68U	2.13U	19.8U	24.95U	11.6U	7.19U	2.21U	2.58U	2.18	2.20U	2.28U	2.42U
Endrin	5.81U	6.07U	6.38U	22.4U	20.0U	6.68U	2.13U	19.8U	24.9U	23.2U	7.19U	2.21U	2.58	1.09U	2.20U	2.28U	2.42U
Endrin Aldehyde	2.91U	6.07U	6.38U	22.4U	20.0U	6.68U	2.13U	19.8U	24.9U	7.23J	7.19U	2.21U	2.58U	2.18U	2.20U	2.28U	2.42U
Endrin Ketone	5.81U	6.07U	6.38U	22.4U	20.0U	6.68U	2.13U	19.8U	24.9U	8.34J	7.19U	2.21U	2.58U	2.18U	2.20U	1.14U	2.42U
Gamma-BHC	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.14U	1.21U
Gamma-Chlordane	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.14U	1.21U
Heptachlor	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.14U	1.21U
Heptachlor Epoxide	2.91U	3.03U	3.19U	11.2U	10.0U	3.34U	1.07U	9.90U	12.5U	11.6U	3.59U	1.11U	1.29U	1.09U	1.10U	1.14U	1.21U
Methoxychlor	29.1U	30.3U	31.9U	112U	100U	33.4U	10.77U	99.0U	125U	36J	35.9U	11.1U	12.9U	10.9U	11.0U	1.14U	12.1U
Toxaphene	145U	152U	159U	561U	501U	167U	53.3U	495U	623U	579U	180U	55.3U	64.5U	54.6U	55.0U	57.0U	60.4U

*Estimated value between the detection limit and reporting limit.
**Not detected at or above the specified reporting limit.

TABLE 7 (continued). Bulk pesticides analyses on Cleveland Harbor Federal navigation channel sediments. Boldface/shaded values indicate a concentration that is greater in comparison to the open-lake reference area (from EEI 2007).

	Harbor Sediments													Open-Lake Reference Area			
	Sampling Sites													Sampling Sites			
Pesticide (ug/kg)	CH-18	CH-19	CH-20	CH-21	CH-22	CH-23	CH-24	CH-25	CH-26	CH-27	CH-28	CH-29	CH-30	CL-1	CL-2	CL-3	CL-4
4,4-DDD	2.28U	6.53U	5.51U	2.03U	7.19U	7.78JU	6.66J	7.64J	7.55J	8.85J	**13.5**	9.82J	**12.5**	7.89J	8.95J	15.5U	7.92J
4,4-DDE	2.28U	6.53U	5.51U	2.03U	7.19U	7.78U	6.66U	7.64U	7.55U	8.85U	8.67U	9.82U	9.17U	15.8U	16.2U	15.5U	15.6U
4,4-DDT	2.28U	6.53U	5.51U	2.03U	7.19U	7.78U	6.66U	7.64U	7.55U	8.85U	12.7	9.82U	9.17U	15.8U	16.2U	15.5U	15.6U
Aldrin	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	7.76U	7.80U
Alpha-BHC	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	7.76U	7.80U
Beta-BHC	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	7.76U	7.80U
Chlordane	14.2U	40.8U	34.4U	12.7U	44.9U	48.6U	41.6U	47.7U	47.2U	55.3U	54.2U	61.4U	57.3U	98.7U	101U	97.0U	97.5U
Delta-BHC	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	7.76U	7.80U
Dieldrin	2.28U	6.53U	5.51U	2.03U	7.19U	7.78U	6.66U	7.64U	7.55U	8.85U	8.67U	9.82U	9.17U	15.8U	16.2U	15.5U	15.6U
Endosulfan I	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	7.76U	7.80U
Endosulfan II	2.28U	6.53U	5.51U	2.03U	7.19U	7.78U	6.66U	7.64U	7.55U	8.85U	8.67U	9.82U	9.17U	15.8U	16.2U	15.5U	15.6U
Endosulfan Sulfate	2.28U	6.53U	5.51U	2.03U	7.19U	3.89U	6.66U	7.64U	7.55U	8.85U	8.67U	9.82U	9.17U	15.8U	16.2U	15.5U	15.6U
Endrin	2.28U	6.53U	5.51U	2.03U	7.19U	7.78U	6.66U	7.64U	7.55U	8.85U	8.67U	9.82U	9.17U	15.8U	16.2U	15.5U	15.6U
Endrin Aldehyde	2.28U	6.53U	5.51U	2.03U	7.19U	7.78U	6.66U	7.64U	7.55U	8.85U	8.67U	9.82U	9.17U	15.8U	16.2U	15.5U	15.6U
Endrin Ketone	2.28U	6.53U	5.51U	2.03U	7.19U	7.78U	6.66U	7.64U	7.55U	8.85U	8.67U	9.82U	9.17U	15.8U	16.2U	7.76U	15.6U
Gamma-BHC	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	7.76U	7.80U
Gamma-Chlordane	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	15.8U	16.2U	15.5U	15.6U
Heptachlor	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	15.5U	7.80U
Heptachlor Epoxide	1.14U	3.27U	2.75U	1.02U	3.59U	3.89U	3.33U	3.82U	3.78U	4.43U	4.33U	4.91U	4.58U	7.89U	8.09U	7.76U	7.80U
Methoxychlor	11.4U	32.7U	27.5U	10.2U	35.9U	38.9U	33.3U	38.2U	37.8U	44.3U	43.3U	49.1U	45.8U	78.9U	80.9U	77.6U	78.0U
Toxaphene	56.9U	163U	138U	50.8U	180U	195U	166U	191U	189U	221U	217U	245U	229U	395U	405U	388U	390U

*Not detected at or above the specified reporting limit.

**Estimated value between the detection limit and reporting limit.

TABLE 8. TPB for ∑DDT concentrations in Cleveland Harbor Federal navigation channel sediments (based on data from EEI 2007). Boldface/shaded values indicate a TBP that is greater than the calculated open-lake reference area ∑DDT TBP of 33.8 μg/kg.

Site	∑DDT concentration (μg/kg)	TOC concentration (%)	BSAF	Lipid level (%)	TBP (μg/kg)
CH-1	16.3	0.0142	2.5	0.01	28.6971831
CH-2	18.2	0.0205	2.5	0.01	22.195122
CH-3	19.1	0.0212	2.5	0.01	22.5235849
CH-4	105	0.0219	2.5	0.01	**119.863**
CH-5	95.7	0.0201	2.5	0.01	**119.0299**
CH-6	21.8	0.0252	2.5	0.01	21.6269841
CH-7	15.6	0.0241	2.5	0.01	16.1825726
CH-8	59.4	0.0173	2.5	0.01	**85.83815**
CH-9	43.8	0.0265	2.5	0.01	**41.32075**
CH-10	37.7	0.0274	2.5	0.01	**34.39781**
CH-11	16.8	0.0229	2.5	0.01	18.3406114
CH-12	17.3	0.0203	2.5	0.01	21.3054187
CH-13	16.8	0.028	2.5	0.01	15
CH-14	15.1	0.014	2.5	0.01	26.9642857
CH-15	14.7	0.0145	2.5	0.01	25.3448276
CH-16	17.4	0.0145	2.5	0.01	30
CH-17	9.2	0.0223	2.5	0.01	10.3139013
CH-18	6.84	0.0199	2.5	0.01	8.59296482
CH-19	19.6	0.0175	2.5	0.01	28
CH-20	16.5	0.0125	2.5	0.01	33
CH-21	6.09	0.00685	2.5	0.01	22.2262774
CH-22	21.6	0.00678	2.5	0.01	**79.64602**
CH-23	23.3	0.0263	2.5	0.01	22.148289
CH-24	19.9	0.0207	2.5	0.01	24.0338164
CH-25	22.9	0.0204	2.5	0.01	28.0637255
CH-26	22.7	0.0194	2.5	0.01	29.2525773
CH-27	26.6	0.0156	2.5	0.01	**42.62821**
CH-28	34.9	0.0204	2.5	0.01	**42.76961**
CH-29	29.5	0.0156	2.5	0.01	**47.27564**
CH-30	30.8	0.04	2.5	0.01	19.25

TABLE 9. Inorganic Modified Elutriate Test results on Cleveland Harbor Federal navigation sediments (from EEI 2007).

	Harbor Sediments									
	Sampling Sites									
	CH-UEMU		CH-URMU		CH-LRMU		CH-OHMU		CH-ORMU	
Metal (µg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Aluminum	4970	51.4	4970	126	2940	35.1	4530	46.9	3810	69
Antimony	1.3	0.89	2.3	0.85	1.7	1.1	0.5U	0.5U	0.8	0.75
Arsenic	16	4.6	13	9.4	16	12.1	10	4	7	4.1
Barium	81.9	32.3	83.2	46.4	82.2	59.1	104	67.7	53.4	30.2
Beryllium	0.42	0.1U*	0.31	0.1U	0.19	0.1U	0.2	0.1U	0.22	0.1U
Cadmium	0.88	0.11U	1.7	0.11U	1.1	0.11U	0.34	0.11U	0.39	0.11U
Calcium	49900	45900	55700	55400	59800	57800	44600	44200	36600	36100
Chromium	15.9	1U	17.8	1U	11	1U	7.3	1U	9.1	1U
Cobalt	5.1	1.2	4	1.6	2.5	1.1	2.8	1.1	2.1	1.2
Copper	37.5	1.3	27.9	1.5	18.1	0.66	11	1.1	13	1.5
Iron	13200	267	9090	582	5930	651	6280	245	5560	199
Lead	33.2	0.5U	30.3	0.77	20.9	0.5U	11.9	0.5U	13.8	0.5U
Magnesium	13300	11400	13500	13600	13800	13300	10800	10400	9820	8600
Manganese	748	323	430	396	591	509	1660	1530	248	157
Mercury	0.0398	0.0012	0.0391	0.0024	0.0267	0.0017	0.0212	0.00099	0.0251	0.0011
Nickel	20.6	4.1	17.3	5.4	11.7	4	9.1	3	8.2	2.2
Potassium	8030	6460	7750	7230	7080	6810	5010	4290	4520	3620
Selenium	1U	1U	1U	1U	1U	1U	1U	1U	1U	1U
Sodium	22100	21200	25500	29900	28600	25000	20700	18500	22500	23400
Thallium	0.3U	0.3U	0.3U	0.3U	0.3U	0.3U	0.3U	0.3U	0.51	0.3U
Vanadium	14.1	3U	7.4	3U	4.8	3U	5.2	3U	4.5	3U
Zinc	131	3.4	163	7.4	103	2.8	48.5	3.3	61.2	6.6

	CH-UEMU		CH-URMU		CH-LRMU		CH-OHMU		CH-ORMU	
Misc. (mg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Ammonia	6.06	5.93	11	9.37	8.74	8.67	7.52	7.32	5.22	7.22
Total cyanide	0.00232J	0.00226J	0.0021J	0.00361J	0.0015U	0.0038	0.005U	0.00331U	0.00237J	0.0034J

*Not detected at or above the specified reporting limit.

**Estimated value between the detection limit and reporting limit.

TABLE 10. PAH Modified Elutriate Test results on Cleveland Harbor Federal navigation sediments (from EEI 2007).

	Harbor Sediments									
	Sampling Sites									
	CH-UEMU		CH-URMU		CH-LRMU		CH-OHMU		CH-ORMU	
PAH compound (µg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Acenaphthene	0.481U*	0.521U	0.485U	0.521U	0.197J**	0.521U	0.481U	0.521U	0.472U	0.521U
Acenaphthylene	0.481U	0.521U	0.485U	0.521U	0.481U	0.521U	0.481U	0.521U	0.472U	0.521U
Anthracene	0.481U	0.521U	0.485U	0.521U	0.481U	0.521U	0.481U	0.521U	0.472U	0.521U
Benzo(a)Anthracene	0.104	0.0786	0.127	0.0776	0.149	0.156	0.0839	0.0855	0.091	0.0784
Benzo(a)Pyrene	0.113	0.0917	0.152	0.0961	0.168	0.181	0.122	0.112	0.137	0.0957
Benzo(b)Fluoranthene	0.201	0.184	0.36	0.125	0.223	0.405	0.241	0.129	0.23	0.118
Benzo(ghi)Perylene	0.106	0.0871	0.142	0.0704	0.129	0.143	0.0762	0.0698	0.0693	0.0609
Benzo(k)Fluoranthene	0.024U	0.026U	0.0243U	0.026U	0.024U	0.026U	0.024U	0.026U	0.105	0.026U
Chrysene	0.134	0.113	0.17	0.0929	0.167	0.172	0.0918	0.0851	0.0922	0.0786
Dibenz(a,h)Anthracene	0.0481U	0.0521U	0.0485U	0.0521U	0.0481U	0.0521U	0.0481U	0.0521U	0.472U	0.0521U
Fluoranthene	0.287	0.234	0.379	0.169	0.411	0.254	0.213	0.149	0.134	0.0989
Fluorene	0.481U	0.521U	0.485U	0.521U	0.123J	0.521U	0.481U	0.521U	0.472U	0.521U
Indeno(1,2,3-cd)Pyrene	0.0481U	0.0521U	0.0485U	0.0521U	0.0481U	0.0521U	0.0481U	0.0521U	0.0472U	0.0521U
Naphthalene	0.481U	0.521U	0.485U	0.521U	0.481U	0.521U	0.481U	0.521U	0.472U	0.521U
Phenanthrene	0.481U	0.521U	0.294J	0.521U	0.258J	0.521U	0.481U	0.521U	0.472U	0.521U
Pyrene	0.303	0.249	0.444	0.203	0.506	0.386	0.268	0.159	0.237	0.154

*Not detected at or above the specified reporting limit.
**Estimated value between the detection limit and reporting limit.

TABLE 11. PCB Modified Elutriate Test results on Cleveland Harbor Federal navigation sediments (from EEI 2007).

	Harbor Sediments									
	Sampling Sites									
	CH-UEMU		CH-URMU		CH-LRMU		CH-ORMU		CH-OHMU	
Aroclor (µg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
1016	0.0952U*	0.0106U	0.100U	0.103U	0.0952U	0.104U	0.098U	0.103U	0.0962U	0.0102U
1221	0.0952U	0.0106U	0.100U	0.103U	0.0952U	0.104U	0.098U	0.103U	0.0962U	0.0102U
1232	0.0952U	0.0106U	0.100U	0.103U	0.0952U	0.104U	0.098U	0.103U	0.0962U	0.0102U
1242	0.0952U	0.0106U	0.100U	0.103U	0.0952U	0.104U	0.098U	0.103U	0.0962U	0.0102U
1248	0.0952U	0.0106U	0.100U	0.103U	0.0952U	0.104U	0.098U	0.103U	0.0962U	0.0102U
1254	0.0952U	0.0106U	0.100U	0.103U	0.0952U	0.104U	0.098U	0.103U	0.0962U	0.0102U
1260	0.0952U	0.0106U	0.100U	0.103U	0.0952U	0.104U	0.098U	0.103U	0.0962U	0.0102U

*Not detected at or above the specified reporting limit.

TABLE 12. Pesticide Modified Elutriate Test results on Cleveland Harbor Federal navigation sediments (from EEI 2007).

Pesticide (µg/L)	Harbor Sediments									
	Sampling Sites									
	CH-UEMU		CH-URMU		CH-LRMU		CH-OHMU		CH-ORMU	
	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
4,4-DDD	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
4,4-DDE	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
4,4-DDT	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
Aldrin	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Alpha-BHC	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Alpha-Chlordane	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Beta-BHC	0.0943U	0.111U	0.100U	0.111U	0.192U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Chlordane	1.18U	1.39U	1.25U	1.39U	1.20U	1.39U	0.243U	0.278U	1.23U	1.39U
Delta-BHC	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Dieldrin	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
Endosulfan I	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Endosulfan II	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
Endosulfan Sulfate	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
Endrin	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
Endrin Aldehyde	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
Endrin Ketone	0.189U	0.222U	0.200U	0.222U	0.192U	0.222U	0.0388U	0.0444U	0.196U	0.222U
Gamma-BHC	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Gamma-Chlordane	0.0943U	0.111U	0.200U	0.111U	0.0962U	0.111U	0.0194U	0.0444U	0.098U	0.111U
Heptachlor	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Heptachlor Epoxide	0.0943U	0.111U	0.100U	0.111U	0.0962U	0.111U	0.0194U	0.0222U	0.098U	0.111U
Methoxychlor	0.943U	1.11U	0.100U	1.11U	0.962U	1.11U	0.194U	0.222U	2.45U	1.11U
Toxaphene	2.36U	2.78U	2.50U	2.78U	2.40U	2.78U	0.485U	0.556U	2.45U	2.78U

*Not detected at or above the specified reporting limit.

TABLE 13. Results of 10-day solid phase toxicity tests (bioassays) on Cuyahoga River sediments near upstream limit of Cleveland Harbor Federal navigation channels (from EEI 2007). Boldface/shaded values indicate statistically significant (P=0.05) difference relative to the open-lake reference area.

Composite sediment sample	Test species		
	H. azteca	***C. tentans***	
	Mean survival (%)	**Mean survival (%)**	**Mean growth (mg/org***
CH-UEMU	**0.52±02**	**0.72±0.03**	1.06±0.09
CL	0.88	0.94	1.01

*Ash-free dried weight.

Enclosure 7

Evaluation of Cleveland Harbor Federal Navigation Channel (Upper Cuyahoga River Channel) Dredged Material with Respect to Suitability for Open-Lake Placement – 2013

EVALUATION OF CLEVELAND HARBOR FEDERAL NAVIGATION CHANNEL (UPPER CUYAHOGA RIVER) DREDGED MATERIAL WITH RESPECT TO SUITABILITY FOR OPEN-LAKE PLACEMENT

EXECUTIVE SUMMARY

Cleveland Harbor, Ohio sediments within the upper reach of the Cuyahoga River Channel were evaluated to determine their suitability for open-lake placement. In 2012, sediments from this reach of the harbor were sampled as management units DMMU-1, DMMU-2a and DMMU-2b, and subjected to a suite of tests. In addition, bottom sediments from two separate, two-square mile deep-water areas in Lake Erie (open-lake placement areas CLA-1 and CLA-4) being investigated for the placement of this dredged material were sampled and subjected to a similar suite of tests. Testing generally included bulk sediment physical and chemical analyses, cationic metal simultaneously extracted metals/acid volatile sulfide (SEM/AVS) analysis, elutriate testing, standard sediment and elutriate bioassays, and sediment bioaccumulation testing for polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE). Data generated from this effort were used to evaluate whether this material meets Federal (U.S. Environmental Protection Agency [USEPA]/U.S. Army Corps of Engineers [USACE]) guidelines for open-lake placement, which includes compliance with applicable water quality standards (WQSs) or criteria (WQC).

To determine whether this dredged material meets Federal guidelines for open-lake placement with respect to contaminant-related impacts, relevant contaminant pathways were examined to evaluate fate, exposure and risks. Primary contaminant exposure pathways in the water column include the uptake of contaminants by plankton and fish as they are released from the dredged material during discharge. Water column bioassays using a water flea (48-hour survival of *Ceriodaphnia dubia*) and minnow (96-hour survival of *Pimephales promelas*) were used as measurement endpoints to assess these risks. Contaminant exposure pathways from the dredged material on the lake bottom include uptake (bioaccumulation) and/or trophic transfer through bioaccumulation. Standard whole sediment bioassays using an amphipod (10-day survival of *Hyalella azteca*) and midge (10-day survival and growth of *Chironomus dilutus*), and bioaccumulation experiments using worm (28-day *Lumbriculus variegatus* bioaccumulation) were used as measurement endpoints to assess these risks. With respect to whole sediment, the bioassay data demonstrated that the dredged material would not be acutely toxic when placed on the lake bottom. Nickel, ammonia-nitrogen (Ammonia-N), toluene, PCBs and sum DDT (ΣDDT) were determined to be contaminants of concern (COCs) in the sediments. Nickel was identified

as a COC due to one higher bulk concentration but was eliminated because its bioavailability was low as shown through SEM/AVS analysis. Ammonia is most appropriate addressed through the water column pathway. Toluene was identified as a COC due to bulk concentrations (maximum 14.5 mg/kg [DMMU-2a]) exceeding open-lake placement area concentrations. However, it was determined to not be toxic because the maximum total potential hydrocarbon toxicity (including contribution from toluene) of the sediments relative to *H. azteca* and *C. dilutus* were 0.5 TU and 0.2 TU (DMMU-2a), respectively. These values were less than 1.0 TU, indicating that the dredged material would not be a significant source of narcotic toxicity to benthic organisms. PCBs (tPCBs) and ΣDDT were determined to be COCs in sediments due to their potential to bioaccumulate in benthic invertebrates and organisms higher in the food web. The quantification of bioaccumulation of these COCs in *L. variegatus* was used to predict potential exposure to yellow perch (*Perca flavescens*) and walleye (*Sander vitreus*) as receptor species. While *L. variegatus* bioaccumulation of these COCs from most of the dredged material was found to be statistically higher (ΣPCB range 33.2±4.20 µg/kg-tissue to 55.6±4.30 µg/kg-tissue; ΣDDT range 3.41±0.38 µg/kg-tissue to 5.64±0.66 µg/kg-tissue) relative to sediments at one or both open-lake areas (ΣPCB range 12.9±1.22 µg/kg-tissue to 32.2±4.70 µg/kg-tissue; ΣDDT range 2.7±2.2 µg/kg-tissue to 5.4±0.5 µg/kg-tissue), the differences were determined to not be biologically significant because of the low level of exposure to yellow perch and walleye. In fact, the predicted increased exposure of receptor species via the bioaccumulation pathway to PCB and DDT residues in invertebrates associated with the dredged material was found to be within the generally accepted range of analytical variability alone.

With respect to the release of contaminants from the dredged material during discharge and associated toxicity in the water column, elutriate testing, water column bioassays and sediment pore water predictions identified ammonia-N (maximum measured elutriate concentration 16.8 mg/L [DMMU-2a]) and toluene (maximum predicted pore water concentration 2485 µg/L [DMMU-2a]) as COCs in the water column. However, ammonia is transient and not environmentally persistent, and rapidly dilutes in water and would not be toxic to fish or water column organisms at the concentrations observed. Further, toluene is not bioaccumulative, readily partitions to water and air and volatilizes such that much would be liberated during the dredging process, and it would not be toxic to fish and other water column organisms at the concentrations observed. Finally, evaluation of total phosphorus (TP) releases during placement of the dredged material indicated no potential to contribute toward nuisance algae proliferation, including harmful algal blooms (HABs). Elutriate data and modeling indicated that discharge of the dredged material at the two open-lake areas would comply with relevant WQSs/WQC for the protection

of aquatic life after consideration of mixing and dilution.

Subject to specific conservative limitations, this evaluation indicates that the discharge of material dredged from DMMU-1, DMMU-2a and DMMU-2b at open-lake areas CLA-1 and CLA-4 would not culminate in contaminant-related, unacceptable adverse impacts to the aquatic ecosystem. Therefore, it is concluded that this dredged material meets Federal guidelines for open-lake placement. Open-lake placement controls include: (1) use of mechanical equipment to dredge and discharge the dredged material; (2) spatially limiting the placement of material dredged from DMMU-1, DMMU-2a and DMMU-2b to a one-square mile area within CLA-4 and CLA-1; and (3) spatially limiting the placement of material dredged from DMMU-1 to a two-third square mile area within CLA-4.

Sediment data from 2002, 2007 and 2012 sampling events were examined in an attempt to decipher trends in the quality of DMMU-1, DMMU-2a and DMMU-2b sediments over the last five years. This assessment indicated a net decline or no ecologically meaningful increase in sediment contaminant-based concentrations and/or toxicity over time.

1.0 INTRODUCTION AND BACKGROUND

Cleveland Harbor, Ohio is located on south shore of Lake Erie at the mouth and lower reach of the Cuyahoga River at Cleveland, Ohio. Federal navigation channels in the harbor are deep-draft and designed to accommodate commercial navigation, and include a River Channel, Turning Basin, Old River Channel and Outer Harbor channels. These channels have authorized depths ranging from -23 to -29 feet low water datum (LWD)[1]. Cleveland Harbor is situated within the designated Cuyahoga River Great Lakes Area of Concern (AOC) (U.S. Environmental Protection Agency [USEPA] 2013a). The AOC includes the lower 45 miles of the river from the Ohio Edison Dam to the mouth, and approximately 10 miles of Lake Erie shoreline from Edgewater Park to Wildwood Park on the west and east sides of Cleveland, respectively.

Cleveland Harbor requires maintenance dredging on an annual basis to facilitate commercial, deep-draft navigation. About 80 percent of the harbor's annual dredging needs are typically in the upper reach of the River Channel between the upstream limit (Station 799+00) and downstream upper Turning Basin (Station 736+00). The quantity of material annually dredged from this reach is on the order of 200,000 cubic yards, the vast majority of which has been placed in Federal and non-Federal confined disposal facilities (CDFs) since about 1968. Cleveland Harbor is typically dredged in two phases; in the Spring between May and June, and Fall in between October and November. The vast majority of material is dredged during the Spring phase.

The objective of this report is to evaluate and determine whether material dredged from Cleveland Harbor's Federal navigation channels in the upper Cuyahoga River Channel (between Station 799+00 and Station 736+00) meets Federal guidelines for open-lake placement. This evaluation is in accordance with the protocols and guidelines prescribed in the Great Lakes Dredged Material Testing and Evaluation Manual (USEPA/U.S. Army Corps of Engineers [USACE] 1998a) and Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.—Testing Manual (USEPA/USACE 1998b), and is specific to 40 CFR 230.11(d) ("contaminant determination") (USEPA 2013b). Further, it is consistent with 33 CFR 336 toward establishment of the Federal standard relating to the least costly dredged material management alternative, consistent with sound engineering practices and selected through

[1] Low Water Datum for Lake Erie is elevation 569.2 feet above mean water level at Rimouski, Quebec, Canada (International Great Lakes Datum [IGLD] 1985).

Section 404(b)(1) Guidelines (USACE 2013a).

2.0 SEDIMENT SAMPLING AND TESTING

This evaluation emphasizes 2012 analyses performed on sediment samples collected from Cleveland Harbor Federal navigation channels and two deep water open-lake areas in Lake Erie (USACE 2013b). It also considers relevant sediment data from 2007 (USACE 2007) and 2010 (Kreitinger *et al.* 2011).

2.1 2012 Investigation

2.1.1 Objective

The overall objective of the 2012 sediment sampling and analysis effort was to determine whether material dredged from Cleveland Harbor Federal navigation channels meets Federal guidelines (which includes compliance with applicable State water quality standards [WQSs]) for open-lake placement.

2.1.2 Sediment sampling

This investigation entailed the collection of bulk surface sediment grab samples from the Federal navigation channels, which were represented by discrete sites CH-1 through CH-37 (**Figures 1, 2 and 3**). In addition, surface sediment grab discrete samples were collected from two proposed, two square mile deep-water open-lake placement areas in Lake Erie; open-lake area CLA-1 (discrete sites CLA1-1 through CLA1-4) and open-lake area CLA-4 (discrete sites CLA4-1 through CLA4-4) (**Figure 4**). Discrete sediment samples were also composited into a dredged material management unit (DMMU)/composite, or open-water placement area samples as follows (see Figures 1 through 4): Federal navigation channel management units – composite DMMU-1 (discrete sites CH-1 through CH-5), composite DMMU-2a (discrete sites CH-6 through CH-10), composite DMMU-2b (discrete sites CH-11 through CH-15), composite MRR (discrete sites CH-16 through CH-20) and composite LRR (discrete sites CH-21 through CH-26) in the Cuyahoga River Channel; composite ORR (discrete sites CH-27 though CH-29) for the Old River Channel; and composite OHR (discrete sites CH-30 through 37) for the Outer Harbor channels; proposed open-water placement areas—composite CLA-1 (discrete sites CLA1-1 through CLA1-4) and composite CLA-4 (discrete sites CLA4-1 through CLA4-4). Finally, a single composite sample of sandy material

was collected from the dredged material contained in confined disposal facility (CDF) 10B in the Cleveland Outer Harbor (CDF comp).

2.1.3 Sediment analyses

The sediment samples were analyzed as follows:

a. Bulk sediment analyses

(1) ***Discrete samples*****—Discrete** sediment samples from the harbor and lake were analyzed for bulk grain size (sieve and hydrometer) and percent moisture, target analyte list (TAL) metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, thallium, vanadium and zinc), total cyanide (CN), ammonia-nitrogen (ammonia-N or NH_3), total phosphorus (TP), total Kjedlahl nitrogen (TKN), total organic carbon (TOC), polychlorinated biphenyls (PCBs) (as Aroclors), pesticides and polycyclic aromatic hydrocarbons (PAHs) (16 USEPA priority pollutants and methylnaphthalenes). In addition, discrete samples representing only DMMU-1, DMMU-2a, DMMU-2b, CLA-1 and CLA-4 were analyzed for percent organic matter, simultaneously extracted metals/acid volatile sulfide (SEM/AVS), benzene-toluene-ethylbenzene-xylenes (BTEX), solid-phase microextraction (SPME) fiber burdens and total extractable hydrocarbons.

The primary purpose of this bulk sediment testing was to identify any preliminary contaminants of concern (PCOCs) or contaminants of concern (COCs) in the dredged material and, should any toxicity be observed via biological testing, provide information concerning the potential cause of that toxicity at the benthic level.

(2) ***Composite samples*****—Composite** sediment samples from the harbor (DMMU-1, DMMU-2a and DMMU-2b only) and lake (CLA-1 and CLA-4) were also analyzed for bulk grain size (sieve and hydrometer) and percent moisture, TAL metals, CN, NH_3, TP, TKN, TOC, PCBs (as Aroclors and congeners [PCBs 1, 3, 5, 6, 7, 8, 9, 12/13, 14, 15/16, 17, 18, 19, 20, 22, 24, 25, 26, 27, 28/31, 29, 32, 33, 34, 35, 37, 40, 41, 42, 44, 45, 46, 47, 48, 49, 51, 52, 53, 54, 56, 59, 60, 63, 64, 66, 67, 69, 70, 71, 73, 74, 75, 77, 81, 82, 83, 84, 85, 87, 90/101, 91, 92, 93, 95, 97, 99, 100, 103, 104, 105, 107, 110/115, 114, 117, 118, 119, 122, 123, 124, 128, 129, 130, 131, 132, 134, 135, 136, 137, 138/163, 141, 144, 146,

147, 149, 151, 153, 154, 156, 157, 158, 164, 165, 167, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 183, 185, 187, 189, 190, 191, 193, 194, 195, 196, 197, 199, 200, 201, 202, 203, 205, 206, 207 and 208]), pesticides and PAHs (16 USEPA priority pollutants and methylnaphthalenes). The composite samples were analyzed for percent organic matter, SEM/AVS, SPME fiber burdens and total extractible hydrocarbons. In addition, sediment pore water was analyzed for 34 PAHs (USEPA 2003), a list including many of the most common parent PAH compounds and many alkylated PAH compounds frequently found in PAH mixtures.

b. Biological testing

(1) ***10-day Hyalella azteca and Chironomus dilutus toxicity tests (bioassays) (solid phase)***—10-day solid phase bioassays employing the test species *H. azteca* (amphipod) and *C. dilutus* (midge fly) were applied to harbor composite samples DMMU-1, DMMU-2a and DMMU-2b, and lake composite samples CLA-1 and CLA-4. The biological measurement endpoints for these tests were survival, and survival and growth, respectively. The primary purpose of these bioassays was to assess the potential toxicity of the dredged material to benthic organisms relative to lake bottom sediments.

(2) ***28-day Lumbriculus variegatus bioaccumulation (from sediment)***—28-day *L. variegatus* bioaccumulation tests for PCBs (analysis of the primary PCB congeners PCBs 1, 3, 5, 6, 7, 8, 9, 12/13, 14, 15/16, 17, 18, 19, 20, 22, 24, 25, 26, 27, 28/31, 29, 32, 33, 34, 35, 37, 40, 41, 42, 44, 45, 46, 47, 48, 49, 51, 52, 53, 54, 56, 59, 60, 63, 64, 66, 67, 69, 70, 71, 73, 74, 75, 77, 81/87, 82, 83, 84, 85, 90/101, 91, 92, 93, 95, 97, 99, 100, 103, 104, 105, 107, 110, 114, 115, 117, 118, 119, 122, 123, 124, 128, 129, 130, 131, 132, 134, 135, 136, 137, 138, 141, 144, 146, 147, 149, 151, 153, 154, 156, 157, 158, 163/164, 165, 167/185, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180/193, 183, 187, 189, 190, 191, 194, 195, 196, 197, 199, 200, 201, 202, 203, 205, 206, 207 and 208) were applied to harbor composite samples DMMU-1, DMMU-2a and DMMU-2b and lake composite samples CLA-1 and CLA-4. *L. variegatus* tissues from these experiments were also analyzed for residues of the pesticides dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethylene (DDE) and dichlorodiphenyldichloroethane (DDD). Lipid content in *L. variegatus* tissue was determined. The primary purpose of these experiments was to assess the PCB and ΣDDT bioaccumulation risks of placing material

dredged from these management units in the open-lake.

(3) ***48-hour Ceriodaphnia dubia and 96-hour Pimephales promelas bioassays (water column)***—48-hour *C. dubia* (water flea) and 96-hour *P. promelas* (fathead minnow) bioassays were performed on 100% elutriate from harbor composite sample DMMU-1, DMMU-2a and DMMU-2b. Survival was the biological measurement endpoint for both tests. If required, toxicity reduction evaluations (TRE) were performed for these water column bioassays (USEPA 1991). The primary purpose of these bioassays was to assess the toxicity of contaminants potentially released to the water column during dredged material placement in the lake/bay environs.

c. Elutriate testing

(1) ***Standard elutriate test (SET)***—SET on harbor (DMMU-1, DMMU-2a and DMMU-2b) and lake (CLA-1 and CLA-4) composite samples were run for TAL metals, CN, NH_3, TP, TKN, TOC, water hardness, total suspended solids (TSS) and turbidity. In addition, SET elutriates from harbor composite samples DMMU-1, DMMU-2a and DMMU-2b were analyzed for PCBs (as Aroclors), pesticides and PAHs (16 USEPA priority pollutants and methylnaphthalenes).

(2) ***Modified elutriate test (MET)***—MET on harbor composite samples DMMU-1, DMMU-2a, DMMU-2b, MRR, LRR, ORR and OHR were run for TAL metals, CN, NH_3, TP, TKN, TOC, water hardness, total suspended solids (TSS) and turbidity (Note: water hardness was not run on MRR, LRR, ORR and OHR composite samples). In addition, MET elutriates from harbor composite samples DMMU-1, DMMU-2a, DMMU-2b, MRR, LRR, ORR and OHR were analyzed for PCBs (as Aroclors), pesticides and PAHs (16 USEPA priority pollutants and methylnaphthalenes).

A lake water sample was analyzed for TAL metals, CN, NH_3, TP, ortho-phosphate, TKN, TOC, TSS, water hardness, turbidity, PCBs (as Aroclors), pesticides and PAHs (16 USEPA priority pollutants and methylnaphthalenes).

The primary purpose of the SET and MET was to quantify the potential release of contaminants from the dredged material during placement and ascertain compliance with applicable water quality standards (WQSs).

3.0 DREDGED MATERIAL EVALUATION

This evaluation focuses on material dredged from the upper Cuyahoga River Channel as represented by DMMU-1, DMMU-2a and DMMU-2b, and its placement at open-lake areas CLA-1 and CLA-4 in Lake Erie.

3.1 Site conceptual model

The site conceptual model for this activity focuses on potential contaminant-related adverse impacts to the aquatic ecosystem that would occur as a result of the discharge of the dredged material at the two deep-water open-lake areas designated as CLA-1 and CLA-4. Both areas are two square miles in area and are in water depths of between 50 and 60 feet. Aquatic habitats at these open-lake placement areas are similar and consist primarily of warmwater, mud-bottom (mainly silt/clay), benthic substrate with overlying water column. Open-lake area CLA-1 has been impacted as it was previously used for the placement of material dredged from Cleveland Harbor over 40 years ago. Bottom sediments at these areas are colonized by a community of benthic invertebrates that are relatively low in species diversity and dominated by oligochaetes and chironomids. The water column at these areas is used by most fish, nekton and plankton on a transient basis as required for foraging and migration. Aquatic birds use the water surface and water column on a transient basis for resting and foraging. Examples of key biological receptors at these open-lake areas include pelagic and/or demersal fish species such as walleye, yellow perch and rainbow smelt.

Under this dredged material management alternative, material from Cleveland Harbor would typically be mechanically dredged from the channel using a clamshell bucket, then placed in a scow for transport and discharged at a designated open-lake placement area. The dredged material is composed of sands, silts, clays and water with residual bulk concentrations of contaminants and organic matter. During discharge, dredged material is released from the scow and descends through the water column until it hits the bottom substrate, then collapses and spreads out before coming to rest on the lake bottom. Contaminant-related impacts can occur in both the water column and benthic environs, and are assessed mainly through toxicity and bioaccumulation endpoints relative to biological receptors. Typical exposure pathways between the dredged material and receptors would include uptake through absorption (bioconcentration) and absorption/ingestion (bioaccumulation), and trophic transfer through

bioaccumulation. With respect to contaminant-related impacts in the water column, effects require exposure to biota and include the release of dissolved contaminants from the dredged material and turbidity, both of which are short-term events. These effects are evaluated via comparison of sediment elutriate data with water quality standards after considering the effects of mixing, and by elutriate bioassays using a minnow and water flea as representative test species, and modeling. With respect to contaminant-related benthic impacts associated with the placed dredged material, effects require exposure to biota and include toxicity and bioaccumulation. These effects are evaluated through bulk sediment chemistry, solid phase bioassays using an amphipod and midge as representative test species, bioaccumulation experiments using an aquatic worm, and modeling. Regarding dredged material movement on the lake bottom, the placed sediment would behave in a manner similar to the adjacent and surrounding lake bottom sediments; deeper depths of the open-lake placement areas would serve to allay the potential for sediment erosion, resuspension and movement. However, some of the dredged material could migrate from the areas under severe storm conditions.

3.2 2012 Investigation

The initial step toward evaluating the toxicological effects of placing the dredged material in the open-lake is to compare bulk contaminant concentrations in the management unit samples to those from the open-lake placement areas. If any management unit contaminant concentration significantly exceeded open-water placement area sediment concentrations such that they would present a potential toxicological risk, it was identified as preliminary contaminant of concern (PCOC) or COC, and then subjected to further testing and/or evaluation.

3.2.1 Bulk sediment analyses

a. Physical testing

Table 1 presents the results of these analyses. The particle size data across the DMMU-1, DMMU-2a and DMMU-2b sediment samples show that the sediments are comprised of between about 4% (Site CH-2) to 96.9% (Site CH-13) silts and clays, with the remainder sands and gravels (average 63.7% sand/gravels; DMMU-1 composite 77% sands/gravels). Sediments within DMMU-1 and the immediately downstream Site CH-6 were more coarse-grain in nature, ranging from 37.3% (Site CH-5) to 95.5% (Site

CH-6) sands and gravels. Bottom sediments across the two open-lake placement areas were consistently fine-grain in nature, and composed of 87.8% (CLA1-comp) to 97.9% silts and clays (Site CLA1-2), with the remainder sands and gravels. Note that most of the sand present in the management units sediments was fine and was not much different in size than silt particles.

b. Chemical testing

(1) *Inorganic analyses*

(a) Metals—Table 2 presents the results of these analyses. The bulk concentration of most metals in sediment samples from DMMU-1, DMMU-2a and DMMU-2b were comparable or lower than those at one or both open-lake placement areas. With respect to open-lake placement areas CLA-1 and CLA-4, copper (76.7 mg/kg at Site CH-2) and nickel (139 mg/kg at Site CH-2) were the only notable exceptions. The copper concentration was not of significant toxicological concern. The concentration of nickel was about twice that of both open-lake placement area sediment concentrations and could potentially be of toxicological concern. Therefore, nickel was identified as a sediment COC at Site CH-2.

●*SEM/AVS*—AVS is regarded as a key sediment partitioning phase that binds cationic metals (cadmium, copper, lead, nickel, silver and zinc) to form insoluble sulfide complexes, thereby reducing their presence in sediment interstitial water and bioavailability (Di Toro *et al*. 1992).

SEM/AVS data on the DMMU-1, DMMU-2s and DMMU-2b sediment samples are summarized in Table 3. Methodology from USEPA (2005) was applied to determine whether an excess of SEM relative to AVS (on a molar basis) existed in these samples. Based on that methodology, the ΣSEM/AVS model holds that when the molar concentrations of metals exceeds that of AVS (i.e., the ΣSEM-AVS difference is greater than 0 µmol), the solid phase concentrations of metals may not be protective of benthic organisms.

Across the discrete samples in the management units, ΣSEM-AVS values ranged from being less than 0 (almost all) (excess AVS 20.5 µmol/g; Site CH-9) to 1.6 µmol/g (Site CH-2). For the discrete open-lake placement area samples, ΣSEM-AVS values ranged from less than 0 (most) (excess AVS 7.16 µmol/g; Site CLA1-4) to 0.58 µmol/g (Site CLA4-2).

Site CH-2 was the only management unit sample that showed an excess of SEM, and zinc (3.55 µmol/g) was the major contributor among the six metals (remaining ΣSEM=0.37 µmol/g). The sediment concentrations of nickel of 6.78 µg/g and 0.12 µmol/g were within the range of the other sites (range 4.5 µg/g and 0.08 µmol/g [Site CH-15] to 11.5 µg/g and 0.20 µmol/g [Site CH-1]), and about half of that measured in the sediment composite (9.95 µg/g and 0.17 µmol/g) which showed no significant toxicity (see paragraph 3.2.2). Based on this information, nickel at Site CH-2 was concluded to be insufficiently bioavailable to exert significant toxicity and was therefore eliminated as a sediment COC.

Further evaluation of the excess SEM and bioavailable zinc at Site CH-2 was necessary to decipher whether it had the potential to exert significant benthic toxicity at the open-lake placement areas. This is explained as follows:

◊<u>ΣSEM/AVS model and zinc toxicity</u>—This model predicts that no toxicity in sediment will occur if ΣSEM/AVS ≤ 1.0, although it is not intended to predict whether a sediment is toxic if ΣSEM/AVS > 1.0. While the AVS/SEM ratio of 1.68 at Site CH-2 exceeds 1.0, experiments using zinc-spiked freshwater field sediments found that ΣSEM/AVS ratios less than 2.0 will not be toxic (Burton *et al.* 2005). This suggests that zinc at Site CH-2 is not sufficiently bioavailable to induce significant toxicity to benthic organisms.

◊<u>ΣSEM-AVS model normalized to organic carbon (OC)</u>—Normalizing ΣSEM-AVS to OC content reduces variability associated with the prediction of sediment toxicity. The excess SEM through OC normalization yielded an ΣSEM-AVS/f_{oc} of 726 µmol/g_{oc}. This value falls within the OC-normalized excess SEM range of 130 µmol/g_{oc} to 3000 µmol/g_{oc} in which toxicity to benthic organisms is considered uncertain (toxicity associated with values below 130 µmol/g_{oc} is not likely) (USEPA 2005). However, the TOC concentration of 0.22% at Site CH-2 site was determined to be an outlier and estimated to be 1% (see paragraph 3.1.1[b][1][b]). Use of this corrected TOC content in this model then yields 160 µmol excess SEM/g_{oc}. This value falls within the extreme lower (almost 1%) 130 µmol/g_{oc} to 3000 µmol/g_{oc} range, suggesting low or insignificant toxicity. Further, this excess SEM also approaches 147.5 µmol/g_{oc} below which sediments were found to not be chronically toxic, although sediments with an excess of between 148 and 154 µmol/g_{oc} were shown to be variably toxic to benthic macroinvertebrates (Burton *et al.* 2005).

◊Spatial considerations—Site CH-2 shows isolated excess SEM. It was the only site within DMMU-1, DMMU-2a and DMMU-2b to yield excess SEM under the 2012 sampling event, and is flanked by Sites CH-1 and CH-3 with surplus AVS (ΣSEM-AVS = -3.88 µmol/g and -3.89 µmol/g, respectively). Further, no excess SEM was observed across this same harbor reach under the 2010 sampling event (i.e., ΣSEM-AVS range -0.66 µmol/g to -0.42 µmol/g) (Kreitinger *et al.* 2011). In reality, Sites CH-1, CH-2 and CH-3 are much more representative of a scow load of dredged material (e.g., 1500 cubic yards) than a single site. The surplus 6.17 µmol/g AVS across these sites exceeded the averages (but not composites) of sediments at both open-lake areas (CLA-1 average 3.58 µmol/g, composite 10.2 µmol/g; CLA-4 average 2.24 µmol/g, composite 24.5 µmol/g). Allowing for this spatial factor and when conservatively setting ΣSEM-AVS at Sites CH-1 and CH-3 to 0, an average ΣSEM-AVS/f_{oc} of 55 µmol/g_{oc} is yielded, which, while greater than the calculated excess SEM for the two discrete open-lake area placement sites, is well below the 130 µmol/g_{oc} (USEPA 2005) and 148 µmol/g_{oc} (Burton *et al.* 2005) values, indicating that chronic (and acute) toxicity is unlikely. Moreover, the considerable spatial difference between the CH-1 to CH-3 dredging reach (estimated 3.5 acres) and just one eighth of the open-lake placement areas (160 acres) assumed to offer excess SEM make this difference inconsequential.

Based on this information, zinc was not identified as a PCOC at Site CH-2.

(b) Other inorganics—Table 4 presents the results of these analyses.

●*TOC*—TOC content in the sediment samples from DMMU-1, DMMU-2a and DMMU-2b ranged from 0.22% (Site CH-2) to 2.4% (Site CH-12). The abnormally low TOC content at Site CH-2 was concluded to be an outlier because the POM to percent TOC ratio of 13.2 was clearly different than the ratios for the remaining sites analyzed (range 1.6 to 4.2) (Figure 5). Without the Site CH-2 value, POM to percent TOC ratios for all of the other sites were not statistically different (analysis of variance [ANOVA] least significant difference [LSD] test; α=0.05). Use of the average ratio of 2.9 without the TOC outlier yielded an estimated TOC content of 1% at Site CH-2. TOC content in the open-lake placement area sediment samples was very consistent and ranged from 1.9% (Site CLA4-4) to 2.6% (Site CLA1-1).

●*TP*—Concentrations of TP in the sediment samples from DMMU-1, DMMU-2a and DMMU-2b ranged from 400 µg/kg (Site CH-2) to 824 µg/kg (Site CH-11). In the open-lake placement area sediments, TP concentrations ranged from 683 µg/kg (Site CLA4-2) to 925 µg/kg (Site CLA1-1). TP concentrations in both harbor and open-lake placement area sediments were on the high end. However, none of the TP concentrations in the management unit sediments exceeded the maximum concentrations in the open-lake placement area sediments.

It should be noted that when evaluating TP in dredged material proposed for open-water placement, comparisons of bulk sediment concentrations to those at open-lake reference areas are relatively unimportant. The most important and relevant measurement endpoint for TP in the sediment is how much soluble reactive phosphorus (SRP) would be released to the water column during placement. SRP is the form of P that is most bioavailable to algae, including nuisance algae and cyanobacterium species such as *Microcytis aeruginosa* (plantonic algae) and *Lyngbya wollei* (filamentous, benthic, mat-forming algae) that are known to be involved in Lake Erie harmful algal blooms (HABs). SRP is usually not analyzed for, but within a given sample, it is a fraction of dissolved TP measured in a SET. A conservative assumption is 100% of the dissolved TP is SRP. Note that there is no functional relationship between TP in sediment and what is predicted to be released in the dissolved form to the water column during open-lake placement. However, typically, dissolved TP is less than 1% (usually orders of magnitude less than 1%) of the measured bulk TP. See paragraph 3.2.5 (a)(1)(b) for an evaluation of the TP SET data with respect to water quality and potential to influence HABs.

●*Ammonia*—Ammonia levels in the sediment samples from DMMU-1, DMMU-2a and DMMU-2b ranged from 25 µg/kg (Site CH-2) to 211 µg/kg (Site CH-13). Ammonia levels in the open-lake placement area sediments ranged from 60.4 µg/kg (Site CLA4-1) to 152 µg/kg (Site CLA1-2). Ammonia was identified as a COC at Site CH-5, and Sites CH-7 through CH-15 because concentrations significantly exceeded those in the open-lake placement area sediments. Ammonia is an atypical COC because it is not persistent. While it may be toxic to some benthic organisms in sediments at very high concentrations, ammonia can leach from dredged material during open-lake placement and temporarily reach high enough concentrations in the water column to become acutely toxic to fish (invertebrates are typically not as sensitive as fish to ammonia levels [USEPA 1999]). Therefore, ammonia toxicity is most appropriately characterized through the water column pathway and is addressed in

paragraph 3.2.5 (a)(1)(a).

●*TKN*—Concentrations of TKN in the sediment samples from DMMU-1, DMMU-2a and DMMU-2b ranged from 287 µg/kg (Site CH-2) to 2000 µg/kg (Site CH-8). In the open-lake placement area sediments, TKN concentrations ranged from 1850 µg/kg (Site CLA1-3) to 3900 µg/kg (Site CLA1-2). None of the TKN concentrations in the management unit sediments exceeded the maximum concentrations in the open-lake placement area sediments.

(2) *Organic analyses*

(a) PAHs—Table 5 presents the results of these analyses. Total PAH concentrations in the sediments samples from DMMU-1, DMMU-2a and DMMU-2b ranged from 0.84 mg/kg (Site CH-2) to 16.4 mg/kg (Site CH-8). At open-lake placement areas CLA-1 and CLA-4, total PAH concentrations in the sediment samples ranged from 2.07 mg/kg to 8.10 mg/kg and 1.64 mg/kg to 33.4 mg/kg, respectively. Total PAH concentrations at Sites CH-3 through CH-15 exceeded those relative to open-lake placement area CLA-1. Total PAH concentrations in all of the management unit samples were less than those at open-lake placement area CLA-4.

With respect to placement of the dredged material at open-lake placement area CLA-1, total PAHs at Sites CH-3 through CH-15 were further examined to determine if they should be of potential toxicological concern. The potential risk of PAH mixtures in these sediment samples to the freshwater amphipod *H. azteca* was estimated using hydrocarbon narcosis and equilibrium partitioning (EqP) models (USEPA 2003). Note that sediments typically contain a mixture of PAHs from both petrogenic and pyrogenic sources. In comparison to petrogenic PAHs, pyrogenic PAH compounds are often more persistent and less mobile and bioavailable in the environment, often resulting in lower toxicities (Gustaffsson *et al.* 1997). PAH mixtures that arise from pyrogenic sources often include forms of black carbon that exhibit strong partitioning behavior. Such mixtures strongly adsorb to this black carbon, thus limiting their concentration in interstitial water, and reducing mobility, bioavailability and toxicity (on a bulk sediment concentration basis) (e.g., Pastorok *et al.* 1994).

To decipher the predominant origin of PAH mixtures, PAH compound diagnostic ratios were calculated for the sediment samples collected at Sites CH-3, CH-5 and CH-7. These sites were used as a worst-case scenario in this case because they offered among the highest bulk total PAH concentrations coupled with the lowest TOC content. Neff *et al.*

(2005) recommends that fluoranthene/pyrene (FL/PY) and phenanthrene/anthracene (PH/AN) ratios both be used to aid in differentiating between sediment-associated pyrogenic and petrogenic PAHs. The FL/PY ratios for these sediment samples (range 2.15 [Site CH-5] to 3.25 [Site CH-7]) were all greater than 1.0, indicating that they were of pyrogenic origin. While the PH/AH ratios approach or exceeded 5 (range 4.78 [Site CH-3] to 7.03 [Site CH-5]) (Neff *et al*. 2005), a PAH profile showing a PH/AN ratio less than 10 are indicative of pyrogenic sources and PH/AN ratio greater than 15 are predominantly petrogenic in origin (Brown *et al*. 2008). Based on this information, it was concluded that the PAH assemblages were predominantly of pyrogenic origin.

The hydrocarbon narcosis and EqP models (USEPA 2003) assume that the risk of PAH mixtures to benthic organisms is attributable to the number of PAH toxic units that are freely dissolved in sediment pore water, and is used to calculate EqP Sediment Benchmark Toxic Units, Final Acute Value ($\sum ESBTU_{FAV}$) (USEPA 2003). The presence of TOC is an important partitioning parameter as it acts to sequester PAHs in the sediment phase, thus lowering the amount of PAHs available in the water phase. $ESBTU_{FAV}$s are calculated as follows:

$$ESBTU_{FAV} = \frac{C/f_{OC}}{C_{OC\ PAHi,\ FAVi}} \quad (1)$$

Where:
$C_{OC,\ PAHi,\ FAVi}$ = Final acute (FAV) concentration in sediment (µg/g_{OC}) (see USEPA 2003)
C = Concentration of PAH compound in sediment (µg/g dry weight)
f_{OC} = Decimal fraction of TOC in sediment (TOC) (µg/g_{OC} dry weight)

Freshwater sediments containing $\sum ESBTU_{FAV}$ <1.0 for a mixture of 34 or more PAH compounds are predicted to be acceptable for the protection of benthic organisms. Conversely, $\sum ESBTU_{FAV}$ ≥1.0 suggest that sensitive benthic organisms may be affected by the PAH mixture. USACE guidelines (USEPA/USACE 1998) emphasize acute toxicity tests for dredged material evaluations. This model employed $C_{OC,\ PAHi,\ FAVi}$ specific to *H. azteca* (Kreitinger, personal communication; USEPA 2003), which is one of two recommended test species used for standard acute toxicity tests in

dredged material toxicity evaluations (USEPA/USACE 1998a), and is anticipated to be more sensitive to PAHs than most other freshwater organisms (including *C. dilutus*). The $C_{OC\ PAHi,FAVi}$ values for *H. azteca* are based on an acute toxicity critical body burden of 13.9 µmol/g lipid, which is the geometric mean of the acute value for fluoranthene within the genus (GMAV) based on data originally published by Spehar *et al.* (1999) (see Appendix C of USEPA 2003). Use of this single critical body burden in the model is assumed to be valid because hydrophobicity-normalized toxicity is considered to be equivalent among Type I narcotic chemicals. The 13.9 µmol/g octanol GMAV for *H. azteca* has been confirmed in the literature. Hawthorne *et al.* (2007) predicted a critical body burden of 15 µmol/g lipid (lower 95% confidence interval) for 85% or greater survival when 97 field collected sediments were evaluated in 28-day laboratory tests and the dissolved PAH concentration in sediment porewater was determined by ASTM D7363 (Hawthorne *et al.* 2007). In addition, the lethal residue (LR_{50}) value of 33.0 µmol/g lipid determined by Hawthorne *et al.* (2007) using these 97 field samples was in very good agreement with the LR_{50} value of 32 µmol/g lipid determined in water only laboratory exposures using radio-labeled fluoranthene (Schuler *et al.* 2006).

The calculation of $C_{OC\ PAHi,FAVi}$ for individual PAH compounds was based on the following equation:

$$C_{OC\ PAHi,FAVi} = K_{OC} * MW * [10^{-0.945*\log(Kow)+\log(GMAV)}] \quad (2)$$

Where:
K_{OC} = Organic carbon-water partition coefficient for PAH compound
K_{OW} = Octanol-water partition coefficient for PAH compound
MW = Molecular weight of PAH compound, g/mol
GMAV = Geometric mean of acute toxicity (critical body burden) values for fluoranthene within the genus, 13.9 µmol/g lipid

For PAH mixtures at Sites CH-3, CH-5 and CH-7, an uncertainty factor of 3.6 with a confidence level of 95% (Hawthorne *et al.* 2006) was applied to the $\sum ESBTU_{FAV}$ because the analyses covered only the 16 USEPA priority pollutant PAH compounds, and because the PAHs were assumed to be predominantly of pyrogenic origin based on the diagnostic ratios. Calculated $\sum ESBTU_{FAV}$ across these sites were all less than 1 (range 0.63 [Site CH-7] to 0.77 [Site CH-5]), suggesting no unacceptable PAH-associated acute toxicity to *H. azteca* in these sediments. The

predicted low acute toxicity resulting from the total PAH concentration in these sediment samples is consistent with a no observed effect concentration (NOEC) of 17 mg/kg determined for Buffalo River Area of Concern (AOC) sediments (Kreitinger, personal communication) based on standard 10-day solid phase bioassay data using *H. azteca* and *C. dilutus*, with survival, and survival and growth, as the biological measurement endpoints, respectively (USEPA/USACE 1998a).

Table 6 summarizes sediment pore water concentrations of 34 PAH structures (18 non-alkylated parent compounds and 16 groups of generic alkylated forms) which have been identified as being generally most abundant in the environment and commonly measured (USEPA 2003). Sediment pore water concentrations of these compounds were measured as it is the phase that is bioavailable and has the potential to cause toxicity. Across the management units, calculated $\sum ESBTU_{FAV}$ (the chronic endpoint) ranged from <1 (DMMU-1) to 0.1 (DMMU-2a and DMMU-2b), indicating that PAH contamination in the sediments is sufficiently protective of benthic organisms.

Based on this information, total PAHs were not identified as a PCOC at Sites CH-3 through CH-15.

(b) PCBs

●*Aroclors*—Table 7 summarizes the results of these analyses. Aroclors 1248 and 1254 were usually detected in sediment samples from DMMU-1, DMMu2a and DMMU-2b, as well as from the two open-lake placement areas. Total PCBs (tPCBs) were determined by summing Aroclor 1248 and 1254 with non-detectable concentrations valued at the method detection limit (MDL). Across sites within the three management units, tPCB concentrations ranged from 33.3 µg/kg (Site CH-1) to 343 µg/kg (Site CH-3). Total PCB concentrations at Sites CLA-1 and CLA-4 were similar, ranging from 107 µg/kg to 150 µg/kg and 104 µg/kg to 157 µg/kg, respectively. Except for Site CH-3, all tPCB concentrations in the management unit sediments were below the maximum open-lake placement area sediment concentrations. On a TOC-normalized basis, concentrations at several sites across the three management units (range 8100 ng/g-TOC to 26385 ng/g-TOC) exceeded those of the maximum open-lake placement areas (6000 ng/g-TOC [CLA-1] and 7957 ng/g-TOC [CLA-4]). Based on this information, tPCBs were identified as a sediment COC.

●*Congeners*—Table 8 presents the results of these analyses on the

management unit and open-lake placement area composite samples. The majority of PCB congeners were non-detectable. Sum PCB (ΣPCB) concentrations were determined by summing all detected congeners and non-detecable congeners valued at one-half the MDL. In the management unit sediments, ΣPCB concentrations ranged from 147 µg/kg (DMMU-2a and DMMU-2b) to 149 µg/kg (DMMU-1). In the open-lake placement area sediments, ΣPCB concentrations ranged from 135 µg/kg (CLA-4) to 148 µg/kg (CLA-1).

Table 9 summarizes estimated tPCB concentrations using the congener data. Total PCB concentrations in the sediment samples were determined based on an assumption that the total of 209 congeners can be reliably estimated as follows (e.g., see Committee on Remediation of PCB-Contaminated Sediments *et al.* 2001; USEPA 2002a):

$$\text{tPCBs} = 2 \times \left(\Sigma\text{PCB } 8, 18, 28, 44, 49, 52, 66, 87, 101, 105, 118, 128, 138, 153, 170, 180, 183, 184, 187, 195, 206, 209\right) \quad (3)$$

Note that PCBs 184 and 209 were not included in the analysis and therefore could not be included in the estimates. These two congeners are not typically found in minnows, oligochaetes or carp (McFarland and Clarke 1989), suggesting low environmental concentrations and bioavailability. Recent analyses of Duluth-Superior Harbor sediments in which PCB 184 and PCB 209 were non-detectable in all harbor samples (<0.10 µg/kg to <0.16 µg/kg and <0.09 µg/kg to <0.13 µg/kg, respectively) are consistent with low environmental concentrations of these congeners (Futurenet Group 2012). Therefore, it was concluded that the absence of these congeners in the estimates had minimal effect on the results. In the tPCB estimations, non-detectable congener concentrations were assigned a value of one-half the MDL. Estimated tPCB concentrations in the Federal navigation channel DMMU sediments ranged from 112 µg/kg to 126 µg/kg. In the open-lake placement area sediments, estimated tPCB concentrations ranged from 122 µg/kg to 124 µg/kg. On a TOC-normalized basis, concentrations in all three management unit composite samples (range 8407 ng/g-TOC to 12625 ng/g-TOC) exceeded those of the maximum open-lake placement areas (4962 ng/g-TOC [CLA-1] and 5114 ng/g-TOC [CLA-4]). This result supported the identification of tPCBs as a COC.

(c) Pesticides—Table 10 summarizes the results of these analyses.

DDT, DDD and DDE were detected in the majority of the sediment samples from DMMU-1, DMMu2a and DMMU-2b, and DDD and DDE were detected in samples from the two open-lake placement areas. Sum DDT (ΣDDT) was determined by summing DDD, DDE and DDT with non-detectable concentrations valued at the MDL. Across sites within the three management units, ΣDDT concentrations ranged from 3.36 µg/kg (Site CH-1) to 26.3 µg/kg (Site CH-7). ΣDDT concentrations at CLA-1 and CLA-4 ranged from 7.89 µg/kg to 8.21 µg/kg and 8.88 µg/kg to 17.9 µg/kg, respectively. Except for Sites CH-1 and CH-2, and Sites CH-15 through CH-37 (except for CH-25), all ΣDDT concentrations in management unit sediments exceeded the maximum sediment concentrations at open-lake placement area CLA-1 and/or CLA-4. Based on this information, ΣDDT was identified as a sediment COC. Most other pesticides in the management unit sediments were undetectable at MDLs ranging from 0.003 µg/kg to 1.40 µg/kg. Dieldrin was measured at 8.96 µg/kg at Site CH-3. At Site CH-4, aldrin was measured at 42.9 µg/kg and gamma-chlordane was measured at 2.62 µg/kg at Site CH-6. Note that aldrin is often rapidly metabolized by many species to dieldrin (USEPA 1980), indicating that its ecological risk is better assessed as the more toxic metabolite. At Site CH-7, alpha-chlordane and beta-BHC were measured at 5.74 µg/kg and 4.18 µg/kg, respectively. None of these bulk concentrations are of significant toxicological concern.

(d) BETEX—Table 11 summarizes the results of these analyses. Except for toluene, none of the volatile organic compounds (VOCs) were detected at any of the sediment samples from DMMU-1, DMMu2a and DMMU-2b, or from the two open-lake placement areas, at MDLs ranging from 0.092 µg/kg to 92.7 µg/kg. Toluene was measured at concentrations ranging from 0.231 µg/kg (CH-1) to 14,500 µg/kg (CH-8), and well over those at the open-lake placement areas. Therefore, toluene was identified as a COC. Concentrations across the management units were very variable; geometric mean concentrations were 141 µg/kg (DMMU-1), 2225 µg/kg (DMMU-2a) and 221 µg/kg (DMMU-2b). Toluene is not bioaccumulative and tends to not be environmentally persistent, partitions to water and air, and volatilizes. There are several lines of evidence as to why such toluene concentrations would not be toxic in the aquatic environs:

●*Bioassays*

◊<u>Solid-phase bioassays</u>. The results of the two solid phase tests are discussed in paragraph 3.2.2 and did not evidence any significant sediment-associated acute toxicity. However, water in the bioassays

was periodically exchanged due to high ammonia levels, which also likely served to remove a portion of the toluene contamination. This process in the laboratory, however, can be regarded as having an effect similar to that which a field dredging operation would have on sediment-associated toluene contamination. Dredging with a clamshell bucket entrains water from the water column with the excavated material which would dilute released toluene. This material is then placed in a scow where a portion of the toluene would volatilize.

◊Water column bioassays. The results of the two water column bioassays are discussed in paragraph 3.2.5(b). One of the water column bioassays indicated some acute toxicity relative to elutriate associated with the DMMU-2a and DMMU-2b samples. However, the subsequent TRE and a review of the literature strongly suggest that the observed toxicity was attributable to ammonia, and therefore not associated with toluene.

●*Prediction of toxicity via narcotic modes of action*—USEPA (2008) derives Tier 2 equilibrium partitioning sediment benchmarks (ESBs) for nonionic organic compounds (including toluene) that are protective of freshwater benthic organisms. The EqP approach is used because it addresses compound bioavailability across different sediments and associates a concentration with biological effects at the benthic level. The calculated narcosis ESB is 810 $\mu g/g_{OC}$ and three orders of magnitude greater than the conventional freshwater/marine ESB of 5 $\mu g/g_{OC}$. The conventional approach uses secondary chronic values (SCVs) that incorporate higher uncertainties and the use of protective adjustments due to the absence of additional toxicity data (USEPA 2008), and as such, can yield very conservative values with a degree of uncertainty. First, generic secondary acute factors (SAFs) used to compute the conventional SCVs (range 2 to 242) are inappropriate and too high for narcotic chemicals (range >1.7 to 3.1), which directly translates into significant discrepancies among the two ESBs. Second, acute-chronic ratios (ACRs) used to convert secondary acute values (SAVs) to SCVs were higher for the conventional ESBs. For example, a default ACR of 18 (based on a variety of chemicals) was often applied for the conventional ESBs, and Di Toro *et al*. (2000a and 2000b) calculated an ACR of 5.09 specific to narcotic chemicals. Finally, the SVC for toluene also did not conform to the minimum requirement of using toxicity data from a single taxonomic family (e.g., daphnids). Using this information in combination with the strong agreement among narcosis ESBs and observed toxicity demonstrates that the toxicity of toluene is explained through the narcosis mode of action. Moreover,

toluene fell directly on the one-to-one line comparing observed vs. predicted LC_{50} (concentration causing 50% mortality) values (USEPA 2008). Therefore, it is concluded that the narcosis ESB is the most relevant ESB to gauge toluene toxicity.

Table 12 summarizes the calculated toluene narcosis EBSs in comparison to bulk sediment concentrations across the sediment samples from DMMU-1, DMMU-2a and DMMU-2b. With the exception of two discrete samples, none of the bulk sediment concentrations exceed the respective ESB. The two exceedances were at Site CH-5 at 10.8 µg/g (ESB 8.91 µg/g) and at Site CH-10 at 13.4 µg/g (12.2 µg/g). These excursions ranged from 10% to 21% and were concluded to be of minor consequence. First, these ESBs were a result of relatively higher toluene concentrations coupled with lower TOC content. Regardless of the toluene concentration, a modest 10% increase in f_{OC} would be required to generate ESBs that are comparable or lower to the bulk sediment concentration. Not only is this well within the range of generally accepted analytical variability, but TOC and toluene concentrations across the management units varied considerably. In fact, if just sites flanking CH-5 and CH-10 are considered, the average ESBs of 11.6 µg/g across Sites CH-4, CH-5 and CH-6 and 12.4 µg/g across Sites CH-9, CH-10 and CH-11 are well above the respective average bulk sediment toluene concentrations of 6.86 µg/g and 8.41 µg/g. Second, the geometric mean ESBs of 12.2 µg/g, 7.21 µg/g and 10.5 µg/g for DMMU-1, DMMU-2a and DMMU-2b, respectfully, all fall well below the corresponding bulk sediment concentrations of 0.25 µg/g, 4.9 µg/g and 0.76 µg/g. These geometric mean ESBs are 1.5 to 49 times higher than the bulk sediment toluene concentrations and given the dredging process, are the most representative of the dredged material that would be discharged.

It should be noted that ESBs do not consider the potential antagonistic, additive or synergistic toxicity resulting from the presence of other co-occurring chemicals in the sediments, particularly those with a narcotic mode of action due in part to their additive toxicity (USEPA 2003). Nevertheless, the bulk concentrations of other neutral organic compounds (NOCs) in the sediments were quite low, suggesting minimal contributions to overall narcotic potency. The results of both solid phase and water column bioassays support insignificant toxicity including via the narcotic mode of action. The hydrocarbon toxicity potential (HTP) discussion below more directly addresses this question.

●*HTP*—Solid-phase microextraction (SPME) is a sample preparation

technique involving the use of fiber coated with a liquid or sorbent (in this case, polydimethylsiloxane [PDMS]) to extract hydrophobic organic compounds (HOCs) from sediments in the laboratory. This technique measures the freely dissolved interstitial concentration (or chemical activity) of the HOC. SMPE was utilized to extract the bioavailable fraction of HOCs from DMMU-1, DMMU-2a and DMMU-2b composite samples, and used to estimate the total narcotic toxicity potential of the sediment samples. The HOC analysis using SPME includes analysis of the unresolved complex mixtures (UCM) of hydrocarbons that may be bioavailable; the UCM component represents weathered petroleum hydrocarbons, the aqueous aromatic fraction of which has been identified as a potentially significant source of narcotic toxicity to aquatic organisms (Scarlett *et al*. 2007). In addition to UCM of aromatic hydrocarbons, analysis of SPME fibers using the gas chromatography/flame ionization detection (GS/FID) method permits the quantitification of other HOCs (such as toluene) that may also contribute to narcotic toxicity.

SPME fiber concentrations can be correlated to organism body residues, allowing for the derivation of critical body burdens to assess the narcotic toxicity of petroleum hydrocarbon mixtures (and other HOCs) to a number of aquatic organisms (Pakerton *et al*. 2007 and 2009). SPME fiber burden concentrations relative to the DMMU-1, DMMU-2a and DMMU-2b sediment samples were expressed in millimoles of hydrocarbon per fiber (mM PDMS). HTP was then converted into toxic units (TUs) for *H. azteca* and *C. dilutus* where one TU is equivalent to 20 mM PDMS (Pakerton *et al*. 2007) and 66 mM PDMS (Pakerton *et al*. 2009), respectively. TUs ≤1.0 are acceptable for the protection of the benthic organism, while TUs >1.0 signify that the benthic organisms may be unacceptably affected. Table 13 summarizes the SPME fiber burden and TU results with corresponding bulk sediment toluene concentrations. Although there are no fiber burden/TU data for the maximum toluene concentration of 14.4 mg/kg measured at Site CH-8, the TUs for the DMMU-2a sample and remaining sites with the highest bulk concentrations (CH-10, CH-5 and CH-3; range 10.5 to 13.4 mg/kg) ranged from 0 to 0.5 and 0 to 0.2 for *H. azteca* and *C. dilutus*, respectively.

Toluene was determined to not be toxic because the maximum total HTP (including contribution from toluene) of the sediment samples relative to *H. azteca* and *C. dilutus* were 0.5 TU and 0.2 TU (DMMU-2a), respectively. These values are <1.0 and indicate that the dredged material would not be a significant source of narcotic toxicity to these sensitive benthic organisms.

Based on this information, toluene was eliminated as a COC.

3.2.2 Solid phase bioassays

The results of these tests are summarized in Table 14.

a. H. azteca—The mean survival of this test species exposed to the management unit samples ranged from 82±25% (DMMU-2b) to 94±6% (DMMU-1 and DMMU-2a), and were not statistically different than that associated with the open-lake placement areas (CLA-1 mean survival 84±15% [Dunnett's test; α=0.05]; CLA-4 mean survival 92±11% [Steel's many-one rank test; α=0.05]).

b. C. dilutus—The mean survival of this test species exposed to the management unit samples ranged from 80±7% (DMMU-1) to 90±10% (DMMU-2b), and was not reduced by more than 20 percent and not statistically different than that associated with the open-water placement areas (CLA-1 mean survival 90±10% [Steel's many-one rank test; α=0.05]; CLA-4 mean survival 88±5% [Dunnett's Test; α=0.05]). With respect to *C. dilutus* growth, mean biomass expressed as mean dry weight (MDW) exposed to the management unit ranged from 2.17±0.299 mg (DMMU-2b) to 3.51±0.116 mg (DMMU-1). All values exceeded those associated with the open-lake placement area MDWs as well as a MDW of 0.6 mg (USEPA/USACE 1998b).

These solid phase bioassay data did not show any significant acute or sublethal toxicity associated with the management unit sediments. These results indicate that placement of material dredged from DMMU-1, DMMU-2a and DMMU-2b at open-lake placement areas CLA-1 and CLA-4 would not result in any contaminant-related, unacceptable adverse impacts.

3.2.3 PCB bioaccumulation testing

Bioaccumulation was the most appropriate biological measurement endpoint for sediment-associated PCBs in this case. The results of this testing in terms of ∑PCB tissue residues are summarized in Table 15. Note that the summation of PCB congener concentrations for the statistical comparison of sum PCB tissue residues in management unit vs. open-lake reference area treatments was determined by first screening out congeners that were not detected across all of the treatment replicate samples. Of the remaining congeners, those

detected in less than five harbor management unit replicate samples were screened out. Congeners detected in only the open-lake reference area replicate samples, or congeners measured in the ppen-lake reference area replicate samples at higher concentrations relative to harbor management unit replicate samples, were also screened out. The purpose of this screening was an attempt to minimize the number of NDs for statistical comparison purposes. Based on this approach, the following 22 congeners were included in the PCB summation (note that this list is not the same as the list of 22 congeners utilized to predict tPCB concentrations [see below]): PCB 44, 52, 64, 66, 70, 75, 81/87, 90/101, 95, 97, 105, 107, 110, 118, 122, 138, 149, 151, 153, 163/164, 170 and 187. Mean ∑PCB residues in *L. variegatus* tissues exposed to the management unit samples ranged from 33.2±4.20 µg/kg (DMMU-2a) to 55.6±4.30 µg/kg (DMMU-1). For the open-lake placement area sediments, associated ∑PCB tissue residues ranged from 12.9±1.22 µg/kg (CLA-4) to 32.2±4.70 µg/kg (CLA-1).

Table 16 summarizes the predicted mean tPCB residues in *L. variegatus* tissues for all management unit samples and open-lake placement area sediments using the methodology contained in Committee on Remediation of PCB-Contaminated Sediments *et al.* (2001) and USEPA (2002a) and as shown in Equation 1. As with the tPCB concentrations predicted for the composite sediment samples (**see** Table 9), PCBs 184 and 209 were not included in the analysis and therefore could not be included in the estimates. For the management unit samples, predicted mean tPCB residues in *L. variegatus* tissues ranged from 50.6±6.0 µg/kg (DMMU-2a) to 72±8.2 µg/kg (DMMU-1). Predicted open-lake placement area mean tPCB residues in *L. variegatus* tissues ranged from 19.3±2.8 µg/kg (CLA-4) to 48.2±7.2 µg/kg (CLA-1). PCB bioaccumulation data relative to DMMU-1, DMMU-2a and DMMU-2b were interpreted as follows:

a. <u>Comparisons to open-lake placement areas</u>

Mean ∑PCB residues in *L. variegatus* tissues exposed to DMMU-1 (55.6±4.3 µg/kg), DMMU-2a (33.2±4.2 µg/kg) and DMMU-2b (36.6±2.7 µg/kg) samples were significantly greater relative to sediments at open-lake placement area CLA-4 (one-tailed LSD test; α=0.1). Further, mean ∑PCB residues in *L. variegatus* tissues exposed to the DMMU-1 sample was significantly greater relative to sediments at open-lake placement area CLA-1 (one-tailed LSD test; α=0.1). This indicates that material dredged from these management units requires additional evaluation for placement at the respective open-lake areas. For this

reason, tPCBs was retained as a COC in these management unit sediments relative to the respective open-lake placement area(s). Mean ∑PCB residues in *L. variegatus* tissues exposed to the DMMU-2a and DMMU-2b samples were not significantly greater relative to sediments at open-lake placement area CLA-1 (one-tailed LSD test; α=0.1).

b. Additional evaluation

USEPA/USACE (1998b) provides that when the bioaccumulation of contaminants from dredged material significantly exceeds that associated with an open-water reference area sediment, several other factors should be assessed (Section 6.3) to determine the acceptability of open-lake placement. These factors define the biological significance of the exceedance, and include such things as the toxicological importance of the contaminants, potential for effects at the observed concentrations, magnitude of increase observed, and concentrations found in species living in the vicinity of the proposed dredged material placement area.

(1) ***Tissue levels, toxicological significance and potential to biomagnify***—It is useful to place these benthic bioaccumulation data within the perspective of other Great Lakes dredging projects or open-lake reference/placement areas that have quantified and assessed sediment-associated PCB bioaccumulation. Table 17 summarizes predicted or measured PCB bioaccumulation data on oligochaetes associated with open-lake reference and placement areas in the Central Basin of Lake Erie, showing the variation and range of PCB bioaccumulation at the benthic level. Tissue residue predictions were based on Equation 1 or the theoretical bioaccumulation potential (TBP) model. TBP is an equilibrium theory-based algorithm used to predict the potential bioaccumulation of neutral, organic compounds, such as PCBs, in sediments (McFarland 1984) at the benthic level. This model is expressed as:

$$TBP = BSAF \times L \times (C_s/TOC) \quad (4)$$

Where:
TBP = Predicted whole body tissue concentration of tPCBs (µg/kg-wet weight)
BSAF = Biota-sediment accumulation factor

L = Concentration of lipid in target animal (decimal fraction of wet weight)
C_s = Concentration of tPCBs in sediment (µg/kg-dry weight)
TOC = Total organic carbon concentration in sediment (decimal fraction of dry weight)

The target animal used in this case is an oligochaete worm. In this model, a 1% lipid content, an average that is characteristically representative of oligochaete worms (e.g., Ankley *et al*. 1992, Pickard *et al*. 2001, USAERDC 2013a), a BSAF of 1.48 (USACE 2010), and PCB and TOC data from various sources were used.

Several conclusions can be drawn from the lake sediment-related tPCB oligochaete residue data contained in Table 17. First, the range of 50.6 µg/kg to 72 µg/kg and mean of 58.2 µg/kg predicted tPCB residues in *L. variegatus* exposed to the DMMU-1, DMMU-2a and DMMU-2b samples are quite comparable to the 57.8 µg/kg mean concentration measured in *L. variegatus* exposed to sediments at the actively used Ashtabula Harbor open-lake placement area (USACE 2010). Second, this range and mean are comparable to those for predicted and measured tissue residues associated with other open-lake reference areas in the Lake Erie Central Basin (range 19.1 µg/kg to 168 µg/kg; mean 59.1 µg/kg). Further, this range and mean are also comparable to those for only measured tissue residues associated with other open-lake reference areas in the basin (range 20 µg/kg to 168 µg/kg; mean 63.9 µg/kg). Collectively, this information shows that while the bioaccumulation of PCBs from the dredged material in oligochaetes (and other benthic invertebrates) may be statistically higher relative to Cleveland Harbor open-lake areas, it is still very comparable to or well within the range of background bioaccumulation of PCBs by oligochaetes across the basin.

Biomagnification is the process whereby the tissue concentration of a contaminant increases as it passes up the food web through two or more trophic levels. The biomagnification of PCBs varies among congeners. Table 15 shows that the tissue concentrations of almost all of the congeners in *L. variegatus* exposed to the management unit sediments were at higher concentrations relative to those exposed to open-lake placement area CLA-4 sediments. Nevertheless, few of these congeners (i.e., PCBs 81/87, 118, 105 and 138) were among the "dioxin-like" aryl hydrocarbon hydroxylase (AHH)-inducing PCBs. While PCB 126 is a potent AAH-inducer (pure 3-methylcholanthrene (MC)-type inducer), it was not analyzed for under the 2012 investigation but is also rarely detected

in biological tissues including oligochaetes (McFarland and Clarke 1989) in the parts per billion (ppb) range. AHH-inducing PCBs are structurally-similar to 2378-tetrachlorodibenzo-p-dioxin (TCDD), and include no ortho, two para and two or more meta chlorines, their mono-ortho analogs, and some di-ortho congeners. These congeners elicit similar toxic responses by promoting induction of AHH enzyme system in invertebrates which can result in weight loss, immunotoxicity, and adverse effects in reproduction and development. Trowbridge and Swackhamer (2002) found that 14 dioxin-like PCB congeners preferentially biomagnified in a lower-trophic-level food web relative to the remaining congeners. These AAH-inducing PCBs include congeners 81, 77, 123, 118, 114, 105, 138, 158, 128, 167, 156, 157, 169 and 189. Of these congeners (except for PCB 189 which was not analyzed for), only PCBs 81/87, 105, 118 and 138 were detected in *L. variegatus* tissues among the DMMU-1, DMMu-2a and DMMU-2b samples (assuming the co-eluting 87/81 congener was PCB 81). PCBs 81/87, 118 and 138 were also detected in *L. variegatus* tissues associated with one or both of the open-lake placement area sediments, but usually at lower concentrations. Similarly, PCBs 81, 105, 118 and 138 were also detected at lower concentrations in *L. variegatus* exposed to sediments from open-lake reference areas offshore of Ashtabula Harbor, Ohio (PCB 81 [up to 0.016 µg/kg], 105 [average 0.21 µg/kg], 118 [average 0.53 µg/kg] and 138 [average 1.8 µg/kg]) (USACE 2010). From this information, it can be inferred that PCBs 81, 105, 118 and 138 have the potential to biomagnify from benthic invertebrates associated with the management unit sediments. However, despite the potential to biomagnify, it is also noted that congeners 105, 118 and 138 should be of low toxicological concern. Van den Berg *et al.* (1998) does not include the di-ortho-substituted PCB 138 in its listing of congeners with assigned toxic equivalence factors (TEFs) because of insufficient evidence toward AHH receptor activity. Van den Berg *et al.* also concluded that fish are extremely insensitive to the mono-ortho-substituted PCBs 105 and 118 and, consequently assigned them the lowest TEFs for fish (0.000005). These data on relative toxicity of the congeners measured in *L. variegatus* tissue indicate that with the exception of the detection of PCB 87 (the concentration of which is ambiguous due to co-elution with PCB 87), the magnitude of total PCBs that have toxicological significance is low.

(2) *Magnitude by which bioaccumulation from the dredged material exceeds that associated with open-lake reference area sediments*—Analytical variability, along with all other sources of uncertainty in predicting PCB bioaccumulation into higher trophic level species, are important

considerations for the interpretation of laboratory test results. A statistically significant difference between mean bioaccumulation from dredged material and reference area sediments from laboratory tests may not be biologically or ecologically significant because it may simply fall within the range of natural variation. Therefore, the absolute difference in measured bioaccumulation should be considered in addition to a statistically significant difference. The magnitude of difference (MOD) between mean ∑PCB residues in *L. variegatus* tissues exposed to DMMU-1, DMMU-2a and DMMU-2b samples vs. sediments at open-lake placement area CLA-4 was 4.3, 2.6 and 2.8, respectively. Further, the MOD between ∑PCB residues in *L. variegatus* tissues exposed to the DMMU-1 sample and sediments at open-lake placement area CLA-1 was 1.7.

Standard guidance in American Society of Testing Materials (ASTM) (2010) indicates that a two-fold difference between tissue residues in test and reference sediments should in most cases provide a sufficient signal for potential ecological and human health concerns. This implies that tissue concentrations less than twice those of reference tissue concentrations should not be considered a *biologically* significant difference within the context of bioaccumulation evaluation of dredged material.

(3) *Spatially explicit screening-level exposure evaluation of bioaccumulation test data on dredged material*—Predictions of potential exposure to PCBs, and the associated risk to ecological receptors and human health, require explicit consideration of both spatial and temporal factors within food web models. For example, receptors may utilize habitat and consume organisms originating from the dredged material open-lake placement area will often utilize habitat and forage in other areas well outside of the placement area. Further, their diet is usually not comprised of 100% benthic organisms associated with dredged material placed at the open-lake placement area, either within or outside the placement area.

A spatially explicit screening-level exposure procedure has been developed to address the relatively small spatial area for dredged material placement compared to the overall area utilized by receptors to obtain food. This area is referred to as the receptor’s home range. Fish with a home range larger than the open-lake placement area will obtain only a fraction of their diet from the area influenced by the placement of dredged material, thus resulting in a reduction in net bioaccumulation compared to what is reflected in laboratory bioaccumulation experiments alone. The following equation provides a

simple way to mathematically express this concept by using an area-weighted average concentration for prey species:

$$C_o = \frac{\left[(HR - \{PA+FPA\})(C_r)\right] + \left[(PA)(C_{dm})\right] + \left[(FPA)(C_{dmfpa})\right]}{HR} \quad (5)$$

Where:
C_o = Estimated PCB tissue residue in oligochaete populations across fish species' home range (µg/kg-wet weight)
HR = Assumed home range of fish species of interest (in same units as area of open-water placement site)
PA = Assumed area of dredged material placement site (in same units as receptor's home range)
FPA = Assumed area of formerly used dredged material placement site (in same units as receptor's home range)
C_r = Measured PCB tissue residue in *L. variegatus* exposed to open-water reference/placement area sediments (µg/kg-wet weight)
C_{dm} = Measured PCB tissue residue in *L. variegatus* exposed to dredged material (µg/kg-wet weight)
C_{dmfpa} = Measured PCB tissue residue in *L. variegatus* exposed to dredged material at former placement area (µg/kg-wet weight)

The use of this equation requires a receptor species and an estimate of its home range. In this case, yellow perch (*Perca flavescens*) and walleye (*Sander vitreus*) were used as receptor species'. *P. flavescens* was selected as a receptor species for several reasons: (1) it utilizes and forages in the water column and benthic habitat at the open-lake placement area (e.g., Smith 1985); (2) it is a top sport and commercial species in Lake Erie; (3) it is native and ecologically integral to the lake; (4) it a favorite for human consumption; and (5) its diet has a direct benthic link (e.g., Smith 1985). *S. vitreus* was selected as a second receptor species because: (1) it utilizes water column at the open-lake placement area); (2) it is a top sport and commercial species in the lake; (3) it is native and ecologically integral to the lake; (4) it a favorite for human consumption; and (5) it is a top predator species (e.g., Smith 1985).

A minimum and conservative home range for *P. flavescens* in Lake Erie was estimated based on Lake Michigan *P. flavescens* mark-recapture data

contained in Glover *et al.* (2008). A conservative estimate for the home range of *P. flavescens* was developed by assuming an elliptical-shaped area based on minimum observed mark-recapture distances. The home range estimate for individuals recaptured from various locations was determined to be:

(6)

$$HR_{cs} = \pi\left[(\{N_S x0.5\}+\{N_{ns} x0.5\})/2 + (\{S_s x0.5\}+\{S_{ns} x0.5\})/2\right] \times \left[(\{E_s x0.5\}+\{E_{ns} x0.5\})/2 + (\{W_s x0.5\}+\{W_{ns} x0.5\})/2\right]$$

Where:
HR_{cs} = Estimated cross-season home range (km^2)
π = 3.14
N_S = Average north distance traveled from tagging site in summer (km)
N_{NS} = Average north distance traveled from tagging site in non-summer (km)
S_s = Average south distance traveled from tagging site in summer (km)
S_{ns} = Average south distance traveled from tagging site in non-summer (km)
E_S = Average east distance traveled from tagging site in summer (km)
E_{ns} = Average east distance traveled from tagging site in non-summer (km)
W_s = Average west distance traveled from tagging site in summer (km)
W_{ns} = Average west distance traveled from tagging site in non-summer (km)

Table 18 presents the home range calculations. Note that Glover *et al.* (2008) showed some lacking recaptures in the north and south directions, and few recaptures in the east and west directions. If any directional distance value was lacking, the single remaining distance traveled was used in lieu of a mean toward determining a cross-seasonal directional distance traveled. Further, if a mean X- or Y-distance was lacking for the purposes of computing an estimated site-specific home range, an arbitrary distance of 3.2 km (2 miles) was utilized. The minimum estimated home range was at the Indiana 1 (IN-1) tagging site at 46.5 km^2 or 18 mi^2. This minimum home range was used as the basis for developing area-weighted exposure estimates for *P. flavescens*. While this estimation of home range should not be assumed to be accurate, it is nevertheless conservative in the intended application

based on the following: (1) it uses the minimum cross-season home range value generated (range 18 mi^2 to 69.4 mi^2); (2) it assumes that the home range is simply elliptical based on mark-recapture data when it is likely that the home range is much wider and longer, and irregularly shaped, and therefore significantly greater in spatial extent; (3) as a default value, it assumes a minimal width of two miles; and (4) it is less than other conservative home range estimates for this species of 25.1 mi^2 and 50.2 mi^2 mi to 60.8 mi^2 based on mark-recapture distance data from Lake Michigan at Port Washington, Wisconsin (Smith and Van Oosten 1940) and Green Bay, Wisconsin (Mraz 1950; Glover *et al.* 2008), respectively, using an assumed width (semi-minor axis) of one mile for the elliptical home range.

For **Equation 5**, 18 mi^2 and 51.8 mi^2 home range estimates were used for *P. flavescens* and *S. vitreus*, respectively. The home range for *S. vitreus* was conservatively based on data from Wang *et al.* (2007) by applying **Equation 6** using a calculated 33 mi mean minimum linear distance moved by males in Lake Erie and an assumed semi-minor axis of one mile for the elliptical home range. If it is assumed that the "footprint" of dredged material placement is one square mile resulting in oligochaete ΣPCB bioaccumulation equal to 55.6 µg/kg (using sediments from DMMU-1 as the worst-case scenario) and the remaining area of the fish home range offers oligochaete populations with ΣPCB tissue residues of 12.9 µg/kg (conservatively using open-lake area CLA-4), including within it a one square mile area with oligochaete populations with ΣPCB tissue residues of 32.2 µg/kg (i.e., at CLA-1), this results in an average oligochaete tissue exposure level of 16.3 and 14.1 µg/kg for *P. flavescens* and *S. vitreus*, respectively (Table 19). These values are comparable to the mean ΣPCB tissue concentration of 12.9 µg/kg in *L. variegatus* exposed to the open-lake area sediments and approach or are within the generally accepted range of analytical variability alone (e.g., ±20%).

A spatially-explicit screening-level exposure comparison (SESLEC) approach has been developed that can be applied to conservatively identify the need for more extensive, complicated and costly dredged material evaluations. This approach generates a value referred to as a bioaccumulation exposure factor (BEF), which is a spatially weighted average concentration in prey benthic invertebrate tissues (oligochaetes in this case) after dredged material placement, divided by the spatially weighted average concentration in oligochaete tissues prior to placement. A BEF of 2 or greater indicates that exposure to PCBs via bioaccumulation after dredged material placement is expected

to be twice that associated with open-water placement area sediments. A BEF of less than 2 indicates that the exposure of receptors to PCBs as a result of dredged material placement is less than two times higher than that associated with the open-water reference area sediment condition, and that such bioaccumulation is not predicted to result in unacceptable risk to fish, wildlife and human health via bioaccumulation (see ASTM 2010). This model is essentially a simplification of the dietary exposure portion of the TrophicTrace bioaccumulation model (USAERDC 2013a). The BEF is expressed as follows:

$$BEF = \frac{C_o}{C_r} = \frac{\left[([PA/HR] \times C_{dm}]) + ([FPA/HR] \times C_{dmfpa}])\right] + \left[([HR - \{PA+FPA\}]/HR) \times C_r)\right]}{C_r} \quad (7)$$

Where:
C_o = Estimated PCB tissue residue in oligochaete populations across fish species' home range (µg/kg-wet weight)
PA = Assumed area of dredged material placement site (in same units as receptor's home range)
C_{dm} = Measured mean PCB tissue residue in *L. variegatus* exposed to dredged material (µg/kg-wet weight)
FPA = Assumed area of former dredged material placement site (in same units as receptor's home range)
C_{dmfpa} = Measured mean PCB tissue residue in *L. variegatus* exposed to dredged material at former placement area (µg/kg-wet weight)
C_r = Measured mean PCB tissue residue in *L. variegatus* exposed to open-water reference/placement area sediments (µg/kg-wet weight)
HR = Assumed home range of receptor species (in same units as area of open-lake placement site)

This equation was applied using *P. flavescens* and *S. vitreus* as the receptor species'. Assumptions included that a one square mile placement area results in oligochaete tPCB bioaccumulation equal to 55.6 µg/kg (again using sediments from DMMU-1 as the worst-case

scenario), a one square mile area of dredged material lake bottom from the former open-lake placement area CLA-1 with oligochaete populations with tissue residues of 32.2 µg/kg, and the remaining area of the fish home range offers oligochaete populations with tPCB tissue residues of 12.9 µg/kg (open-lake area sediments CLA-4 sediments). This yields tPCB BEFs of 1.27 and 1.10 for *P. flavescens* and *S. vitreus*, respectively (Table 20). Such BEFs, which are based on a worst-case scenario, are not substantially greater than 1 and either approach or are within the generally accepted range of analytical variability. Further, these BEFs are much less than the two-fold difference between tissue residues in test and reference sediments that is a sufficient signal for potential ecological and human health concerns (ASTM 2010). This indicates that the placement of material dredged from DMMU-1, DMMU-2a and DMMU-2b at open-lake area CLA-4 would result in negligible PCB exposure risk with respect to fish, wildlife and human health. If the placement of material dredged from DMMU-1 was spatially limited within open-lake placement area CLA-4 to a two-third square mile area (this assumes no dispersal of the dredged material after placement), the resulting BEF would be reduced to 1.20 and fall within the generally accepted range of analytical variability. This would be a conservative measure.

3.2.4 DDT/DDD/DDE bioaccumulation testing

Bioaccumulation was the most appropriate biological measurement endpoint for sediment-associated DDT/DDD/DDE in this case. The results of this testing in terms of ∑DDT tissue residues are summarized in Table 21. With one exception, DDT metabolites 4,4'-DDE and 4,4'-DDD, were the only isomers detected in *L. variegatus* tissues. Therefore, a summation of only these isomers was used as ΣDDT tissue residues. Mean ∑DDT residues in *L. variegatus* tissues exposed to the DMMU samples ranged from 3.41±0.38 µg/kg (DMMU-2a) to 5.64±0.66 µg/kg (DMMU-2b). For the open-lake placement area sediments, associated ∑DDT tissue residues ranged from 2.65±2.2 µg/kg (CLA-4) to 5.40±0.55 µg/kg (CLA-1).

a. <u>Comparisons to open-lake placement areas</u>

Mean ∑DDT residues in *L. variegatus* tissues exposed to DMMU-1 (5.3±0.36 µg/kg) and DMMU-2b (5.64±0.66 µg/kg) samples were significantly greater relative to sediments at open-lake placement area CLA-4 (one-tailed LSD test; α=0.1). This indicates that material dredged from these two DMMUs requires additional evaluation for placement at open-lake area

CLA-4. For this reason, ∑DDT was retained as a COC in these management unit sediments. Mean ∑DDT residues in *L. variegatus* tissues exposed to the DMMU-1, DMMU-2a and DMMU-2b samples were not significantly greater relative to sediments at open-lake placement area CLA-1 (one-tailed LSD test; α=0.1). In addition, mean ∑DDT tissue residues exposed to the DMMU-2a sample were not significantly greater relative to sediments at open-lake placement area CLA-4 (one-tailed LSD test; α=0.1).

b. Additional evaluation

In addition to PCBs, ΣDDT was the second contaminant found to bioaccumulate in *L. variegatus* from the dredged material to levels that were statistically greater relative to one or both of the open-lake placement area sediments. PCBs and ΣDDT were both identified as bioaccumulative PCOCs in the dredged material (except for the ΣDDT for the DMMU-2a sample). PCBs were subsequently eliminated as a COC.

As with PCBs, several factors were used to assess the biological significance of the exceedance of ΣDDT bioaccumulation relative to open-lake placement area CLA-4 (USEPA/USACE 1998b). These include toxicological importance of the contaminants, potential for effects at the observed concentrations, magnitude of increase observed, and concentrations found in species living in the vicinity of the proposed dredged material placement area.

(1) *Tissue levels, toxicological significance and potential to biomagnify*—DDT and its metabolites biomagnify. However, ΣDDT tissue residues observed in *L. variegatus* associated with the DMMU-1 and DMMU-2b samples (range 5.3 µg/kg to 5.6 µg/kg) were low. Total DDT in Lake Erie walleye are declining and are below a Great Lakes Water Quality Agreement (GLWQA) tissue criterion of 1 mg/kg for top predator fish (USEPA 2013b). According to Rowan and Rasmussen (1992), DDT was found to range in mid to higher trophic level fish from 90 µg/kg (e.g., emerald shiner [*Notropis atherinoides*], rainbow smelt [*Osmerus mordax*]) to 1220 µg/kg (e.g., *P. flavescens*, *S. vitreus*, coho salmon [*Oncorhychus kisutch*]).

(2) *Magnitude by which bioaccumulation from the dredged material exceeds that associated with open-lake reference area sediments*—A statistically significant difference between mean bioaccumulation from dredged material and reference area sediments from laboratory tests may not be biologically or ecologically significant because it may simply fall within the range of natural variation. Therefore, the absolute

difference in measured bioaccumulation should be considered in addition to a statistically significant difference. The MOD in reference to CLA-4 for the DMMU-1 and DMMU-2b samples was 2 and 2.2, respectively. These differences approach the less than two-fold difference between tissue residues in test and reference sediments that is a sufficient signal for potential ecological and human health concerns (ASTM 2010).

(3) ***Spatially explicit screening-level exposure evaluation of bioaccumulation test data on dredged material***—Predictions of potential exposure to DDT and its metabolites, and risk to ecological receptors and human health, require explicit consideration of both spatial and temporal factors within food web models. Therefore, the SESLEC was employed to evaluate the potential exposure of receptors to ∑DDT residues in oligochaetes residing in dredged material discharged from DMMU-1 and DMMU-2b. As with tPCBs, *P. flavescens* and *S. vitreus* were evaluated as the receptors. *P. flavescens* and *S. vitreus* in and around the open-lake placement areas are expected to have minimum home ranges of 18 mi^2 (based on data from Glover *et al.* 2008) and 51.8 mi^2 (based on data from Wang *et al.* 2007). **Equation 5** was first applied to demonstrate that only a fraction of these receptors' diet could potentially be exposed to dredged material placed at open-lake area CLA-4. If it is assumed that the "footprint" of dredged material placement is one square mile, the presence of the dredged material from DMMU-2b (as a worst-case scenario) at CLA-4 resulting in oligochaete ∑DDT bioaccumulation equal to 5.64 µg/kg and the remaining area of the fish home range offers oligochaete populations with tissue residues of 2.65 µg/kg (including dredged material from the former open-lake placement area [CLA-1] with oligochaete populations with tissue residues of 5.40 µg/kg), this results in average oligochaete tissue exposure levels of 2.95 µg/kg and 2.75 µg/kg for *P. flavescens* and *S. vitreus*, respectively (Table 22). These values are comparable to the mean ∑DDT tissue concentration in *L. variegatus* of 2.65 µg/kg exposed to the open-lake area sediments and the difference between them is well within the generally accepted range of analytical variability.

Application of the BEF model (**Equation 7)** with the assumptions that a one square mile placement area results in oligochaete ΣDDT bioaccumulation equal to 5.64 µg/kg (using dredged sediments from DMMU-2b as the worst-case scenario) and the remaining area of the fish home ranges offer oligochaete populations with ΣDDT tissue residues of 2.65 µg/kg (within which a one square mile area at CLA-1 offers oligochaete populations with ΣDDT tissue residues of 5.40 µg/kg) yields BEFs of 1.12 and 1.04 for *P. flavescens* and *S. vitreus*, respectively (Table

23). Such BEFs, which are based on a worst-case scenario, are not substantially greater than 1 and well within the generally accepted range of analytical variability. Further, these BEFs are almost half the two-fold difference between tissue residues in test and reference sediments that is a sufficient signal for potential ecological and human health concerns (ASTM 2010). This indicates that the placement of material dredged from DMMU-1 and DMMU-2b at open-lake area CLA-4 would result in negligible ΣDDT exposure risk with respect to fish, wildlife and human health.

3.2.5 Elutriate testing

a. SET/MET

(1) ***Metals and other inorganics***—Tables 24 and 25 summarize the results of this testing for metals and other inorganics, respectively. The elutriate data show low to moderate releases of metals and other inorganics. Dissolved (i.e., SET-F) ammonia-N concentrations in the management unit elutriates ranged from 7.1 mg/L (DMMU-1) to 16.8 mg/L (DMMU-2a). Therefore, ammonia was identified as a water column PCOC and would require dilution during dredged material discharge operations.

(a) Ammonia-N—The average dissolved ammonia level in sediment elutriate across management unit samples was 11.5 mg/L (Table 25). Fairchild *et al.* (2005) exposed several fish species to ammonia in the laboratory over a chronic 28-day duration. The most sensitive fish species was *P. promelas* exposed as 4-day olds. For this species, they reported a no observed effect concentration (NOEC), lowest observed effect concentration (LOEC) and chronic value (ChV; the geometric mean of the NOEC and LOEC) of 0.31, 0.60 and 0.43 mg/L unionized ammonia (NH_3), respectively. At 25°C and the reported pH of 8.34, this ChV equates to a total ammonia concentration of approximately 6.3 mg/L. The ChV is considered a protective value (Adams and Rowland 2002) and is very conservative in terms of evaluating acute exposures associated with the discharge of dredged material from a scow. Fairchild *et al.* (2005) also reported no *P. promelas* mortality after a shorter seven day exposure period to 0.31 mg/L NH_3 which translates to 3.7 mg/L total ammonia at 25°C. Therefore, after immediate mixing in the water column (see next paragraph), ammonia released from these sediments would not be of any significant concern with respect to fish toxicity.

The Short-Term (ST)-Fate simulation model was employed to predict and evaluate the release of contaminants to the water column during discharge of dredged material in the open-water. Modeling assumptions include (1) clamshell bucket (mechanical) dredging with discharge of the dredged material via scow; (2) mechanically dredged material with a solids content of 45% (about 10% less than *in-situ* material due to water entrained during dredging); (3) use of a 1500 cubic yard (CY) scow with a bin that is 120 ft x 30 ft x 12 ft; (4) dredged material is a single dump from a slowly moving vessel over a one-minute period; (5) use of a single rectangular two-square mile open-lake placement area in a west-to-east direction with minimum depths of 50 ft; (6) a uniform water column density of 0.999; (7) five depth-averaged current velocities (0.33, 0.66, 0.98, 1.31 and 1.64 feet per second [fps]); (8) the dredged material was free of clumps in DMMU-1, but was predicted to have 37% clumps by volume in DMMU-2a and 41% clumps by volume in DMMU-2b; and (9) volumetrically, the dredged material in DMMU-1 was 57% water, 0% clumps, 33% sand, 9% silt and 1% clay, the dredged material in DMMU-2a was 47% water, 37% clumps, 4% sand, 11% silt and 2% clay, and the dredged material in DMMU-2b was 44% water, 41% clumps, 1% sand, 13% silt and 1% clay; and (10) all fractions except clumps are stripped in the water column with the silt/clay fractions being cohesive. The results of the ST-Fate model runs are presented in USAERDC (2013b).

Assuming a maximum ammonia-N release of 16.8 mg/L (worst-case) from the dredged material discharge and lake water background ammonia concentration of 0.03 µg/L, the ST-Fate model run indicated that the effluent would achieve an OMZM WQS of 2.9 µg/L for the Protection of Aquatic Life (OEPA 2013) during the first two minutes after discharge within the actual discharge footprint and well within the boundaries of the placement areas.

In summary, ample water column mixing for ammonia is available at both open-lake placement areas CLA-1 and CLA-4. Based on this information, ammonia was eliminated as a water column COC.

(b) TP—Dissolved TP in sediment elutriate across management unit samples ranged from 0.07 mg/L (DMMU-1) to 0.12 mg/L (DMMU-2b). However, the measured concentrations in Table 25 were adjusted to estimated dissolved values because measureable levels of TSS were detected in the elutriates, indicating that a fraction of the measured filtered TP was not truly dissolved and bioavailable. ST-Fate modeling of both filtered and dissolved TP releases showed that all water quality standards for filtered/dissolved TP (as low as 0.007 mg/L)

would be met within 5 minutes and 400 feet of the discharge, even when considering a background filtered TP concentration of 0.005 mg/L. Also note that a portion of the measured dissolved TP includes that associated with dissolved organic carbon (DOC), which is not truly bioavailable.

●*Potential of sediment TP release during dredged material placement to influence HABs*—A detailed evaluation of the potential of TP releases from open-lake placement of material dredged from DMMU-1, DMMU-2a and DMMU-2b to influence HABs is presented in USAERDC (2013c). Several water column TP criteria (both dissolved [filtered] and total [unfiltered]) for surface waters were developed to address this question when considering the range, data and uncertainty in dissolved TP values examined: (1) 7 µg/L of dissolved TP, which is considered a conservative value below which little chance for cyanobacteria dominance in algal biomass; (2) 10 µg/L of dissolved TP, which is considered a more realistic value above which the frequency of cyanobacteria dominance over algal biomass increases (this is a mean annual TP concentration goal for the Central Basin established under the Great Lakes Water Quality Agreement [GLWQA]); (3) 20 µg/L of total TP based on an increasing trend of cyanobacteria dominance above 20 µg/L dissolved TP; (4) 35 µg/L of total TP based on a probability of cyanobacteria dominance increasing sharply above 35 µg/L dissolved TP; and (5) 50 µg/L of total TP based on a conservative total TP concentration estimate required to yield 26 µg/L concentration of Chlorophyll a (Chl-*a*) at which most people would tend to recognize a surface water algal bloom. This last criterion assumes that the Chl-*a* yield from TP is less than 0.52 g Chl-*a*/g TP, which is a highly conservative estimate for potential chlorophyll yield in pre-*Dreissena* invaded Lake Erie water. The yield of Chl-*a* yield in the presence of dreissenids can be almost an order of magnitude lower at 0.069 g Chl-*a*/g TP (Nicholls *et al.* 1999).

ST-Fate modeling of filtered/dissolved TP elutriate showed that a dissolved water column TP concentration of 7 µg/L would be achieved after five minutes within a maximum area of 354 x 148 ft, and that plume concentrations would rapidly dissipate below this concentration over time. Although it is clear that the dissolved TP plume decays rapidly to the criteria of 10 µg/L and 7 µg/L, note that a SRP concentration (SRP is a fraction of dissolved TP) of 30 µg/L has been shown to be a critical value to avoid the development of *Microcystis* blooms (Wetzel 2001). With respect to unfiltered TP elutriate, the modeling showed that a total TP water column concentration of 50 µg/L

would be achieved after five minutes within an area of 320 x 125 ft, and that plume concentrations would rapidly dissipate below this concentration over time. Within 32 minutes, unfiltered TP concentrations between the 20 µg/L to 35 µg/L range would be readily achieved in the plume within areas of 1107 x 206 ft and 391 x 141 ft, respectively.

In summary, ample water column mixing for TP is available at both open-lake placement areas CLA-1 and CLA-4. The extent and duration of the predicted TP plumes within the boundaries of open-lake placement areas CLA-1 and CLA-4 are very short-lived and small. Modeled TP plumes at concentrations sufficient to stimulate a HAB (based on conservative criteria for both filtered and unfiltered concentrations) would be inadequate to trigger or pose an effect on the occurrence of HABs, or to significantly impact water quality in the Central Basin of Lake Erie.

(2) ***PAHs***—Table 26 summarizes the results of this testing. Various dissolved PAH compounds were detected in the elutriates at very low concentrations.

(3) ***PCBs***—Table 27 summarizes the results of this testing. Dissolved Aroclors were not detected in any of the elutriates at an MDL of 0.03 µg/L.

(4) ***Pesticides***—Table 28 summarizes the results of this testing. Dissolved pesticides were not detected in any of the elutriates at an MDL of 0.001 µg/L.

(5) ***Toluene***—Toluene was not measured in any of the elutriate tests. In lieu of elutriate data for toluene, conservatively predicted sediment elutriate concentrations were used to estimate concentrations that would be released from the dredged material to the water column during discharge. This approach can also be used to gauge the bioavailability of toluene because of its relatively low hydrophobicity (log K_{OW} = 2.7) and chemical potential of toluene to be more in the dissolved phase. Since a significant amount of the residual toluene measured in the sediments would be lost during the dredging process and storage of the dredged material in the scow, such estimates should be considered to be conservative. A conservative sediment organic carbon/water partition coefficient (K_{OC}) for toluene was selected from the literature; specifically, the geometric mean of 140 L/kg across 12 measured values reported in USEPA (2002b). A DMMU-specific dissolved

concentration of toluene (K_d) was then calculated for each management unit using a sediment-specific K_d computed using the K_{oc} and composited TOC. Next, the total toluene concentration in the simulated elutriate slurry was calculated from a 1:4 dilution of the composited sediment using a volume based compositing of the dry bulk densities and bulk sediment concentrations. The dissolved fraction of the total toluene concentration was calculated for equilibrium conditions based on the simulated solids concentration and the K_d of each DMMU. The fraction dissolved was about 97% for all three management units.

Bulk sediment toluene data from Table 11 and TOC data from Table 4, along with the K_{OC} of 140 L/kg were used in the predictions. Across DMMU-1, DMMU-2a and DMMU-2b, predicted dissolved concentrations at discrete sites ranged from 0.075 µg/L (CH-1) to 2485 µg/L (CH-8). Calculated composite sediment dissolved elutriate concentrations were 1097 µg/L (DMMU-1), 1752 µg/L (DMMU-2a) and 268 µg/L (DMMU-2b). Toluene was identified as a water column PCOC and would require dilution during dredged material discharge operations.

Assuming a maximum sediment toluene release of 2485 µg/L (Site CH-8 within DMMU-2b) (worst-case) from the dredged material discharge, application of the ST-Fate model indicated that the effluent would achieve an outside mixing zone maximum (OMZM) WQS of 560 µg/L for the Protection of Aquatic Life (OEPA 2013) during the first two minutes after discharge. The maximum concentration in the plume prior to migrating outside of the placement area when discharging in the middle of the placement area under the highest velocity conditions was about 5 µg/L and well below even the OMZA of 62 µg/L. Since this OMZA WQS is a chronic criterion value and intended to apply to fixed and continuous discharges, it is a very conservative value toward the evaluation of the intermittent, discontinuous discharges characteristic of mechanical dredged material discharges via scow.

In summary, ample water column mixing for toluene is available at both open-lake placement areas CLA-1 and CLA-4.

b. Water column bioassays

The results of these tests are summarized in Table 29.

(1) ***C. dubia***—Mean survival associated with the lake site water (80±28%) was not statistically different than the laboratory control (100%). The mean survival of this test species exposed to the undiluted (100%)

elutriate ranged from 76±17% (DMMU-2b) to 100% (DMMU-1). Relative to the site water, the undiluted elutriates showed no statistically significant differences in mean survival. These bioassay data indicate no significant acute toxicity and show that the release of contaminants from the dredged material to the water column during open-water placement would not result in any contaminant-related unacceptable, adverse impacts.

(2) ***P. promelas***—Mean survival associated with both the lake site water and laboratory control were 100%. The mean survival of this test species exposed to the undiluted elutriate ranged from 0 (DMMU-2a and DMMU-2b) to 98±4% (DMMU-1). Other than the undiluted elutriates of DMMU-2a and DMMU-2b, no other elutriate concentration showed statistically significant differences in mean survival relative to lake site water. The DMMU-2a and DMMU-2b bioassay data both yielded a no observed effect concentration (NOEC), lowest observed effect concentration (LOEC) and LC_{50} of 50%, 100% and 67%, respectively. These bioassay data indicated acute toxicity associated with the undiluted DMMU-2a and DMMU-2b elutriates. Bioassay data on the remaining elutriates across the management unit samples showed insignificant acute toxicity.

In the DMMU-2a and DMMU-2b 25%, 50% and 100% elutriate treatments, dissolved oxygen (DO) fell below the 40% saturation guidance value (USEPA/USACE 1998b) at one point during the test. It is unlikely that the 100% mortality observed in the undiluted elutriates was attributable solely to low DO because no significant toxicity was evidenced in the 25% and 50% elutriates. Further, subsequent toxicity reduction evaluation (TRE) testing of the DMMU-2a and DMMU-2b undiluted elutriates with aeration exceeding 40% also yielded complete mortality, confirming that DO was not the cause of the mortality in the original bioassay.

The collective results of these water column bioassays suggest that the toxicity observed in the *P. promelas* tests on the DMMU-2a and DMMU-2b elutriate was related to ammonia. First, the toxicity occurred in the *P. promelas* bioassay and not in the *C. dubia* bioassay; *C. dubia* (and other invertebrates) is generally less sensitive to ammonia relative to fish. Further, ammonia levels measured in the DMMU-2a and DMMU-2b elutriates were sufficient to cause the observed toxicity to *P. promelas*. Unionized ammonia (usually the form most responsible for causing toxicity) was 1.0 mg/L and 0.9 mg/L for the DMMU-2a and DMMU-2b elutriates, respectively, and was much lower at <0.1 mg/L for the DMMU-

1 elutriate. The unionized ammonia concentrations in the undiluted DMMU-2a and DMMU-2b elutriates were equal to or exceeded *P. promelas* LC50 values reported in the literature (e.g., Nimmo *et al.* 1989; Buhl *et al.* 2002).

In an attempt to decipher the cause of the observed toxicity to *P. promelas*, a TRE was performed on the DMMU-2a and DMMU-2b samples. In order to accomplish this, the undiluted elutriates, and undiluted elutriate treatments slightly modified for pH, zeolite ammonia stripping and ethylenediaminetetraacetic acid (EDTA) metal chelating were performed. As with the first round of tests, 100% mortality resulted in the undiluted DMMU-2a and DMMU-2b elutriates. For both elutriates, the zeolite stripping treatment completely reduced toxicity and the EDTA treatment did not reduce toxicity. While zeolite can also bind some metals, SET data indicate that all dissolved metal concentrations in the DMMU-2a and DMMU-2b sediment elutriates (Table 24) were protective of aquatic life. These TRE results strongly indicate that ammonia was the cause of toxicity in the DMMU-2a and DMMU-2b undiluted elutriates. Therefore, an application factor of 10 was used to compute a limited permissible concentration (LPC) of 6.7%, as opposed to using an application factor of 100 to compute a LPC of 0.67% if the toxicity were a result of toxicants of other than ammonia.

Assuming a LPC of 6.7% for the dredged material discharge from DMMU-2a and DMMU-2b, application of the ST-Fate model indicated that the effluent would achieve the LPC during the first five minutes after discharge and within 140 ft of the discharge. If the toxicity were not caused by ammonia and an LPC of 0.67% were used (as a worst-case), application of the ST-Fate model indicated that the effluent would achieve the LPC during the first forty minutes after discharge under the lowest velocity conditions and within 2300 ft of the discharge under the highest velocity conditions.

Collectively, these SET and water column bioassay data show that the release of contaminants from the dredged material to the water column during open-water placement would not result in any contaminant-related unacceptable, adverse impacts to the aquatic ecosystem.

3.2.6 COCs

Toluene was identified as a sediment COC in most of the management unit sediments. PCBs and ΣDDT were identified as sediment COCs in some or all of the management unit sediments. Nickel was identified as a

sediment COC at Site CH-2 within DMMU-1. Ammonia-N and toluene were identified as PCOCs in the water column. Further evaluation eliminated all PCOCs and COCs.

3.3 Sediment quality assessment with trends over time

This section assesses the 2012 management unit data in concert with other harbor sediment data generated under USACE (2007) and Kreitinger *et al*. (2011) in order to decipher trends in sediment quality over the last five years. To facilitate comparisons among the three sampling events, Table 30 summarizes the 2007 and 2010 sampling sites relative to those used in 2012, and also groups the sites into management units that were either explicit (as in 2010 and 2012) or combined afterward (DMMU-2 in 2007) for the purposes of data interpretation. Note that there were fewer observations undertaken in the 2007 and 2010 events.

3.3.1 Bulk sediment analyses

a. Physical testing

The particle size data on the management unit sediments across the 2007, 2010 and 2012 investigations showed both variation and similarities in physical composition over time. In 2012, sediments within the general area of DMMU-1 were more coarse-grain in nature (average 69.1% [Sites CH-1 through CH-6]), then mostly fine-grain at all of the downstream sites in DMMU-2a and DMMU-2b. In 2010, sediments within the general area of DMMU-1 were comparably much less coarse-grain being comprised of less than 33.3% (Site CH-1) sands and gravels. Similar to the 2012 investigation, downstream sediments were mostly fine-grain. In 2007, sediments within the general area of DMMU-1 were about one-half coarse-grain (average 55.2% sands and gravels [Sites CH-1 through Ch-5]) and, as in the 2007 and 2012 investigations, downstream sediments were mostly fine-grain.

b. Chemical testing

(1) *Inorganic analyses*

(a) Metals—Copper, lead and zinc were used as metal indicators because they have been shown to be closely correlated with nine metals including cadmium, cobalt, chromium, copper, iron, manganese, nickel, lead and zinc (Birch and Olmos 2008). These metals, and nickel (due to

its higher concentration at Site CH-2), were closely examined to decipher contamination and/or bioavailability trends over time. Where appropriate, bulk concentrations were normalized to clay or TOC to better gauge metal bioavailability. Since AVS (or SEM) data were either not available or not available on discrete sediment samples, AVS binding was not included as a factor in the reduction of cationic metal bioavailability.

●*Copper*—Except for discrete site CH-2, there was a decline across all discrete sites between 2007 and/or 2010, and 2012 (Figure 6). For DMMU-1, there was a net decline between 2007 (geometric mean 50.4 mg/kg) and 2012 (geometric mean 41.7 mg/kg). Data on DMMU-2 indicate a net decline in bulk concentrations between 2007 (geometric mean 47 mg/kg) and/or 2010 (geometric mean 49.2 mg/kg), and 2012 (geometric mean 36.4 mg/kg).

Simple linear regression showed an inverse relationship of bulk concentration to both clay and TOC. Therefore, it was assumed that neither variable had a significant influence on sediment partitioning (and bioavailability) of copper.

●*Lead*—There was an increase across almost all discrete sites between 2007 and 2010. However, there was a decline across all discrete sites between 2007 and/or 2010, and 2012. For DMMU-1, there was a net decline between 2007 (geometric mean 35.3 mg/kg) and 2012 (geometric mean 26.3 mg/kg). Data on DMMU-2 indicate a small decline in bulk concentrations between 2007 (geometric mean 39.4 mg/kg) and/or 2010 (geometric mean 43.9 mg/kg), and 2012 (geometric mean 36.7 mg/kg).

Simple linear regression showed a positive relationship of bulk concentration to both clay (R^2=0.52) and TOC (R^2=0.56). Therefore, it was assumed that both variables had a measureable influence on sediment partitioning of lead. Clay-normalized values declined across all discrete sites between 2007 and/or 2010, and 2012 (Figure 7). For DMMU-1, there was a substantial decline between 2007 (geometric mean 337 mg/kg-clay) and 2012 (geometric mean 18.6 mg/kg-clay). Data on DMMU-2 indicate a substantial decline in clay-normalized lead concentrations between 2007 (geometric mean 320 mg/kg-clay) and 2010 (geometric mean 12.8 mg/kg-clay), and 2012 (geometric mean 5.43 mg/kg-clay). TOC-normalized concentrations increased across all discrete sites between 2007/2010, and 2012 (Figure 8). For DMMU-1, there was a substantial increase between 2007 (geometric mean 1842 mg/kg-TOC) and 2012 (geometric mean 3324 mg/kg-TOC). Data on DMMU-2 indicate an

increase in TOC-normalized lead concentrations between 2007 (geometric mean 320 mg/kg-TOC) and 2010 (geometric mean 1583 mg/kg-TOC), and 2012 (geometric mean 2324 mg/kg-TOC). Nevertheless and despite this overall increase in lead concentrations with respect to TOC, none of the bulk concentrations measured in 2012 would appear to be of toxicological significance.

●*Nickel*—There was a small increase across almost all discrete sites between 2007 and 2010. However, except for Site CH-2, there was a decrease across all discrete sites between 2007 and/or 2010, and 2012 (Figure 9). For DMMU-1, there was a small decrease between 2007 (geometric mean 29.6 mg/kg) and 2012 (geometric mean 35.1 mg/kg). Data on DMMU-2 indicate generally uniform bulk concentrations between 2007 (geometric mean 30.0 mg/kg) and/or 2010 (geometric mean 35.1 mg/kg), and 2012 (geometric mean 30.8 mg/kg).

Simple linear regression showed an inverse relationship of bulk concentration to both clay and TOC. Therefore, it was assumed that neither variable had a significant influence on sediment partitioning of nickel.

●*Zinc*—There was an increase across almost all discrete sites between 2007 and 2010. However, there was a decline across all discrete sites between 2007 and/or 2010, and 2012. For DMMU-1, there was a small decline between 2007 (geometric mean 152 mg/kg) and 2012 (geometric mean 143 mg/kg). Data on DMMU-2 indicate a net decline or general uniformity in bulk concentrations between 2007 (geometric mean 194 mg/kg) and/or 2010 (geometric mean 206 mg/kg), and 2012 (geometric mean 165 mg/kg).

Simple linear regression showed a positive relationship of bulk concentration to both clay (R^2=0.36) and TOC (R^2=0.05). However, the straight line relationship between bulk concentration and TOC was extremely weak. Therefore, it was assumed that only clay had a measureable influence on sediment partitioning of zinc. Except for Site CH-2, clay-normalized values declined across all discrete sites between 2007 and/or 2010, and 2012 (Figure 10). For DMMU-1, there was a substantial decline between 2007 (geometric mean 1450 mg/kg-clay) and 2012 (geometric mean 101 mg/kg-clay). Data on DMMU-2 suggest a substantial decline in clay-normalized zinc concentrations between 2007 (geometric mean 1652 mg/kg-clay) and 2010 (geometric mean 60.2 mg/kg-clay), and 2012 (geometric mean 24.3 mg/kg-clay).

(b) Other inorganics

●*TOC*—TOC data on the management unit sediments across the 2007, 2010 and 2012 investigations showed both variation and similarities. In 2012, sediments within the upstream end of DMMU-1 showed low TOC content (average 0.42% [Sites CH-1 and CH-2]), then relatively higher levels at downstream sites in the lower part of DMMU-1, and DMMU-2a and DMMU-2b, ranging from 0.9% to 2.4% (average 1.56% [Sites CH-3 through CH-15]) (Table 4). TOC content in 2010 was substantially higher and more consistent across the management unit sediments, ranging from 2.4% to 3.9% (average 3.1% [Sites CH-1 through CH-8]). In 2007, TOC content was moderate, fairly consistent and more comparable to the 2012 investigation, ranging from 1.4% to 2.5% (average 2.1% [Sites CH-1 through CH-8]).

●*TP*—Simple linear regression showed a positive relationship of bulk concentration to percent silts/clays (R^2=0.73). Silt/clay-normalized TP values increased across all discrete sites between 2010 and 2012 (Figure 11). For DMMU-1, there was a substantial increase (geometric means 523 mg/kg to 2524 mg/kg) and data on DMMU-2 suggest less but still substantial increase (geometric means 456 mg/kg to 994 mg/kg).

As previously discussed, the most meaningful endpoint with respect to sediment-associated TP is the dissolved concentration predicted to be released to the water column during open-lake placement (i.e., elutriate test result). Although releases from sediments are typically less than 1% of bulk concentration, bulk concentration-based values are typically not indicative of (e.g., proportional to) dissolved TP releases. Both filtered and unfiltered SET data are available on the management unit sediment composites from 2010 (Kreitinger *et al*. 2011) and 2012 (Table 25). Because filtered TP values (e.g., water concentrations of TP in general) inherently vary to some degree, another comparison of TP SET data across the two sampling events in this case is through the use of TSS-normalized unfiltered elutriate concentrations. Figure 12 graphs these values and shows an order of magnitude decline in TSS-normalized TP concentrations in elutriates for both DMMU-1 (2.58 mg/g-TSS to 0.69 mg/g-TSS) and DMMU-2 (4.05 mg/g-TSS to 0.71 mg/g-TSS) between the two sampling events. This demonstrates that the bioavailability of TP in the elutriate, as it is associated with TSS, was substantially lower in 2012 than 2010. Figure 13 shows the dissolved TP in elutriates between 2010 and 2012. The inordinately high dissolved TP of 6 mg/L in the DMMU-2 elutriate sample from 2010 appeared to be an anomaly because of the much lower dissolved TP

concentrations for DMMU-1 (<0.02 mg/L) coupled with similar TSS concentrations in the unfiltered elutriates. Figure 14 also indicates an increase in dissolved TP for both management units between the two sampling events but assumes that the measured 6 mg/L measurement for DMMU-2 in 2010 was an anomaly. Across DMMU-1 and DMMU-2, the increase in dissolved TP releases between 2010 and 2012 was less than 0.03 mg/L.

●*Ammonia*—Simple linear regression showed a positive relationship of bulk concentration to percent silts/clays (R^2=0.80). Silt/clay-normalized TP values increased across all discrete sites between 2010 and 2012 (Figure 15). For DMMU-1, there was a substantial increase (geometric means 7.02 mg/kg to 260 mg/kg) and data on DMMU-2 also suggest a substantial increase (geometric means 5.93 mg/kg to 254 mg/kg).

●*TKN*—Simple linear regression showed a positive relationship of bulk concentration to percent silts/clays (R^2=0.58). Silt/clay-normalized TKN values increased across all discrete sites between 2010 and 2012 (Figure 16). For DMMU-1, there was a substantial increase (geometric means 2177 mg/kg to 4095 mg/kg) and data on DMMU-2 also suggest a substantial increase (geometric means 1690 mg/kg to 2386 mg/kg). However, like TP and ammonia-N, the most relevant way to characterize sediment-associated TKN is through dissolved elutriate measurements. Since TKN elutriate data are not available under the 2007 and 2010 sampling events, dissolved releases could not be assessed among the three sampling events.

(2) *Organic analyses*

(a) Total PCBs—Bulk tPCB concentrations were normalized to TOC because PCBs are typically assumed to predominantly partition to the OC carbon compartment in sediment. Although there was an increase in TOC-normalized PCBs at two discrete sites (CH-2 and CH-3), there was an overall uniformity of PCB residues between 2007 (geometric mean 10665 ug/kg-TOC) and 2012 (geometric mean 10776 µg/kg-TOC) in DMMU-1 (Figure 17). Data on DMMU-2 suggest a decline in sediment-associated PCB residues between 2007 (geometric mean 7242 ug/kg-TOC) and 2012 (geometric mean 5719 µg/kg-TOC). Bulk tPCB concentrations were very low in 2010 relative to both 2007 and 2012.

(b) ΣDDT—Like PCBs, bulk ΣDDT concentrations were normalized to TOC because DDT and its metabolites are typically assumed to

predominantly partition to the OC carbon compartment in sediment. Although there was an increase in TOC-normalized ΣDDT concentrations at several discrete sites between 2007 and 2012 (CH-2, CH-3, CH-6 and CH-14 in both management units), there was an overall decline between 2007 (geometric mean 1450 µg/kg-TOC) and 2012 (geometric mean 1151 µg/kg-TOC) in DMMU-1 (Figure 18). Data on DMMU-2 also suggest a decline in sediment-associated ΣDDT residues between 2007 (geometric mean 1569 ug/kg-TOC) and 2012 (geometric mean 1209 µg/kg-TOC). Bulk ΣDDT concentrations were low in 2010 relative to both 2007 and 2012.

3.3.2 Solid phase bioassays

Solid phase bioassay data were examined across the 2007 (USACE 2007), 2010 (Kreitinger *et al.* 2011) and 2012 (USAERDC 2012) sampling events. The relevant biological measurement endpoints used to assess toxicity in these tests included *H. azteca* survival, and *C. dilutus* survival and growth. Delineated management units (when present) for the bioassay data corresponded generally well across the three events: DMMU-1 used in 2012 was similar to DMMU-1 in both 2010 and 2007, and the combined DMMU-2a and DMMU-2b were spatially equivalent to DMMU-2 from 2010. In 2007, no management unit downstream of DMMU-1 (i.e., DMMU-2, DMMU-2a or DMMU-2b) was used. Trends for these bioassay data were grouped into DMMU-1 and DMMU-2, and assessed as follows:

a. DMMU-1—Bioassay survival data for *H. azteca* and *C. dilutus* are graphed as control-corrected values in Figure 19 (bioassay data were control-corrected to eliminate variation due to testing laboratory). Mean survival of *H. azteca* showed a steady increase in control-corrected values across the three sampling events (59.1% in 2007, 93.6% in 2010 and 104% in 2012). For *C. dilutus*, a trend toward increased survival is evidenced across the three sampling events (76.6% in 2007 to 85.1% in 2012), although there was a reduction between 2010 (106%) and 2012. Note that USEPA (2004) indicates that control-corrected survival rates for *C. dilutus* greater than or equal to an arbitrary 75% is an acceptable measurement endpoint for acute toxicity. Furthermore, the measured mean survivals were not statistically different than those for the open-lake placement area sediments (see paragraph 3.2.2). Mean control-corrected *C. dilutus* growth increased between 2010 (1.23 g) and 2012 (1.70 g) (Figure 20).

b. DMMU-2–Bioassay survival data for *H. azteca* and *C. dilutus* are graphed as control-corrected values in Figure 21. Mean survival of *H. azteca* increased between the 2010 (61.7%) and 2012 (97.8%) sampling

events. A reduction of *C. dilutus* control-corrected survival is evidenced between 2010 (112%) and 2012 (93.6%) which was not biologically significant. Mean control-corrected *C. dilutus* growth increased between 2010 (0.83 g) and 2012 (1.08 g) (Figure 21).

3.3.3 Summary

Evaluation of sediment quality data across the 2002, 2007 and 2012 sampling events indicated either an overall net decline in contamination or contaminant availability, and/or no ecologically meaningful increase in sediment contaminant-based concentrations and/or toxicity over time. This is based on the following findings:

a. Metals—The only evidenced increase in indicator metals between 2007 and 2012, on average across both management units, was TOC-normalized lead. This would not appear to be of toxicological significance given the low measured bulk concentrations (maximum discrete concentrations 52.9 mg/kg and 44 mg/kg in 2010 and 2012, respectively), which themselves showed a net decline between 2010 and 2012. While bulk nickel concentrations substantially increased at discrete Site CH-2 between 2010 (33.6 mg/kg) and 2012 (138 mg/kg), average management unit concentrations showed general uniformity across 2007, 2010 and 2012.

b. TP—The overall bioavailability of TP (unfiltered elutriate normalized to TSS) in dredged material elutriates was lower in 2012 than in 2010. However, if it is assumed that one high TP SET measurement from the 2010 sampling event is an anomaly, predicted releases of dissolved TP between the two sampling events showed a minor increase between 2010 and 2012. This higher release is attributable to measureable TSS in the filtered elutriate samples.

c. PCBs and DDT—The data indicate a decline or overall uniformity in sediment-associated PCBs and DDT (normalized to TOC) residues across the management units between 2007 and 2012.

d. Solid phase bioassays—With respect to the three biological measurement endpoints, the bioassay data show that the toxicity of the sediments in DMMU-1 and DMMU-2 has either declined and/or has been at an acceptable level over the last five years. A steady increase in control-corrected survival was observed for *H. azteca* between 2007 (for DMMU-1 sediments only because DMMU-2 was not yet designated a management unit), 2010 and 2007. While there was an observed increase in control-corrected *C. dilutus* survival between 2007 and 2012 for

DMMU-1 sediments, there was also a decrease in control-corrected survival between 2010 and 2012 for both DMMU-1 and DMMU-2 sediments. Nevertheless, the survivals observed in 2012 were acceptable. Finally, control-corrected *C. dilutus* growth in both DMMU-1 and DMMU-2 increased between 2010 and 2012.

4.0 CONCLUSION

Based on the data contained in USAERDC (2012) and other relevant information, contamination and toxicity associated with Cleveland Harbor Federal navigation channel sediments, as represented by management units DMMU-1, DMMU-2a and DMMU-2b, has been shown to be comparable relative to open-lake placement area sediments and/or would not represent any appreciable increased toxicological risk to the affected aquatic ecosystems if placed at open-lake areas CLA-1 or CLA-4. Therefore, subject to three conservative limitations, all material dredged from DMMU-1, DMMU-2a and DMMU-2b meets Federal guidelines for open-lake placement. These controls are based on water quality modeling, and the PCB and DDT/DDD/DDE bioaccumulation measurement endpoints in receptor species', and include: (1) use of mechanical equipment to dredge and discharge the dredged material; (2) spatially limiting the placement of material dredged from DMMU-1, DMMU-2a and DMMU-2b to a one-square mile area within CLA-4 and CLA-1; and (3) spatially limiting the placement of material dredged from DMMU-1 to a two-third square mile area within CLA-4.

A detailed examination of sediment quality data across the 2002, 2007 and 2012 sampling events indicated a net decline or no ecologically meaningful increase in sediment contaminant-based concentrations and/or toxicity over time.

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FIGURE 1. Cleveland Harbor sediment sampling sites and management units in Upper Cuyahoga River Channel.

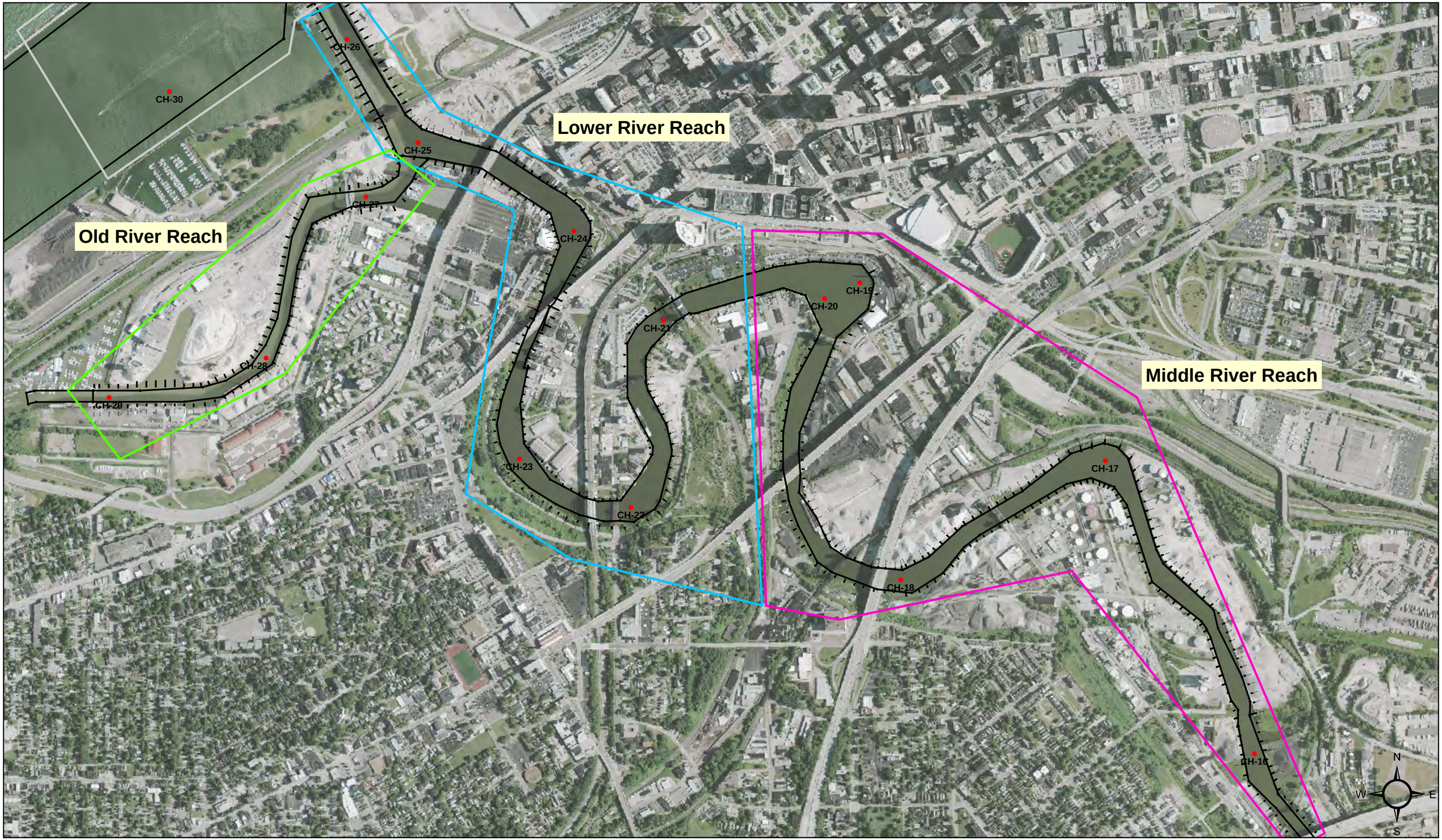

FIGURE 2. Cleveland Harbor sediment sampling sites and composite sample boundaries for the Middle and Lower Cuyahoga River Channel and Old River Channel reaches.

FIGURE 3. Cleveland Harbor Sediment sampling sites and composite sample boundaries for the Outer Harbor Channel reach.

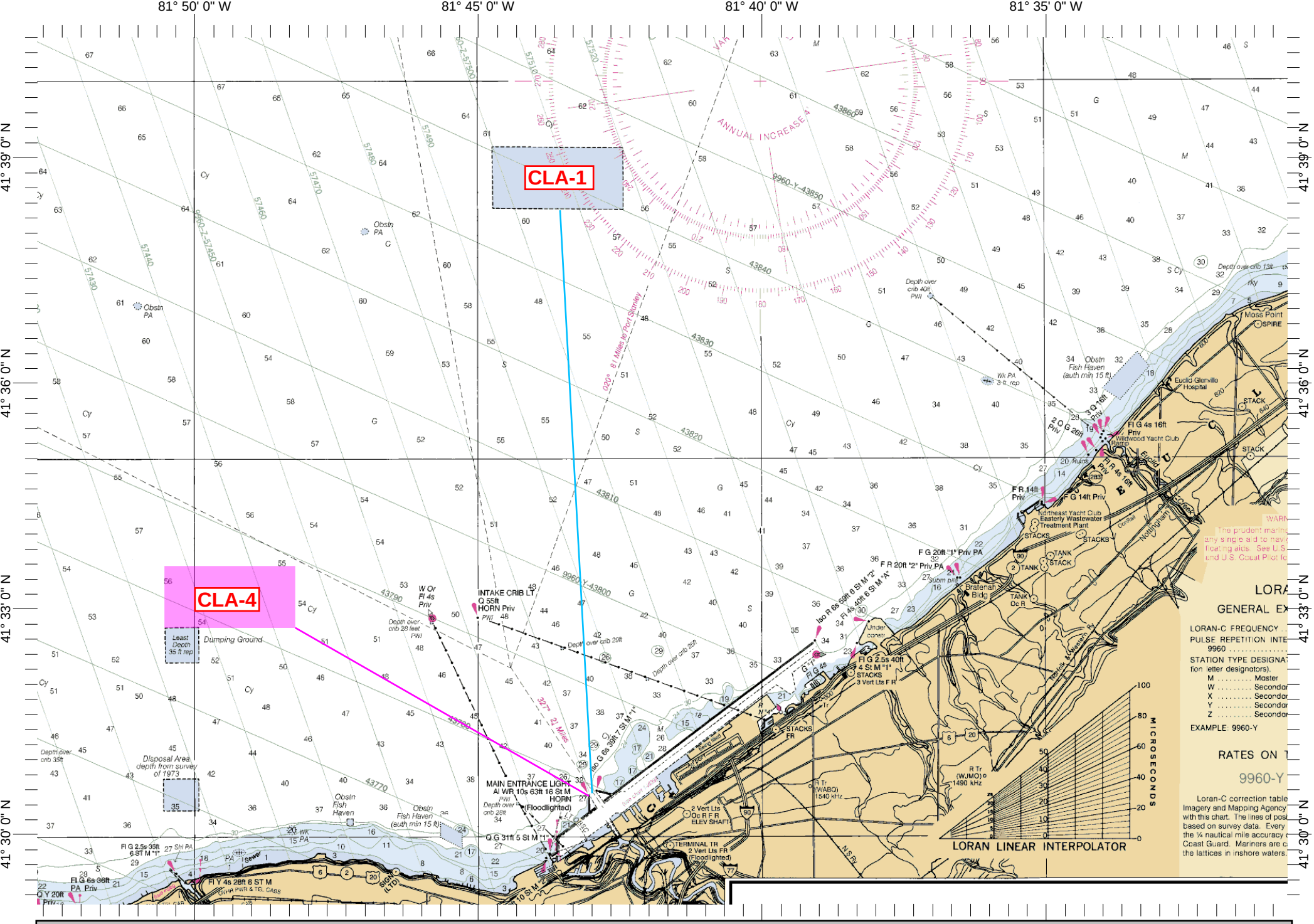

FIGURE 4. Proposed open-lake placement areas CLA-1 and CLA-4 for material dredged from Cleveland Harbor Upper Cuyahoga River Channel.

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FIGURE 5. Graph of organic matter:total organic carbon ratios for upper Cuyahoga River Channel sediments.

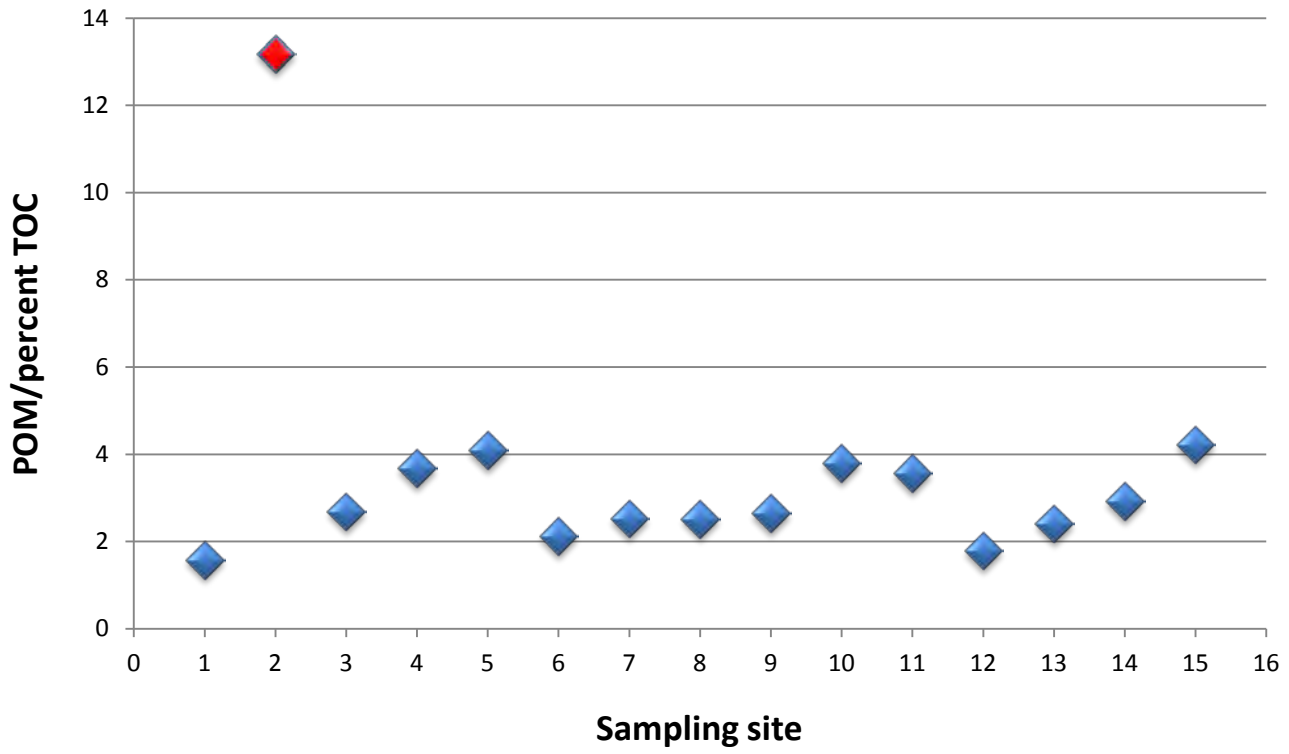

FIGURE 6. Bulk sediment concentrations of copper in upper Cuyahoga River Channel sediments in 2007, 2010 and 2012.

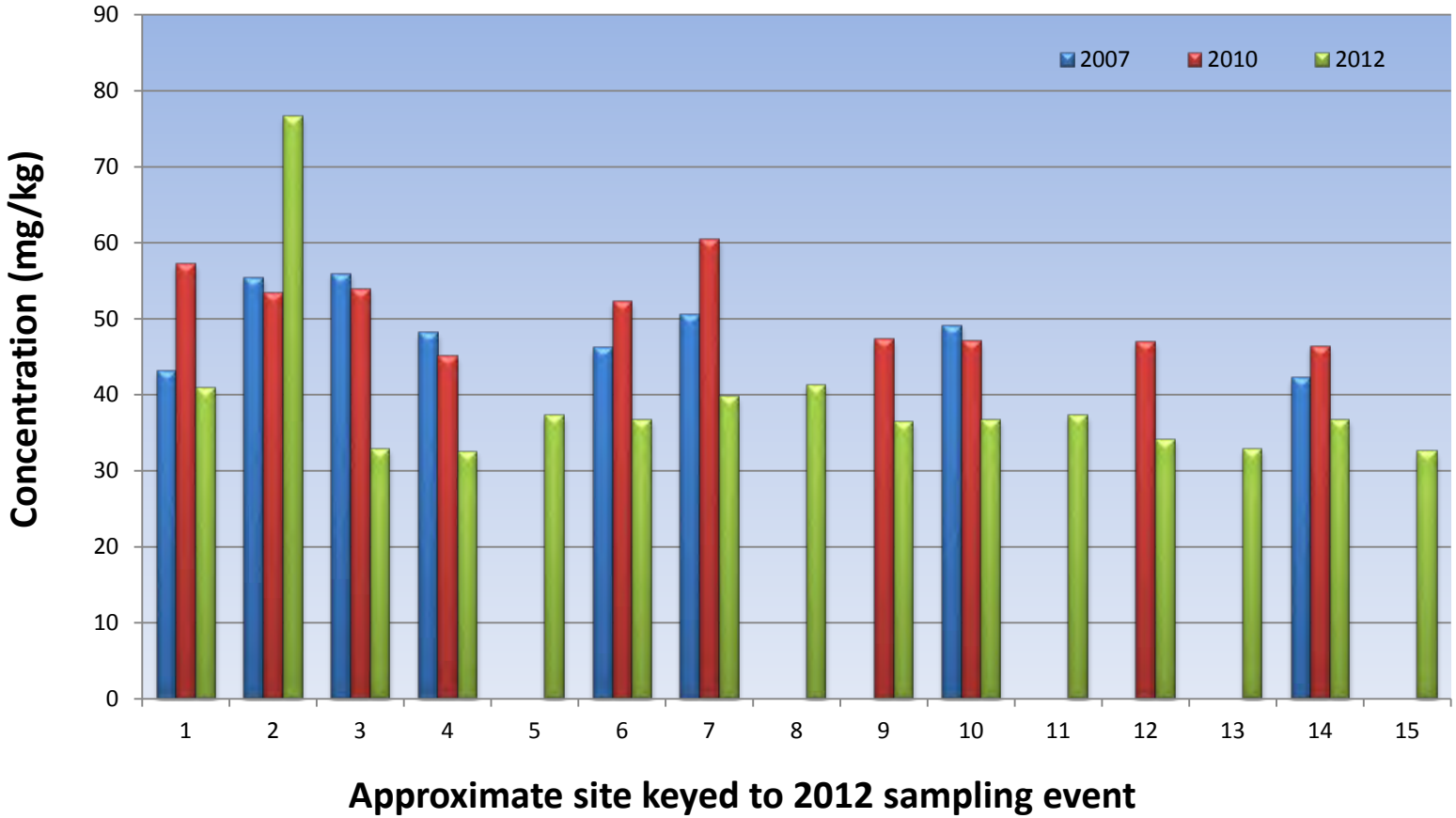

FIGURE 7. Clay-normalized sediment concentrations of lead in upper Cuyahoga River Channel sediments in 2007, 2010 and 2012.

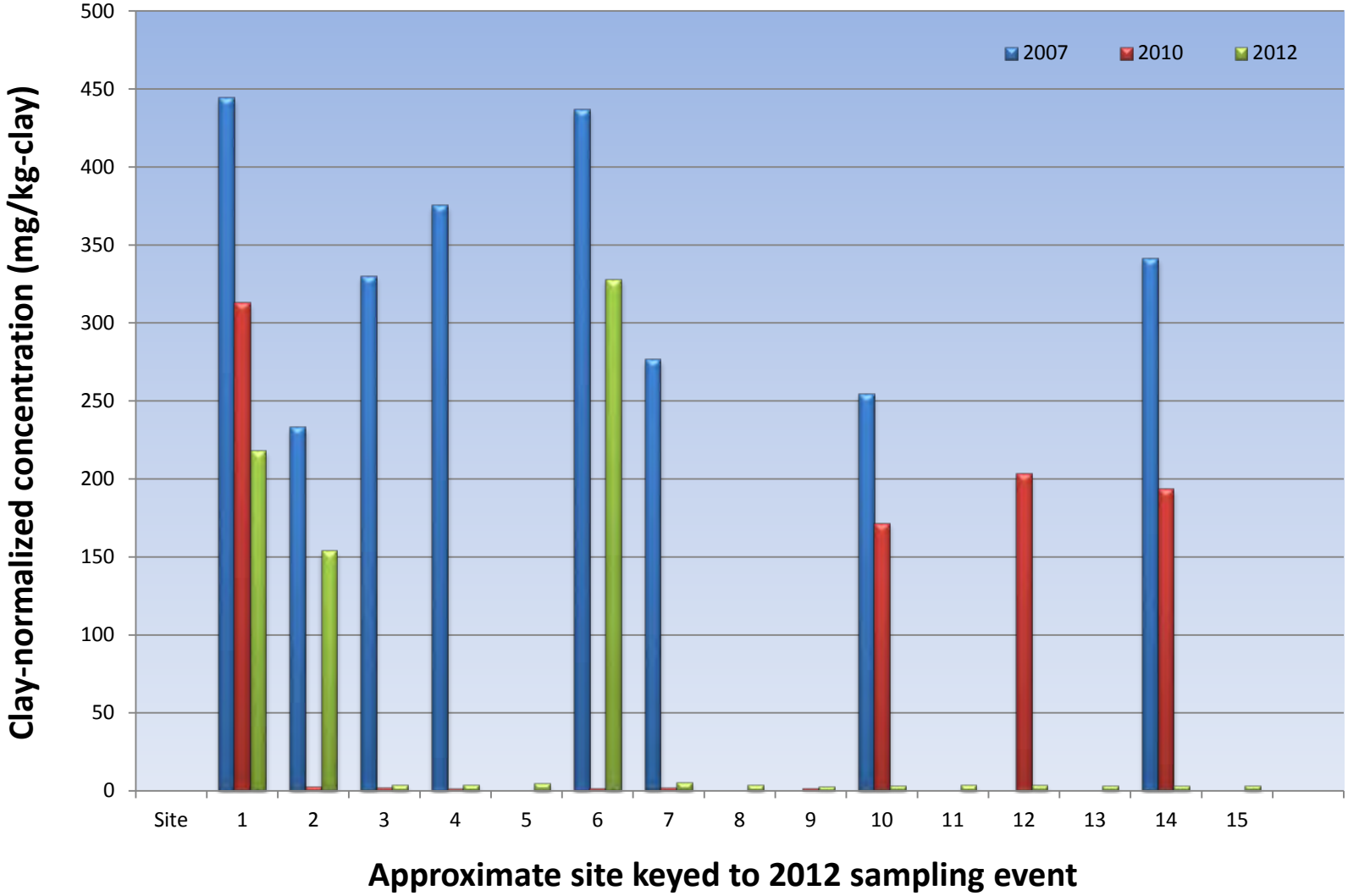

FIGURE 8. TOC-normalized sediment concentrations of lead in upper Cuyahoga River Channel sediments in 2007, 2010 and 2012.

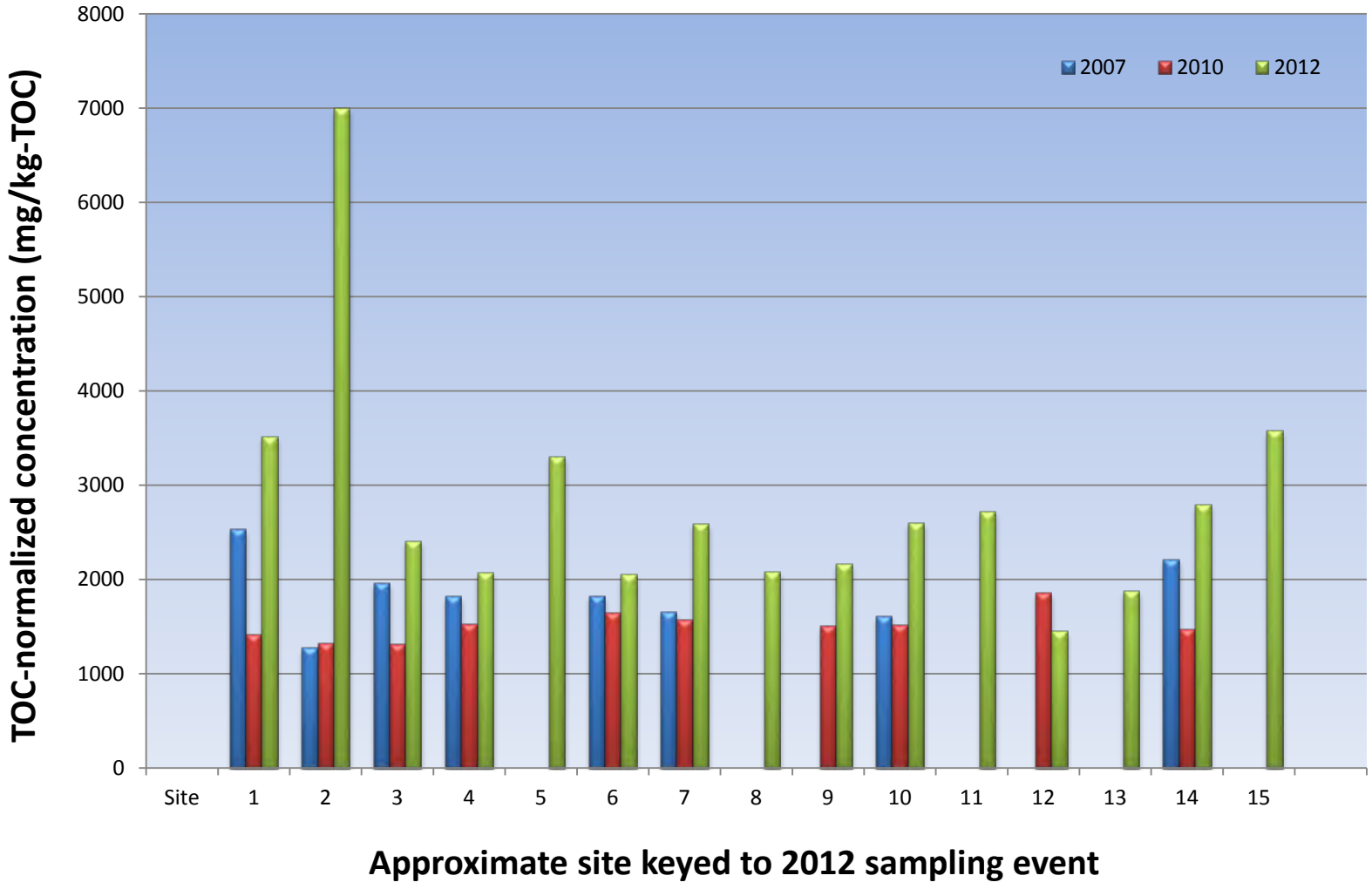

FIGURE 9. Bulk sediment concentrations of nickel in upper Cuyahoga River Channel sediments in 2007, 2010 and 2012.

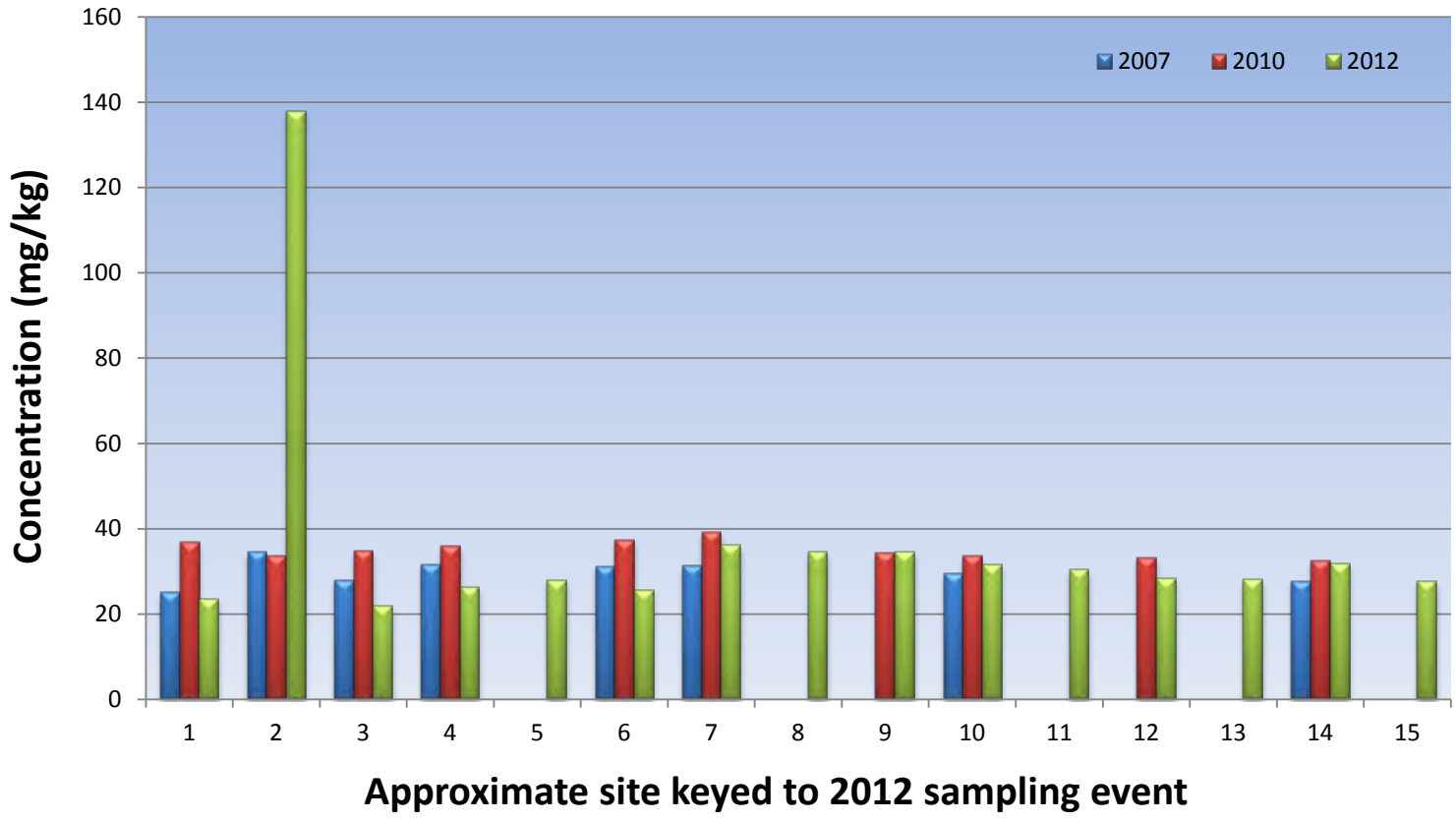

FIGURE 10. Clay-normalized sediment concentrations of zinc in upper Cuyahoga River Channel sediments in 2007, 2010 and 2012.

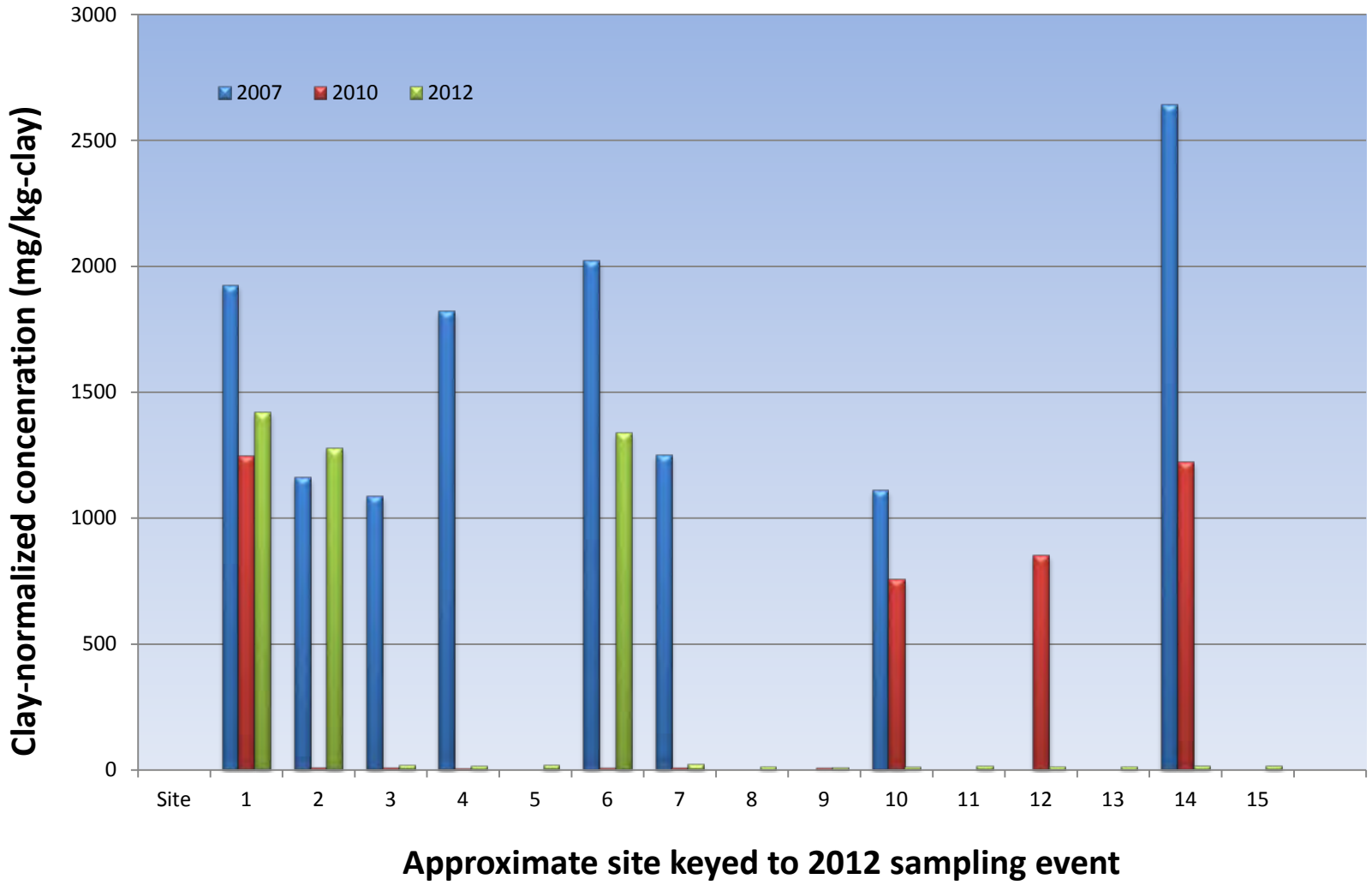

FIGURE 11. Silt/clay-normalized sediment concentrations of TP in upper Cuyahoga River Channel sediments in 2010 and 2012.

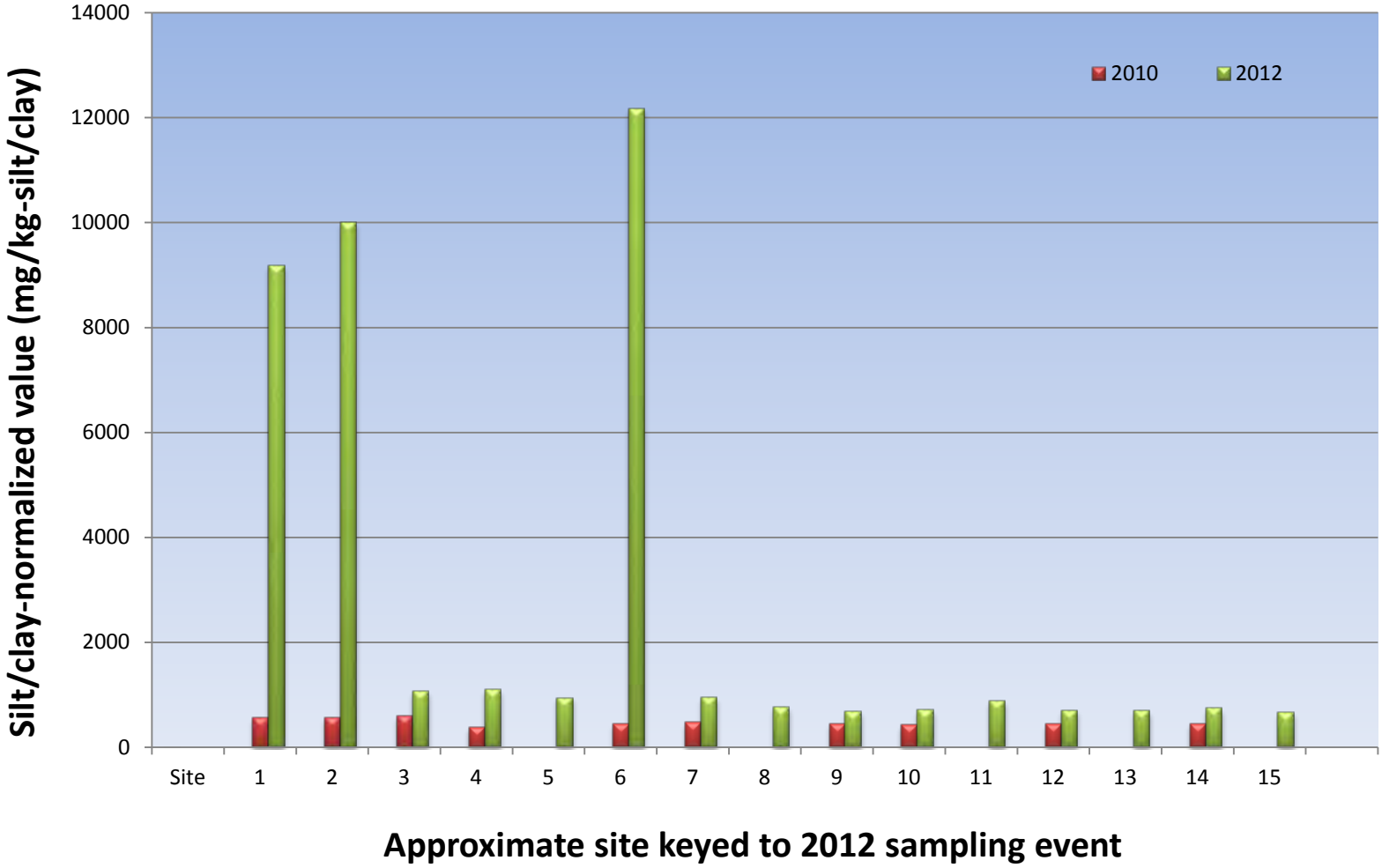

FIGURE 12. Unfiltered elutriate TP normalized to TSS, 2010 and 2012.

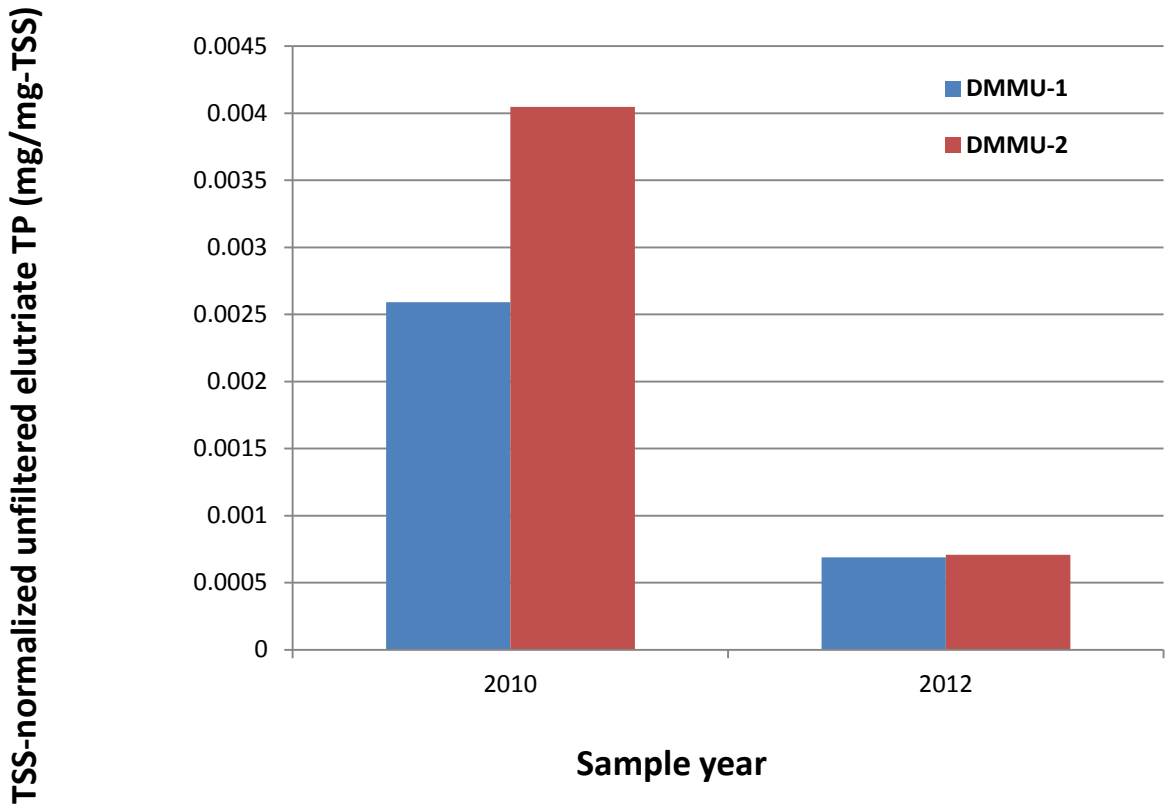

FIGURE 13. Dissolved TP in elutriate, 2010 and 2012.

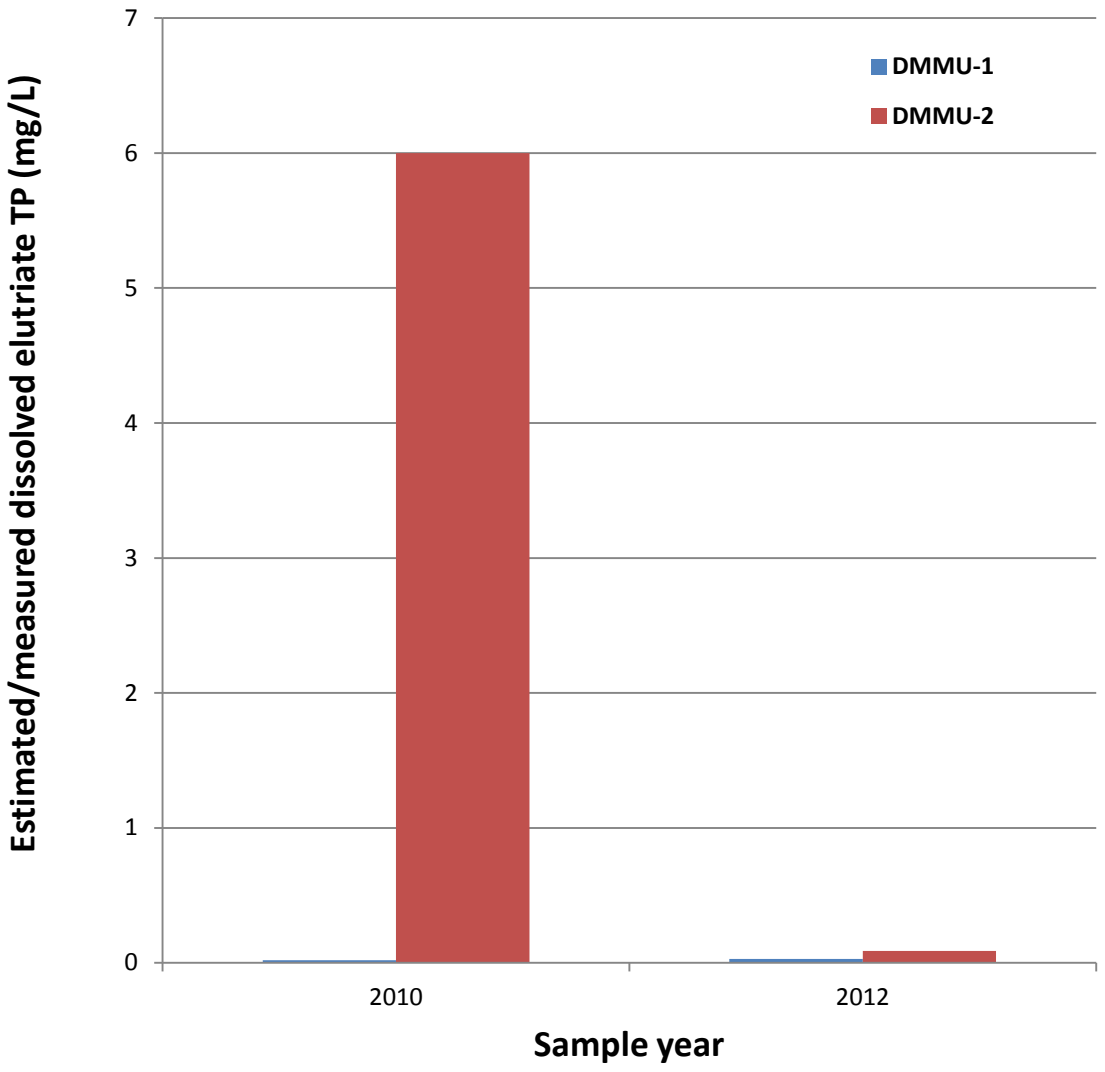

FIGURE 14. Dissolved TP in elutriate (without assumed DMMU-2 anomaly in 2010), 2010 and 2012.

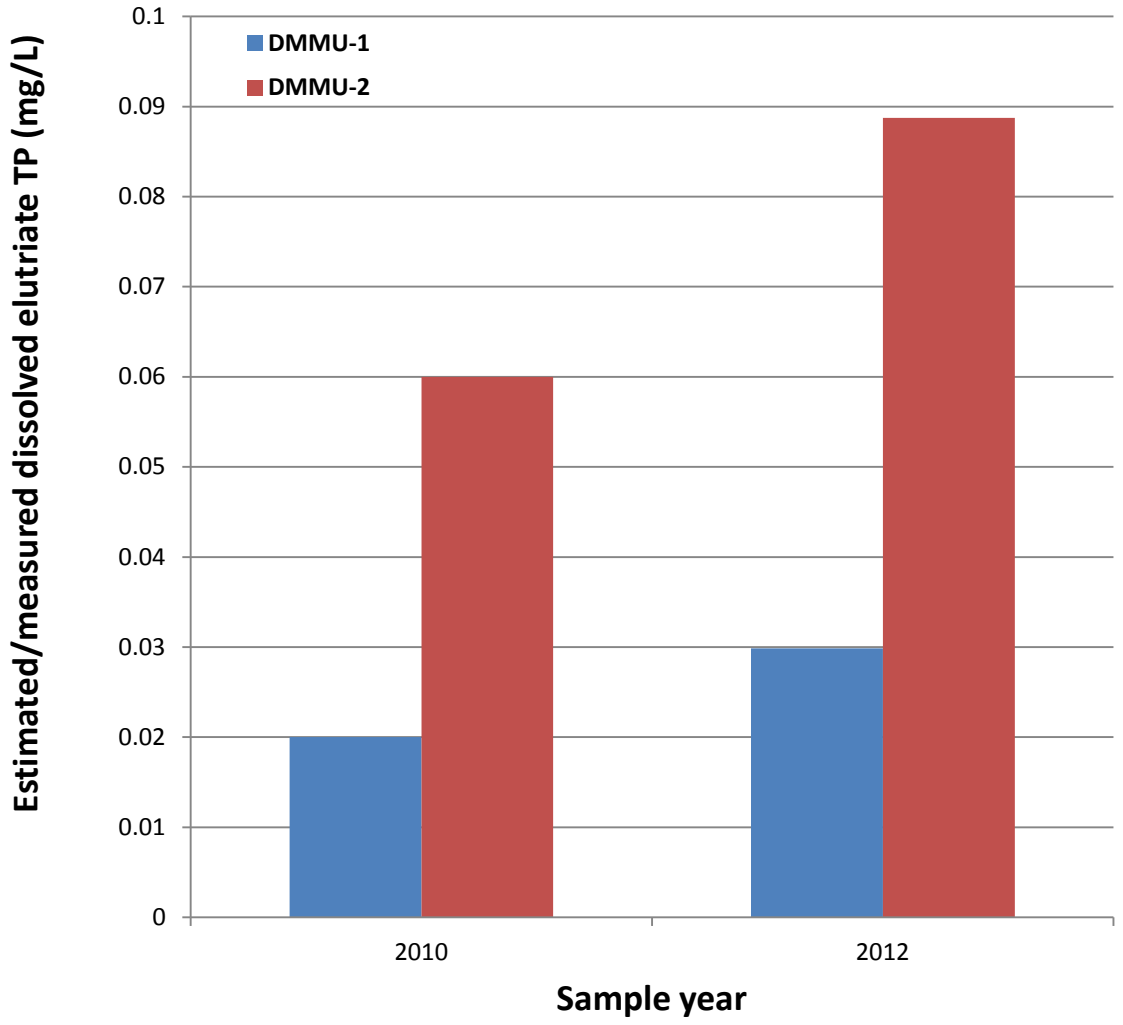

FIGURE 15. Silt/clay-normalized sediment concentrations of ammonia-nitrogen in upper Cuyahoga River Channel sediments in 2010 and 2012.

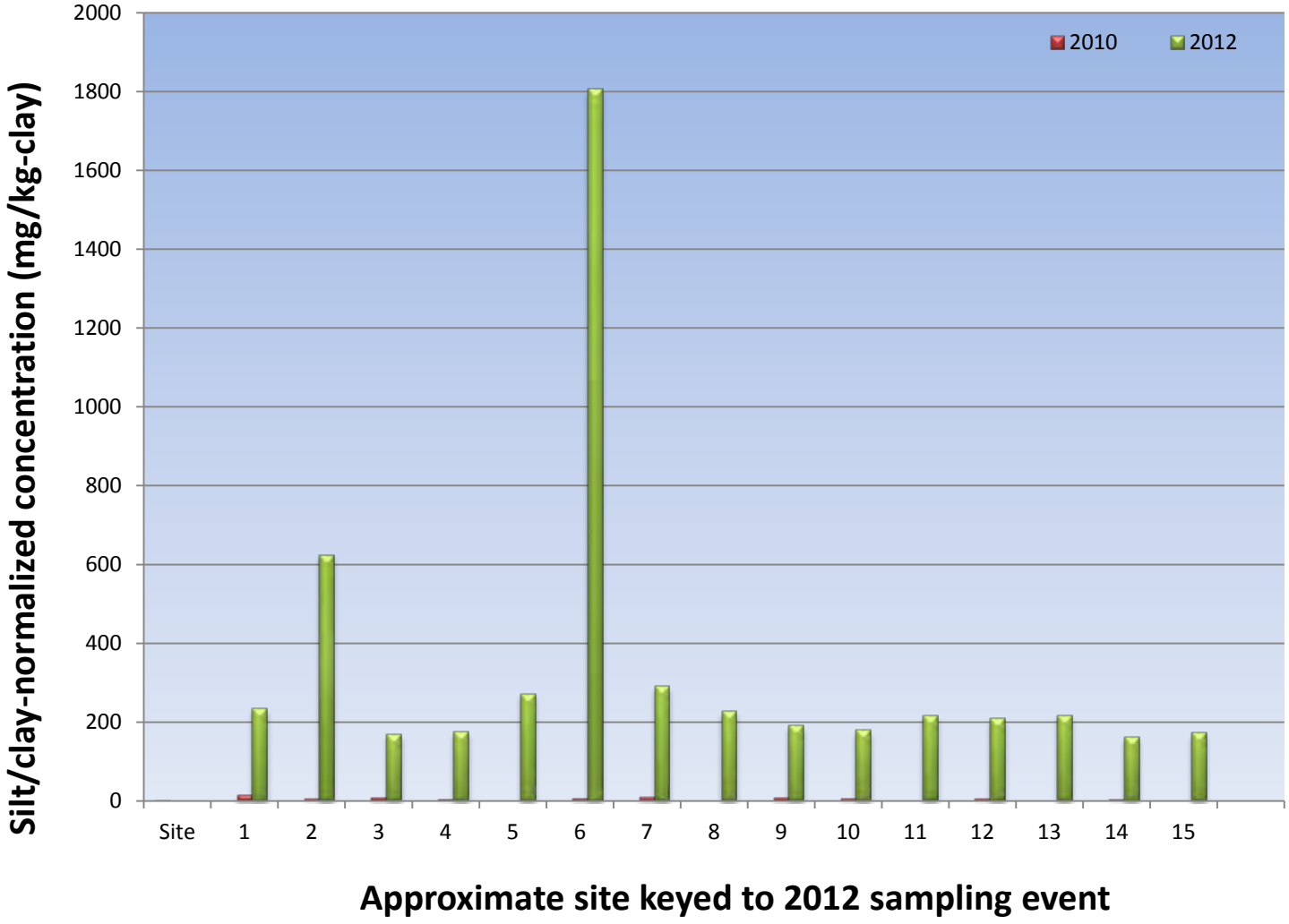

FIGURE 16. Silt/clay-normalized sediment concentrations of TKN in upper Cuyahoga River Channel sediments in 2010 and 2012.

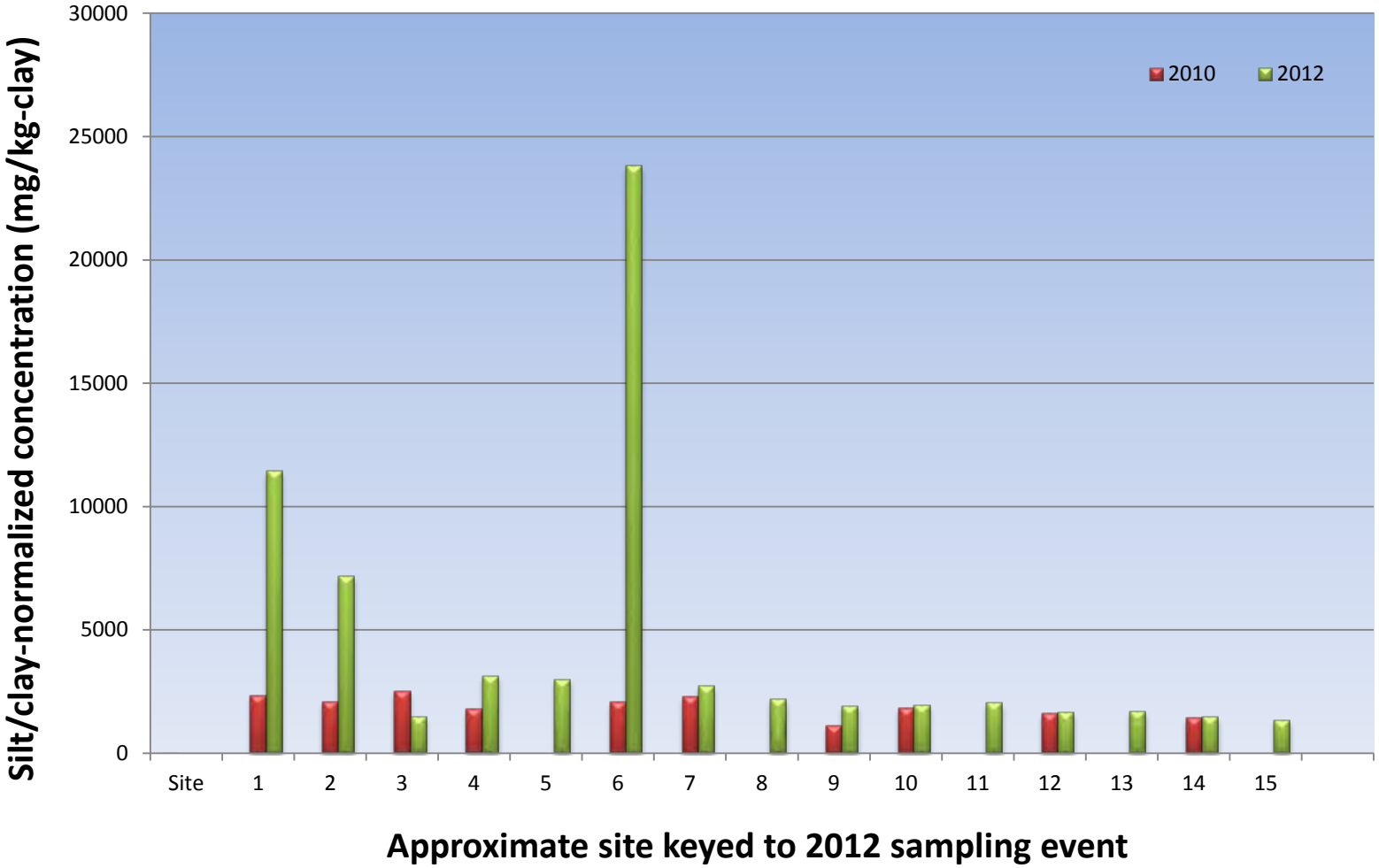

FIGURE 17. Total organic carbon (TOC)-normalized concentrations of tPCBs in upper Cuyahoga River Channel sediments in 2007, 2010 and 2012.

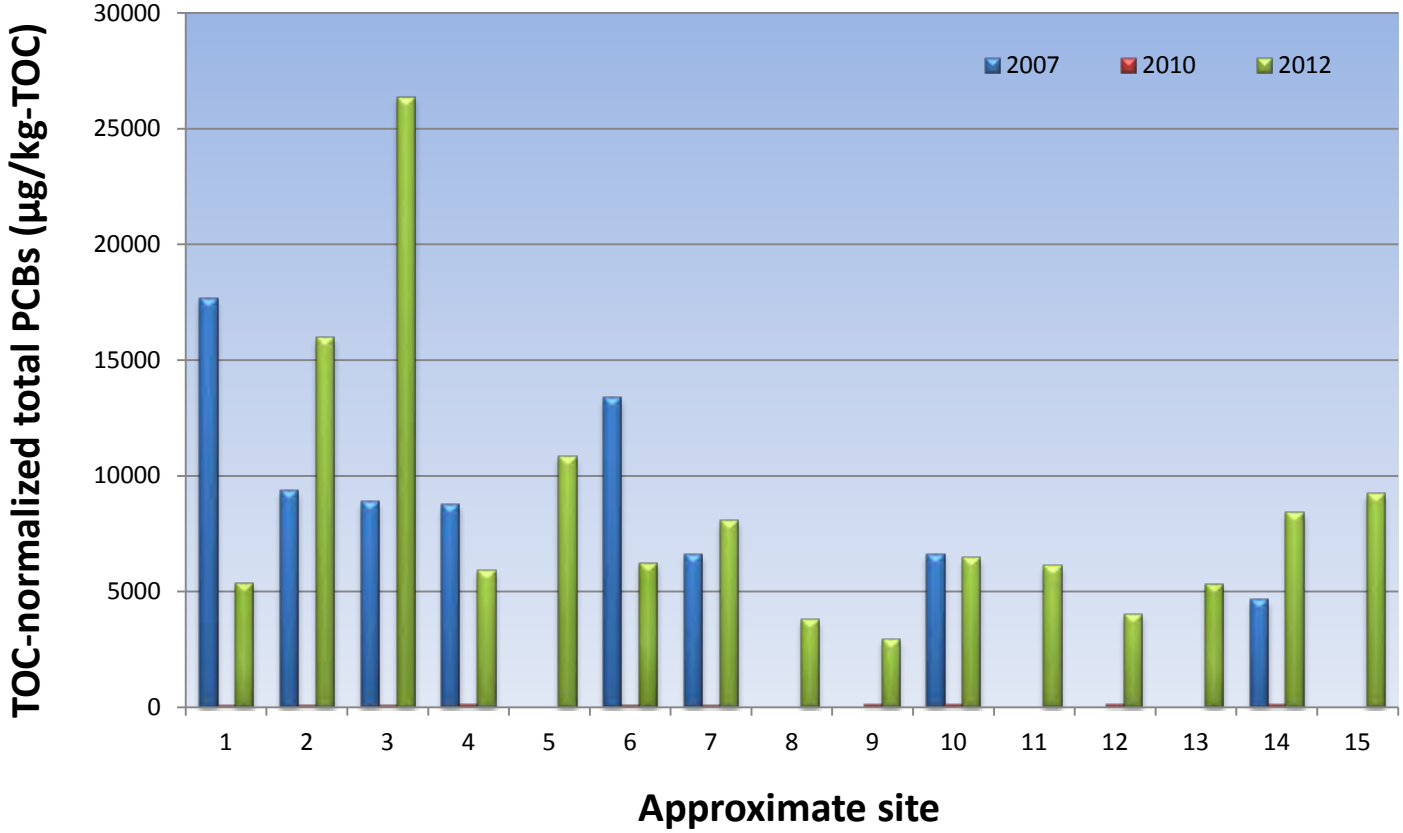

FIGURE 18. Total organic carbon (TOC)-normalized concentrations of ∑DDT in upper Cuyahoga River Channel sediments in 2007, 2010 and 2012.

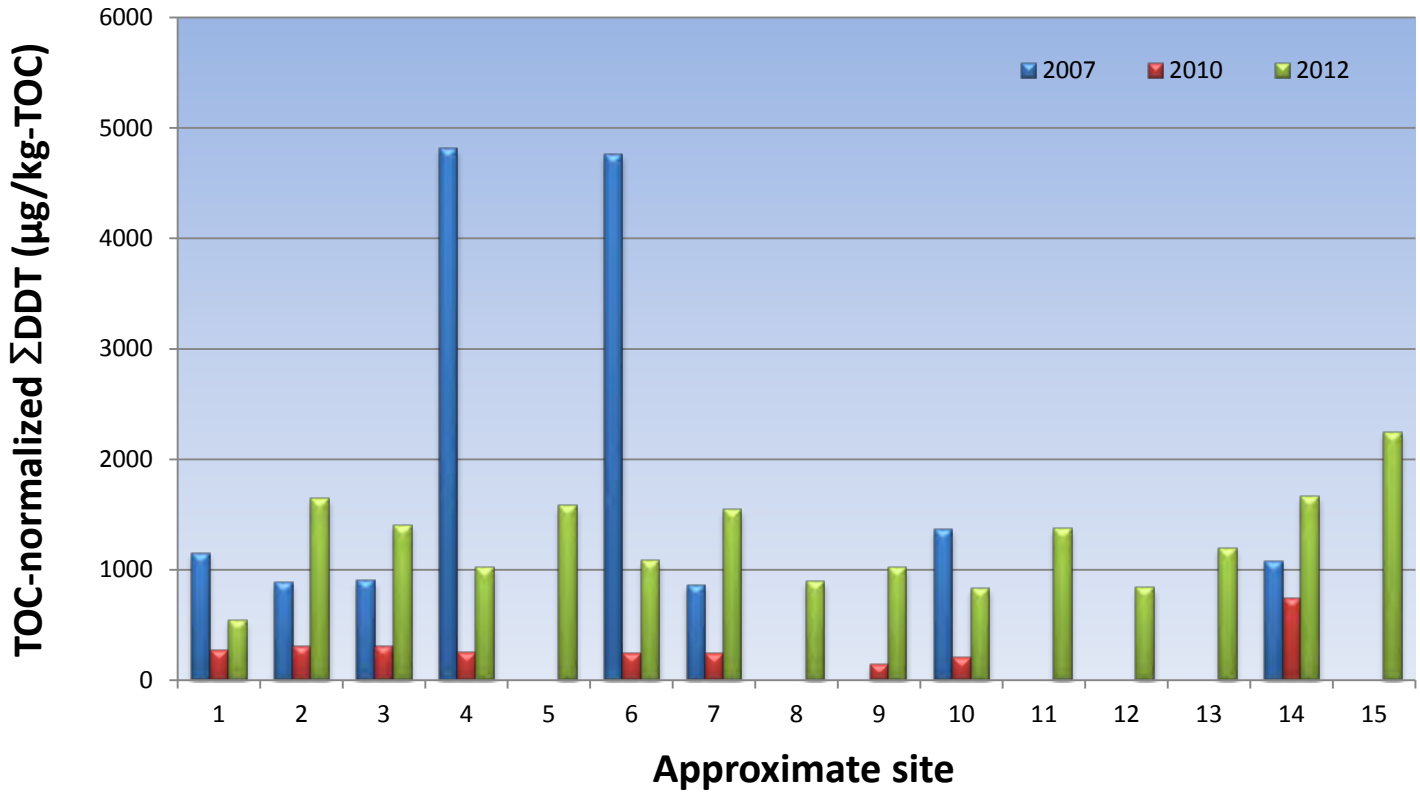

FIGURE 19. Control-corrected survival of test species relative to upper River Channel DMMU-1 sediments in 2007, 2010 and 2012.

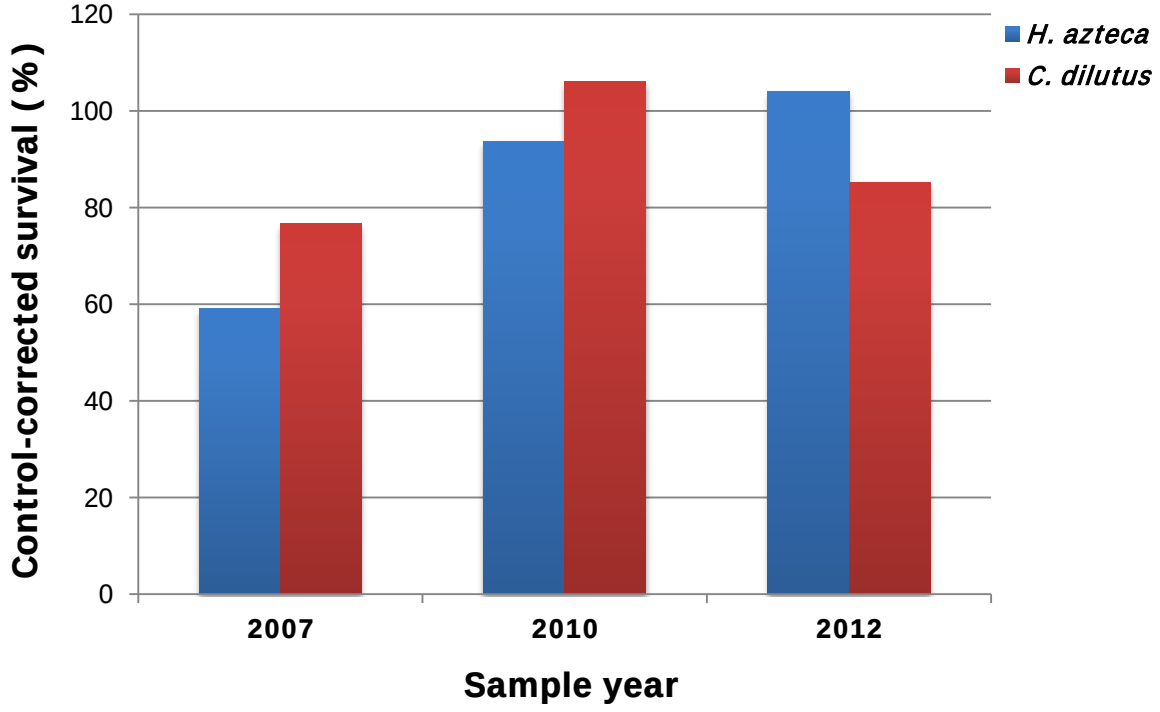

FIGURE 20. Control-corrected growth of *C. dilutus* relative to upper River Channel DMMU-1 sediments in 2010 and 2012.

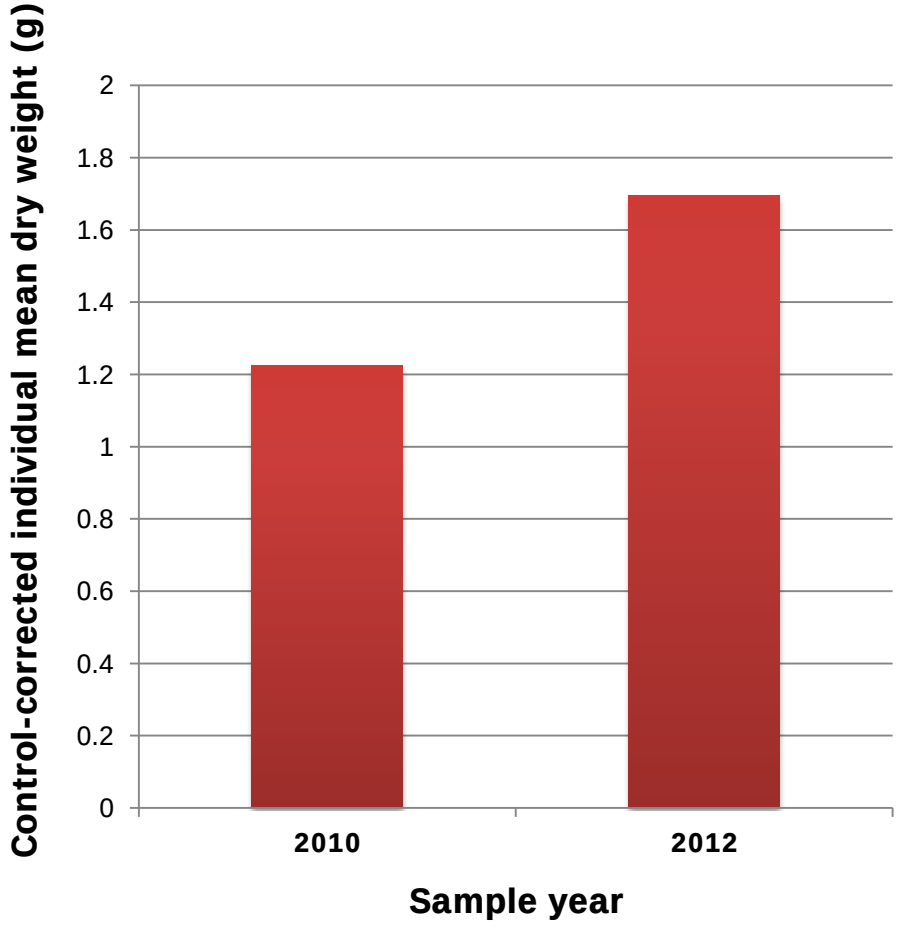

FIGURE 21. Control-corrected survival of test species relative to upper River Channel DMMU-2 (for 2012, averages across DMMU-2a and 2b) sediments in 2010 and 2012.

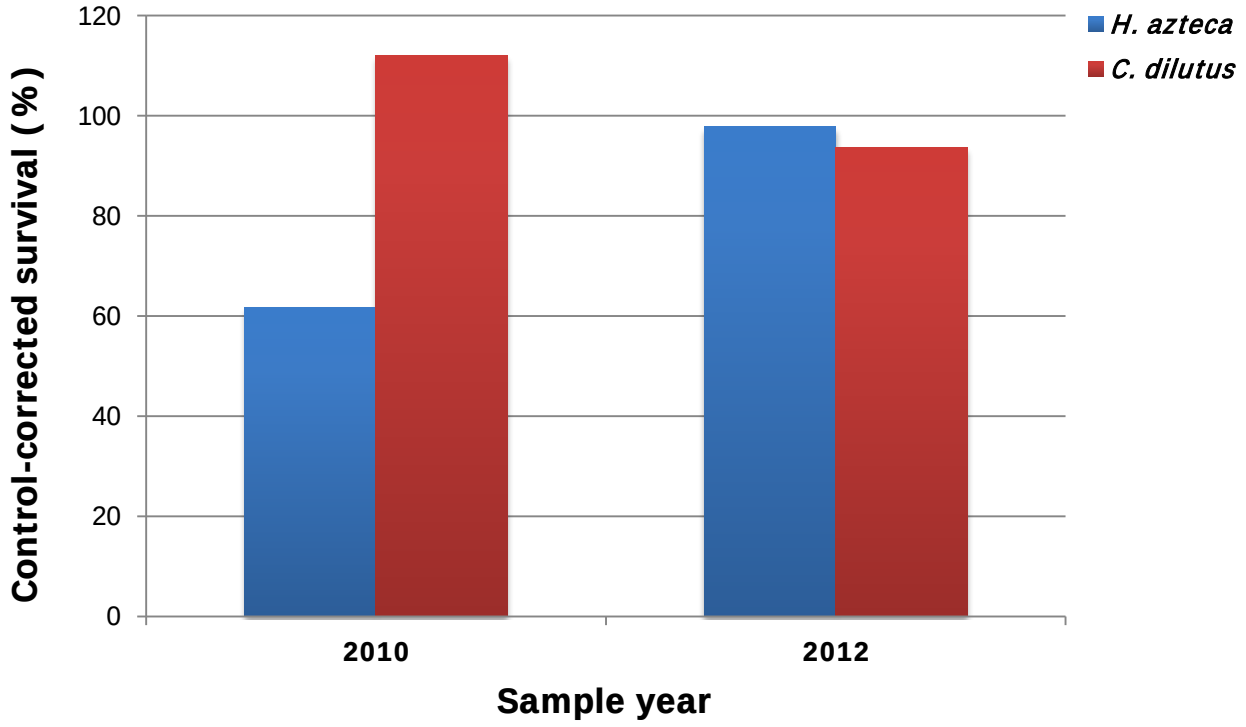

FIGURE 22. Control-corrected growth of *C. dilutus* relative to upper River Channel DMMU-2 (for 2012, average across DMMU-2a and 2b) sediments in 2010 and 2012.

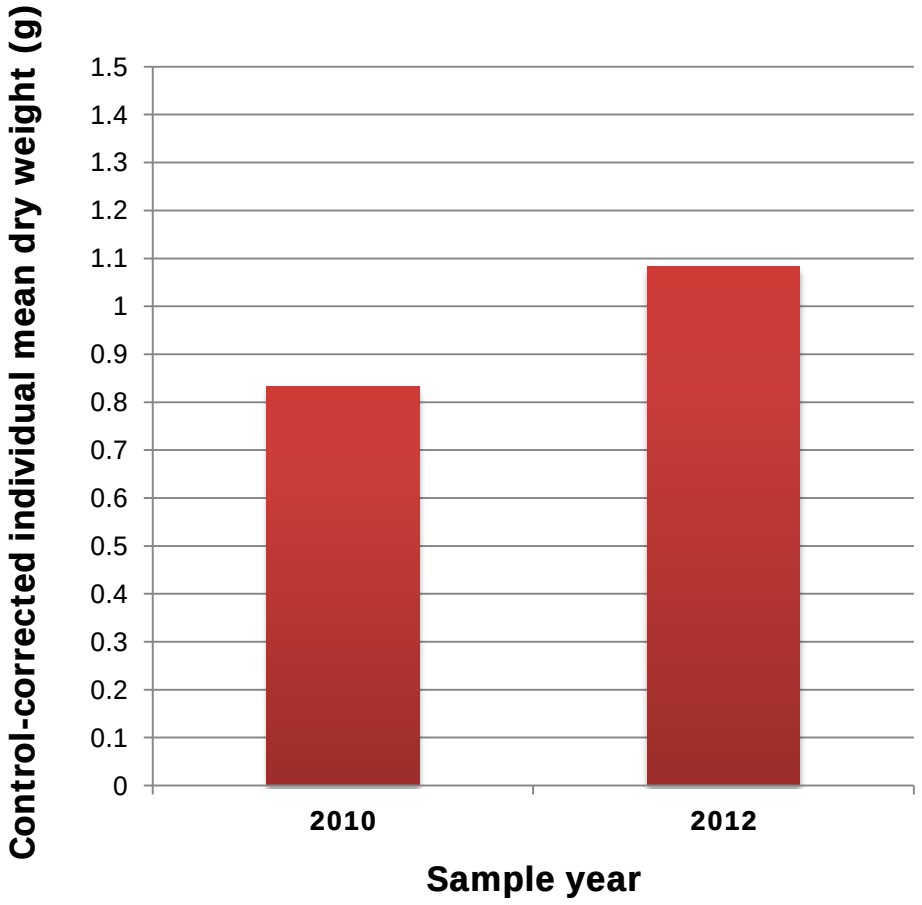

TABLE 1. Particle size data on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

Particle Size (%)	Lake Area #1					Lake Area #4					DMMU 1						DMMU 2a						DMMU 2b						CDF 10B
	CLA1-1	CLA1-2	CLA1-3	CLA1-4	CLA1 Comp	CLA4-1	CLA4-2	CLA4-3	CLA4-4	CLA4 Comp	CH-1	CH-2	CH-3	CH-4	CH-5	DMMU1	CH-6	CH-7	CH-8	CH-9	CH-10	DMMU2a	CH-11	CH-12	CH-13	CH-14	CH-15	DMMU2b	CDF Comp
GRAVEL	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	2.5	0.3	0.8	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	5.7
SAND	4.0	2.0	10.6	2.3	12.2	1.8	0.5	0.7	1.5	1.2	94.9	93.7	42.6	46.0	37.1	77.0	95.5	33.2	8.6	3.9	6.6	23.5	6.4	4.2	3.1	2.8	4.6	4.9	89.9
SILT	66.8	67.7	63.7	72.5	55.5	68.6	65.0	66.9	68.3	63.4	4.4	4.0	48.7	44.9	54.6	21.1	4.7	58.9	79.6	82.1	80.9	66.0	83.5	85.7	86.7	85.2	85.4	85.1	4.5
CLAY	29.2	30.2	25.7	25.2	32.3	29.6	34.5	32.4	30.2	35.4	-0.2	-0.2	8.4	8.3	8.1	1.9	-0.2	7.9	11.8	14.0	12.5	10.4	10.0	10.1	10.2	12.0	10.0	10.0	-0.1

Particle Size (%)	Middle River Reach (MRR)					Lower River Reach (LRR)						Old River Reach (ORR)			Outer Harbor Reach (OHR)							
	CH-16	CH-17	CH-18	CH-19	CH-20	CH-21	CH-22	CH-23	CH-24	CH-25	CH-26	CH-27	CH-28	CH-29	CH-30	CH-31	CH-32	CH-33	CH-34	CH-35	CH-36	CH-37
GRAVEL	4.8	2.2	2.6	3.5	4.9	4.3	3.8	1.2	0.7	0.6	4.5	14.3	1.8	6.2	13.4	4	3.2	6.9	9.7	15.5	3.1	6.2
SAND	23.8	21	21.3	19.2	20.7	22.3	29.9	23.5	24.3	25.5	32.1	43.1	60.3	56.5	37.5	34.5	36.8	27.1	31	38.5	28.4	26.2
SILT	63	66.6	66.8	63.1	62.4	63.8	58	65	61.7	62.5	53.4	36.9	26.7	31.2	42.2	47.6	52.7	54.3	46.8	38.2	54.6	53.2
CLAY	8.4	10.2	9.3	14.2	12	9.6	8.3	10.3	13.3	11.4	10	5.7	11.2	6.1	6.9	13.9	7.3	11.7	12.5	7.8	13.9	14.4

TABLE 2. Metals data on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

Metal (mg/kg)	Lake Area #1					Lake Area #4					DMMU 1						DMMU 2a						DMMU 2b						CDF 10B
	CLA1-1	CLA1-2	CLA1-3	CLA1-4	CLA1 Comp	CLA4-1	CLA4-2	CLA4-3	CLA4-4	CLA4 Comp	CH-1	CH-2	CH-3	CH-4	CH-5	DMMU1	CH-6	CH-7	CH-8	CH-9	CH-10	DMMU2a	CH-11	CH-12	CH-13	CH-14	CH-15	DMMU2b	CDF Comp
	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ
Aluminum	18,100	17,600	14,400	17,700	17,900	17,800	17,600	18,100	16,800	16,000	4,580	5,270	5,480	5,490	7,400	4,730	6,140	8,780	9,120	10,600	9,030	8,210	9,350	8,490	8,480	9,370	8,610	8,810	4,360
Antimony	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Arsenic	11.30	8.46	15.70	8.06	6.04	5.76	5.63	6.55	6.62	11.50	8.06	9.27	10.20	11.00	11.50	9.06	10.70	12.80	13.30	13.50	13.90	13.00	13.90	13.10	13.50	15.10	13.80	13.90	6.62
Barium	119	108	105	110	124	109	108	111	106	118	31	37	49	47	64	49	50	74	70	76	70	70	71	64	64	70	62	71	33
Beryllium	0.96	0.86	0.86	0.94	1.19	0.92	0.90	0.91	0.90	1.09	0.35 J	0.35 J	0.35 J	0.34 J	0.47 J	0.34 J	0.38 J	0.51	0.49 J	0.57	0.47 J	0.60	0.47 J	0.43 J	0.47 J	0.51	0.48 J	0.58	0.46 J
Cadmium	3.30	2.46	4.66	2.47	2.18	1.90	1.95	2.22	2.15	3.54	0.35 J	0.74	0.70	0.70	0.64	0.43 J	0.61	0.79	0.80	0.61	0.70	0.72	0.70	0.54	0.56	0.87	0.57	0.64	0.36 J
Calcium	11,300	11,000	9,920	11,500	11,800	12,600	11,400	11,600	11,300	10,700	7,560	8,700	9,750	10,600	13,100	8,530	11,500	20,000	16,600	14,400	14,600	14,200	16,700	15,400	14,100	13,500	14,200	14,400	8,910
Chromium	60.6	51.7	59.1	53.3	51.0	47.1	47.7	50.4	47.5	56.5	14.5	20.1	15.6	16.5	17.7	15.2	16.1	21.9	22.2	22.2	20.8	20.2	21.4	19.1	18.4	26.3	21.8	21.3	10.5
Cobalt	14.6	13.6	12.9	13.9	14.6	13.5	13.4	13.9	13.1	13.9	5.8	7.0	7.2	7.3	9.0	6.2	7.8	10.3	10.7	11.7	10.7	10.5	10.4	9.9	10.0	10.9	9.9	10.8	5.1
Copper	62.6	52.6	69.1	50.3	48.1	43.9	43.2	46.0	44.1	62.0	41.0	76.7	32.9	32.6	37.4	51.4	36.7	39.8	41.3	36.5	36.8	40.9	37.4	34.2	32.9	36.7	32.7	37.4	25.9
Iron	37,100	35,000	37,700	33,900	33,100	32,900	32,200	33,300	31,700	35,100	17,200	19,800	20,100	20,300	22,900	18,800	21,400	26,200	28,000	29,600	28,300	25,700	29,100	27,600	27,700	30,100	28,400	28,300	16,400
Lead	87.8	70.0	108.0	68.9	59.7	58.2	52.5	59.4	73.5	89.3	21.8	15.4	31.3	33.2	36.3	24.0	32.8	44.0	43.7	36.8	39.0	42.7	38.1	34.8	31.9	36.3	32.2	35.7	19.5
Magnesium	10,700	10,300	8,580	11,000	11,100	11,100	10,600	10,900	10,400	9,900	2,860	3,440	3,640	3,910	4,850	3,410	4,300	5,800	6,260	6,280	5,800	5,560	6,260	6,270	5,910	6,000	6,070	6,140	3,150
Manganese	619	541	632	528	526	473	456	482	473	633	337	441	453	421	529	421	413	645	590	686	619	616	583	516	509	571	486	575	344
Mercury	0.39	0.15	0.12	0.07	0.37	0.04	0.11	0.36	0.16	0.36	0.02	0.03	0.07	0.06	0.08	0.03	0.05	0.08	0.08	0.07	0.08	0.08	0.08	0.07	0.08	0.08	0.07	0.11	0.01
Molybdenum	1.23	1.09	1.69	1.07	1.41	1.10	1.16	1.30	1.30	1.53	2.25	4.18	2.02	2.13	2.38	2.34	2.09	2.53	2.52	2.48	2.39	2.63	2.50	2.29	2.28	2.59	2.27	2.65	3.28
Nickel	58.1	54.5	50.6	56.8	59.1	52.3	52.5	55.7	53.8	56.7	23.6	138.0	22.0	26.4	28.0	25.7	25.7	36.1	34.7	34.5	31.5	35.8	30.5	28.5	28.1	31.9	27.7	32.1	28.9
Potassium	3,140	3,130	2,610	3,210	3,210	3,120	3,100	3,150	2,900	2,950	695	859	953	987	1,250	844	1,070	1,500	1,510	1,710	1,470	1,360	1,550	1,360	1,340	1,490	1,340	1,400	732
Selenium	1.76	1.56	1.36	1.74	1.15	1.53	1.51	1.57	1.52	1.12	0.44 J	0.56	0.65	0.63	0.82	0.25 U	0.64	0.85	0.85	0.89	0.89	0.48 J	0.88	0.80	0.75	0.89	0.73	0.45 J	0.25 U
Silver	0.76	0.51	0.79	0.50 J	0.47 J	5.38	0.50 J	0.47 J	0.53	0.64	0.25 U	0.25 U	0.27 J	0.26 J	0.25 U	0.25 U	0.25 U	0.25 U	0.44 J	0.25 U	0.25 U	0.31 J	0.25 U	0.25 U	0.25 U	0.25 U	0.27 J	0.25 U	0.25 U
Sodium	190	172	174	178	207	181	176	180	161	214	151	181	201	202	232	191	182	278	277	252	228	245	317	269	312	311	281	302	142
Thallium	0.53	0.46 J	0.51	0.48 J	0.48 J	0.45 J	0.46 J	0.48 J	0.45 J	0.51	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.30 J	0.34 J	0.32 J	0.30 J	0.31 J	0.31 J	0.29 J	0.29 J	0.32 J	0.30 J	0.32 J	0.25 U
Vanadium	37.9	35.9	30.6	36.6	36.3	35.2	35.0	35.7	32.9	33.8	12.3	18.6	13.5	14.0	16.0	12.3	13.8	19.2	18.7	20.4	18.4	17.7	18.6	17.0	16.7	18.6	16.9	17.7	13.3
Zinc	335	240	466	228	203	185	188	201	190	335	142	128	155	137	157	111	134	184	176	153	161	173	167	152	147	209	174	181	106

Metal (mg/kg)	Middle River Reach (MRR)					Lower River Reach (LRR)						Old River Reach (ORR)			Outer Harbor Reach (OHR)							
	CH-16	CH-17	CH-18	CH-19	CH-20	CH-21	CH-22	CH-23	CH-24	CH-25	CH-26	CH-27	CH-28	CH-29	CH-30	CH-31	CH-32	CH-33	CH-34	CH-35	CH-36	CH-37
	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ
Aluminum	12,000	11,000	9,400	13,000	12,000	13,000	12,000	10,000	14,000	11,000	13,000	10,000	8,600	8,300	12,000	12,000	11,000	13,000	15,000	18,000	15,000	14,000
Antimony	1.8	1.2	1.1	1.2	1.1	1.3	1.1	1.0	1.0	1.0	1.1	0.99	0.8	1.5	1.2	3.1	1.8	1.5	1.5	1.5	1.5	1.6
Arsenic	17	16	13	18	16	18	17	16	17	14	16	13	9.8	10	16	16	16	17	15	16	15	13
Barium	90	75	65	85	82	90	82	76	86	79	78	69	68	64	83	97	84	92	93	100	100	95
Beryllium	0.81	0.66	0.65	0.86	0.77	0.84	0.81	0.78	0.74	0.67	0.77	0.69	0.75	0.56 J	0.98	0.97	0.71	0.83	0.98	1.1	1.0	1.0
Cadmium	1.4	1.0	0.86	1.2	1.3	1.4	1.3	1.1	1.3	1.1	1.1	1.4	1.3	1.8	1.5	6.9	1.7	1.5	1.4	1.7	1.7	2.0
Calcium	24,000	14,000	14,000	15,000	15,000	14,000	16,000	15,000	16,000	1,800	14,000	19,000	23,000	12,000	12,000	13,000	15,000	11,000	11,000	12,000	10,000	9,800
Chromium	33	24	21	30	29	32	30	27	31	27	27	27	24	32	31	56	29	33	36	40	40	39
Cobalt	13	12	10	14	13	15	14	13	14	12	13	11	7.8	8.6	15	16	14	17	16	17	16	15
Copper	54	42	36	49	47	53	50	43	48	44	44	44	37	54	48	83	59	54	53	57	57	62
Iron	36,000	34,000	30,000	40,000	37,000	39,000	36,000	30,000	40,000	33,000	38,000	29,000	23,000	24,000	34,000	37,000	37,000	40,000	41,000	48,000	41,000	40,000
Lead	72	41	34	46	47	53	48	42	47	47	44	50	53	110	49	98	57	54	51	60	60	66
Magnesium	9,000	5,600	5,800	6,600	6,400	6,300	6,100	5,000	6,900	6,700	6,500	8,400	7,000	4,400	6,000	5,800	5,900	6,300	6,700	7,800	7,000	7,200
Manganese	590	560	490	590	550	550	540	470	620	500	550	470	330	270	560	630	740	650	690	910	740	580
Mercury	0.085	0.065	0.052	0.066	0.074	0.077	0.081	0.062	0.083	0.070	0.074	0.063	0.065	0.130	0.091	0.210	0.110 J	0.110	0.093	0.150	0.130	0.130
Nickel	38	35	30	40	39	41	42	37	41	35	37	34	24	28	44	61	45	48	47	50	49	45
Potassium	2,100	1,800	1,600	2,400	2,300	2,400	2,200	2,000	2,400	2,000	2,100	1,900	1,400	1,500	2,500	2,100	1,700	2,300	2,600	3,000	3,000	2,600
Selenium	1.0 J	0.80 J	0.49 J	0.83 J	0.73 J	0.73 J	0.95 J	0.71 J	0.60 J	0.61 J	0.71 J	0.58 J	0.97 J	0.55 J	0.91 J	1.10 J	0.61 J	0.65 J	0.46 U	1.50 J	0.78 J	0.98 J
Silver	0.36	0.23	0.23	0.26	0.27	0.30	0.23	0.23	0.25	0.22	0.25	0.24	0.19	0.29	0.28	0.95	0.46	0.39	0.45	0.47	0.61	0.57
Sodium	260	180	170	230	190	230	210	210	200	180	150	190	240	260	180	150 J	180	140	160 J	160 J	140 J	140 J
Thallium	0.46 J	0.39 J	0.34 J	0.48 J	0.49 J	0.53	0.48 J	0.44	0.49	0.42	0.43	0.41 J	0.39 J	0.37 J	0.57 J	0.55 J	0.43 J	0.52	0.49 J	0.55 J	0.55 J	0.62 J
Vanadium	26	23	20	28	26	29	27	25	28	24	25	22	16	17	29	26	22	28	31	34	33	31
Zinc	290	210	180	250	270	290	280	240	270	240	240	260	220	280	240	430	240	270	270	290	280	270

LQ - Laboratory qualifiers:
U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).
J = Indicates values below the RL but greater than the MDL.
VQ - Data validation qualifiers:
J = Validator flagged with "J" as a result of MS/MSD recovery problems with the parent sample (CH-32) in the mercury batch (SDG: 1204A28).

TABLE 3. Acid volatile sulfide/simultaneously extracted metals (AVS/SEM) data on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

AVS/SEM Metal (mg/kg)	Lake Area #1														
	CLA1-1			CLA1-2			CLA1-3			CLA1-4			CLA1 Comp		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Cadmium	0.741			0.586			1.51			0.652			0.941		
Copper	10.7			9.07			15.7			9.71			13.3		
Lead	18.5			16.2			34.5			18.7			23		
Nickel	6.21			6.47			8.27			7.59			9.00		
Silver	0.107	J		0.100	U		0.142	J		0.100	U		0.101	J	
Zinc	63.8			43.4			131			47.6			83.8		
Acid volatile sulfide	36.8			104			247			265			384		

AVS/SEM Metal (mg/kg)	Lake Area #4														
	CLA4-1			CLA4-2			CLA4-3			CLA4-4			CLA4 Comp		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Cadmium	0.496			0.616			0.606			0.515			0.564		
Copper	8.54			11.9			10.6			9.2			10.4		
Lead	13.9			16.7			15.3			13.3			15.4		
Nickel	6.68			10.40			9.01			7.79			8.71		
Silver	0.100	U		0.128	J		0.104	J		0.100	U		0.126	J	
Zinc	36.1			57.4			42.8			39.8			46		
Acid volatile sulfide	143			24			89.3			166			835		

AVS/SEM Metal (mg/kg)	DMMU 1																	
	CH-1			CH-2			CH-3			CH-4			CH-5			DMMU1		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Cadmium	0.164	J		0.162	J		0.329			0.392			0.334			0.242	J	
Copper	13.6			10.7			10.7			9.89			12			11.1		
Lead	8.94			22.2			16.8			12.4			17.2			14.9		
Nickel	11.50			6.78			4.83			4.72			5.59			9.95		
Silver	0.100	U		0.100	U		0.100	U		0.100	U		0.100	U		0.100	U	
Zinc	47			232			50			44.1			61			57.5		
Acid volatile sulfide	162			75.1			160			110			248			60.2		

AVS/SEM Metal (mg/kg)	DMMU 2a																	
	CH-6			CH-7			CH-8			CH-9			CH-10			DMMU2a		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Cadmium	0.309			0.287			0.431			0.296			0.359			0.37		
Copper	11.8			11.8			15.5			13.7			12.9			15.7		
Lead	16			16.9			23.6			18.4			17.1			21		
Nickel	5.95			5.10			7.27			8.03			5.56			8.45		
Silver	0.100	U		0.100	U		0.100	U		0.100	U		0.100	U		0.100	U	
Zinc	52.3			61.2			68.3			58.6			54.9			72.3		
Acid volatile sulfide	67.3			224			353			701			292			103		

AVS/SEM Metal (mg/kg)	DMMU 2b																		CDF 10B		
	CH-11			CH-12			CH-13			CH-14			CH-15			DMMU2b			CDF Comp		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Cadmium	0.314			0.326			0.297			0.294			0.3			0.336			0.219	J	
Copper	12.5			12.2			12.5			11.4			11.8			14.3			19.6		
Lead	19.5			17.8			17.9			16.5			16.4			19			10.4		
Nickel	5.76			4.82			4.94			4.70			4.50			6.83			12.30		
Silver	0.100	U		0.100	U		0.100	U		0.100	U		0.100	U		0.100	U		0.100	U	
Zinc	57.1			57.1			64			65.7			67.6			73.7			55.3		
Acid volatile sulfide	310			195			226			255			224			93.3			134		

LQ - Laboratory qualifiers:
U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).
J = Indicates values below the RL but greater than the established MDL.

TABLE 4. Inorganic chemistry data on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

Inorganic Parameter (mg/kg)	Lake Area #1					Lake Area #4				
	CLA1-1	CLA1-2	CLA1-3	CLA1-4	CLA1 Comp	CLA4-1	CLA4-2	CLA4-3	CLA4-4	CLA4 Comp
	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ
Ammonia-N	120	152	104	144	140	106	60.4	83.9	77.7	73.9
Phosphorus, Total (As P)	925	814	804	763	775	742	683	734	690	851
Cyanide, Total	0.95	1	0.8	0.93	0.94	0.89	0.9	0.91	0.89	0.87
Nitrogen, Total Kjeldahl	2,380	3,900	1,850	3,100	2,460	2,770	2,360	3,450	2,480	1,980
Total Organic Carbon	26,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	19,000	24,000
Organic Matter (%)	4.8	5.3	4.1	4	5.2	3.8	3.5	4.2	4	5.2

Inorganic Parameter (mg/kg)	DMMU 1						DMMU 2a					
	CH-1	CH-2	CH-3	CH-4	CH-5	DMMU1	CH-6	CH-7	CH-8	CH-9	CH-10	DMMU2a
	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ
Ammonia-N	10.3	25	96.3	93.6	171	66.2	84.9	195	208	183	167	189
Phosphorus, Total (As P)	404	400	611	587	592	462	572	632	708	654	670	637
Cyanide, Total	0.55	1.8	1.3	0.43	0.41	0.32	0.36	0.75	0.63	0.39	0.65	0.51
Nitrogen, Total Kjeldahl	504	287	850	1,670	1,880	1,570	1,120	1,830	2,000	1,850	1,800	1,910
Total Organic Carbon	6,200	2,200	13,000	16,000	11,000	15,000	16,000	17,000	21,000	17,000	15,000	8,900
Organic Matter (%)	0.98	2.9	3.5	5.9	4.5	2.8	3.4	4.3	5.3	4.5	5.7	4.4

Inorganic Parameter (mg/kg)	DMMU 2b						CDF 10B
	CH-11	CH-12	CH-13	CH-14	CH-15	DMMU2b	CDF Comp
	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ
Ammonia-N	202	201	211	158	165	146	5.6
Phosphorus, Total (As P)	824	678	677	722	636	684	334
Cyanide, Total	0.43	0.43	0.41	0.35	0.39	0.44	0.26
Nitrogen, Total Kjeldahl	1,680	1,570	1,640	1,430	1,290	1,920	230
Total Organic Carbon	14,000	24,000	17,000	13,000	9,000	13,000	1,800
Organic Matter (%)	5	4.3	4.1	3.8	3.8	3.7	0.81

Inorganic Parameter (mg/kg)	Middle River Reach (MRR)					Lower River Reach (LRR)					
	CH-16	CH-17	CH-18	CH-19	CH-20	CH-21	CH-22	CH-23	CH-24	CH-25	CH-26
	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ
Ammonia-N	240	160	140	170	140	180	160	160	140	120	190
Phosphorus, Total (As P)	300	240	230	290	320 J	300	330	270	310	320	300
Cyanide, Total	0.63 J	1.6 U	0.62 J	0.59 J	1.7 U	0.83 J	0.73 J	0.65 J	1.8 U	1.7 U	1.7 U
Nitrogen, Total Kjeldahl	1,200	800	790	1,300	590	1,400	1,100	1,200	1,100	1,000	1,300
Total Organic Carbon (AVG)	32,100	26,800	25,200	25,300	23,600	27,500	22,500	24,900	22,600	21,100	25,000
Percent Moisture (%)	44	39	35	44	43	46	43	42	43	40	41

Inorganic Parameter (mg/kg)	Old River Reach (ORR)			Outer Harbor Reach (OHR)						
	CH-27	CH-28	CH-29	CH-30	CH-31	CH-32	CH-33	CH-34	CH-35	CH-36	CH-37
	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ
Ammonia-N	93	120	130	160	190	200	220	160	140	220	160
Phosphorus, Total (As P)	300	420	530	300	540	310	300	410	400	360	450 J
Cyanide, Total	1.6 U	1.6 U	2.5	2.0 U	1.1 J	1.7 U	2.0 U	2.2 U	2.5 U	2.4 U	2.3 U
Nitrogen, Total Kjeldahl	950	1,400	1,300	1,700	1,600	1,900	1,800	2,100	2,100	2,100	3,000
Total Organic Carbon (AVG)	21,200	24,900	26,100	23,900	24,600	26,400	24,700	22,900	25,200	24,500	31,500
Percent Moisture (%)	37	37	41	51	45	40	49	55	60	58	57

LQ - Laboratory qualifiers:

U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).

J = Indicates values below the RL but greater than the MDL.

VQ - Data validation qualifiers:

J = Phosphorus parent samples CH-20 and CH-37 flagged with "J" as a result of MS/MSD recovery problems in the phosphorus batches (SDG: 1204A28).

TABLE 5. Polycyclic aromatic hydrocarbon (PAH) data on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

PAH (ug/kg)	Lake Area #1										Lake Area #4										DMMU 1									
	CLA1-1			CLA1-2			CLA1-3			CLA1-4			CLA1 Comp			CLA4-1			CLA4-2			CLA4-3			CLA4-4			CLA4 Comp		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
1-Methylnaphthalene	44			11	J		28			22	J		10	J		20	J		20	J		152			10	J		18	J	
2-Methylnaphthalene	100			23	J		56			44			10	J		20	J		20	J		334			10	J		18	J	
Acenaphthene	89			11	J		56			44			38			10	J		10	J		456			10	J		9	J	
Acenaphthylene	33			7	U		9	J		11	J		6	U		6	U		6	U		101			6	U		6	U	
Anthracene	333			23	J		158			88			57			20	J		31			1,250			20	J		28		
Benz(a)anthracene	710			124			427			276			133			110			122			3,130			119			128		
Benzo(a)pyrene	743			169			567			332			114			160			183			3,350			149			165		
Benzo(b)fluoranthene	732			236			520			442			114			230			234			2,560			228			211		
Benzo(g,h,i)perylene	488			146			344			232			48			120			132			1,710			129			147		
Benzo(k)fluoranthene	577	J		225	J		604	J		387	J		95	J		190	J		214	J		2,690	J		168	J		156	J	
Chrysene	665			191			483			320			124			170			173			2,900			149			147		
Dibenz(a,h)anthracene	100			45			74			44			19	J		30			31			344			30			37		
Fluoranthene	954			281			790			508			228			320			183			3,980			178			385		
Fluorene	133	J		23	J		74	J		66	J		38	J		30	J		20	J		618	J		20	J		28	J	
Indeno(1,2,3-cd)pyrene	665			169			353			287			76			130			153			2,340			129			184		
Naphthalene	211			56			177			144			29			50			51			760			30			46		
Phenanthrene	532			90			288			221			162			80			92			2,770			79			83		
Pyrene	1,130			270			762			343			257			150			224			4,450			198			193		
Total PAHs*	8,095			2,065			5,687			3,746			1,537			1,806			1,858			33,409			1,641			1,951		

PAH (ug/kg)	DMMU 1						DMMU 2a						DMMU 2b						CDF 10B
	CH-1	CH-2	CH-3	CH-4	CH-5	DMMU1	CH-6	CH-7	CH-8	CH-9	CH-10	DMMU2a	CH-11	CH-12	CH-13	CH-14	CH-15	DMMU2b	CDF Comp
	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ
1-Methylnaphthalene	36	43	55	74	35	34	45	32	29	40	35	39	29	24	31	35	30	38	17
2-Methylnaphthalene	56	68	87	116	55	44	68	41	43	66	48	52	44	38	45	52	43	51	22
Acenaphthene	26	15	66	93	45	40	59	46	39	40	39	43	54	33	36	35	26	46	14
Acenaphthylene	7 J	6 J	22	28	10 J	3 J	9 J	5 J	5 J	15	4 J	4 J	5 J	5 J	4 J	4 J	4 J	4 J	3 J
Anthracene	33	19	208	287	120	94	131	141	135	126	83	155	137	103	138	105	90	130	30
Benz(a)anthracene	66	55	1,050	1,150	893	484	688	856	1,750	923	575	919	838	657	714	702	584	795	126
Benzo(a)pyrene	95 J	77 J	1,430 J	1,550 J	1,380 J	658	941 J	1,610 J	1,520 J	1,450 J	928 J	1,330	1,420 J	1,150 J	1,160 J	1,120 J	949 J	1,150	165
Benzo(b)fluoranthene	92	68	1,460	1,650	1,720	645	1,040	1,400	1,670	1,790	1,010	1,500	1,600	1,420	1,290	1,300	1,160	1,260	162
Benzo(g,h,i)perylene	72	52	907	916	1,030	460	611	1,280	1,230	1,050	684	1,060	1,150	948	960	933	820	955	113
Benzo(k)fluoranthene	95 J	80 J	1,130 J	1,140 J	1,160 J	537 J	719 J	2,140 J	2,050 J	1,190 J	1,110 J	1,100 J	1,810 J	1,470 J	1,470 J	1,270 J	1,040 J	1,020 J	140 J
Chrysene	72	65	929	977	958	521	597	1,230	1,150	969	732	1,130	1,110	892	942	889	743	985	132
Dibenz(a,h)anthracene	13 J	2 U	246 J	259 J	280 J	81	158 J	91 J	188 J	217 J	105 J	189	176 J	150 J	147 J	166 J	137 J	173	22
Fluoranthene	151	111	1,710	1,600	1,530	796	1,560	2,980	2,850	1,650	1,700	3,620	1,700	1,590	3,330	1,700	1,240	1,360	426
Fluorene	40	19	115	190	75	44 J	68	55	48	66	44	86 J	64	52	45	52	39	55 J	19 J
Indeno(1,2,3-cd)pyrene	105	68	1,680	1,730	1,970	665	1,140	1,800	1,920	1,940	1,040	1,460	1,740	1,430	1,460	1,510	1,340	1,330	146
Naphthalene	49	52	109	213	40	61	59	41	39	40	52	56	54	47	40	39	34	59	22
Phenanthrene	151	83	995	1,250	844	433	624	975	867	832	658	820	907	657	853	802	610	766	148
Pyrene	66	71	760	824	709	729	1,190	984	876	727	640	1,500	1,050	1,410	1,040	671	580	1,220	179
Total PAHs*	1,134	842	12,817	13,856	12,764	6,250	9,594	15,633	16,336	13,026	9,404	14,972	13,814	12,013	13,629	11,299	9,396	11,308	1,847

PAH (ug/kg)	Middle River Reach (MRR)										Lower River Reach (LRR)										Old River Reach (ORR)						Outer Harbor Reach (OHR)																	
	CH-16			CH-17			CH-18			CH-19			CH-20			CH-21			CH-22			CH-23			CH-24			CH-25			CH-26			CH-27			CH-28			CH-29			CH-30			CH-31			CH-32			CH-33			CH-34			CH-35			CH-36			CH-37		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
2-Methylnaphthalene	53	J		54	U		50	U		110	J		100	J		200	J		120	J		57	J		64	J		84	J		82	J		70	J		51	U		58	J		66	U		70	J		84	J		81	J		76	J		20	U		19	U		40	J	
Acenaphthene	54	J		49	U		60	J		83	J		70	J		130	J		84	J		51	U		61	J		84	J		68	J		78	J		47	U		63	J		60	U		89	J		97	J		78	J		65	U		22	J		18	U		53	J	
Acenaphthylene	39	J		47	U		66	J		51	U		50	U		69	J		67	J		49	U		50	U		62	J		48	U		48	J		45	U		85	J		57	U		94	J		75	J		76	J		63	U		35	J		22	J		79	J	
Anthracene	160	Jm		140	J		180	Jm		190	Jm		170	Jm		240	Jm		190	Jm		110	J		150	Jm		220	Jm		180	Jm		160	J		100	J		180	J		110	J		220	J		250	J		220	J		140	J		70	J		42	J		180	Jm	
Benz(a)anthracene	590	m		540	J		710	Jm		610	J		540	J		830	J		650	J		380	J		600	J		700	J		580	J		540	Jm		350	J		550	J		380	J		680	J		800	J		650	J		480	J		210	J		150	J		590	m	
Benzo(a)pyrene	870			800	J		960	J		950	J		720	J		1,100	J		810	J		520	J		750	J		930	J		740	J		680	J		420	J		630	J		490	J		840	J		1,100	J		830	J		670	J		290	J		210	J		770		
Benzo(b)fluoranthene	1,600	m		1,100	m		1,300	m		1,300	m		1,100	Jm		1,800	m		1,100	Jm		850	Jm		1,000	Jm		1,300	m		1,200	m		1,000	Jm		590	Jm		870	Jm		740	Jm		1,300	m		1,600	m		1,300	Jm		1,200	Jm		340	Jm		280	Jm		1,100	m	
Benzo(g,h,i)perylene	350			610	J		660	J		640	J		500	J		610	J		380	J		320	J		360	J		420	J		330	J		280	J		220	J		310	J		300	J		280	J		380	J		280	J		310	J		210	J		170	J		380		
Benzo(k)fluoranthene	510	m		420	Jm		570	Jm		580	Jm		340	Jm		500	Jm		380	Jm		290	Jm		440	Jm		510	Jm		390	Jm		380	Jm		230	Jm		340	Jm		230	Jm		530	Jm		590	Jm		540	Jm		380	Jm		160	Jm		91	Jm		330	Jm	
Chrysene	950			860	J		1,100			1,000	J		870	J		1,200			840	J		590	J		780	J		960	J		850	J		730	J		430	J		690	J		530	J		880	J		1,100			930	J		780	J		310	J		220	J		820		
Dibenz(a,h)anthracene	47	U		170	U		160	U		190	U		180	U		200	U		180	U		180	U		190	U		180	U		180	U		170	U		170	U		180	U		210	U		190	U		180	U		210	U		230	U		66	U		63	U		87	J	
Fluoranthene	1,800			1,700			2,100			1,800			1,700			2,500			1,700			1,200			1,600			1,900			1,700			1,400			770	J		1,300			1,000	J		1,700			2,300			1,800			1,300	J		540			380			1,500		
Fluorene	70	J		66	J		88	J		110	J		95	J		160	J		110	J		65	U		82	J		110	J		91	J		110	J		59	U		92	J		76	U		170	J		140	J		130	J		83	U		34	J		22	U		84	J	
Indeno(1,2,3-cd)pyrene	300			490	J		600	J		540	J		420	J		540	J		340	J		270	J		350	J		380	J		310	J		270	J		180	J		250	J		250	J		250	J		370	J		280	J		260	J		180	J		140	J		350	J	
Naphthalene	42	J		42	U		49	J		100	J		95	J		190	J		110	J		48	J		54	J		69	J		68	J		61	J		41	U		56	J		52	U		75	J		69	J		81	J		62	J		26	J		18	J		53	J	
Phenanthrene	830			710	J		940	J		960	J		770	J		1,200			800	J		500	J		700	J		880	J		830	J		700	J		330	J		560	J		480	J		850	J		1,100			830	J		580	J		260	J		160	J		580		
Pyrene	1,700			1,300			1,700			1,500			1,300			1,800			1,400			840	J		1,400			1,600			1,300			1,100			680	J		1,200			840	J		1,500			1,800			1,600			1,100	J		440			310	J		1,300		
Total PAHs*	9,912			9,044			11,243			10,604			8,920			13,069			9,141			6,263			8,567			10,305			8,865			7,707			4,662			7,356			5,805			9,648			11,951			9,835			7,703			3,193			2,296			8,256		

LQ - Laboratory qualifiers:
U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).
J = Indicates values below the RL but greater than the MDL.
m = Manual integration used to determine area response.

VQ - Data validation qualifiers:
PAH analysis (8270) for discrete samples CH1 to CH15 (Batch B205006) had recoveries of benzo(a)pyrene, benzo(k)fluoranthene, and dibenz(a,h)anthracene that were above criteria. Associated sample results that were detected were flagged with a J. Non-detect results did not require further qualification.
PAH analysis (8270) for samples CLA1-1 to CLA1-4; CLA4-1 to CLA4-4; CDF 10B, DMMU-1, DMMU-2a, DMMU-2b, CLA1 Comp, CLA4 Comp, and CDF Comp (Batch B205033) had a recovery of benzo(k)fluoranthene that was above criteria. Associated sample results that were detected were flagged with a J. Non-detect results did not require further qualification.
It also had a recovery of fluorene that was below criteria. Associated sample results that were detected were flagged with a J. Fluorene was detected in all samples so no data were rejected.

*Total PAHs represents the sum of the 16 priority pollutant PAHs (excluding 1- and 2-Methylnaphthalene) assigning non-detectable congeners a value of one-half the MDL.

TABLE 6. PAH pore water data on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

PAH Compounds (ug/L)	Lake Area						Harbor Management Unit									CDF 10B		
	CLA1 Comp			CLA4 Comp			DMMU 1			DMMU 2a			DMMU 2b			CDF Comp		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Naphthalene	0.802	U		0.802	U		0.802	U		0.802	U		0.854			0.802	U	
2-methylnaphthalene	0.4	U		0.4	U		0.4	U		0.4	U		0.4	U		0.4	U	
1-methylnaphthalene	0.4	U		0.4	U		0.4	U		0.4	U		0.4	U		0.4	U	
C2-Naphthalenes	0.59			0.557	U		0.557	U		0.557	U		0.557	U		0.557	U	
C3-Naphthalenes	4.78			0.911	U		0.911	U		0.911	U		0.911	U		0.911	U	
C4-Naphthalenes	6.14	B		1.13	B	U	1.13	BU		1.13	BU		1.13	BU		1.13	BU	
Acenaphthylene	0.2	U		0.2	U		0.2	U		0.2	U		0.2	U		0.2	U	
Acenaphthene	0.459			0.2	U		0.2	U		0.2	U		0.2	U		0.2	U	
Fluorenes	0.12	U		0.12	U		0.12	U		0.12	U		0.12	U		0.12	U	
C1-Fluorenes	1.46			0.164	U		0.164	BU		0.164	BU		0.164	U		0.164		U
C2-Fluorenes	3.12			0.203		U	0.203	BU		0.203	BU		0.203	B	U	0.203	BU	
C3-Fluorenes	0.343	B	U	0.343		U	0.343	BU		0.343	BU		0.343	B	U	0.343	BU	
Phenanthrene	0.407			0.12	U		0.142	B		0.272			0.314			0.12	U	
Anthracene	0.12	U		0.12	U		0.12	U		0.12	U		0.12	U		0.12	U	
C1-Phenanthracenes/Anthracenes	0.952			0.21	U		0.21	BU		0.21	BU		0.21	U		0.21	U	
C2-Phenanthracenes/Anthracenes	1.6	B		0.375	U		0.375	BU		0.375	U		0.375	U		0.375	U	
C3-Phenanthracenes/Anthracenes	0.635	B		0.414	U		0.414	U		0.414	U		0.414	U		0.414	U	
C4-Phenanthracenes/Anthracenes	1	U		1	U		1	U		1	U		1	U		1	U	
Fluoranthene	0.291			0.04	U		0.114	B		0.188			0.198			0.04	U	
Pyrene	0.255			0.04	U		0.074	B		0.128			0.139			0.04	U	
C1-Fluoranthenes/pyrenes	0.184			0.078	U		0.078	U		0.078	U		0.078		U	0.078	U	
Benz[a]anthracene	0.019			0.004	U		0.007			0.011			0.014			0.004	U	
Chrysene	0.027			0.004	U		0.016			0.03			0.027			0.004	U	
C1-Benzo(a)anthracenes/Chrysenes	0.006	U		0.006	U		0.006	U		0.006		U	0.006	U		0.006	U	
C2-Benzo(a)anthracenes/Chrysenes	0.014	U		0.014	U		0.014	BU		0.014	BU		0.014	U		0.014	B	U
C3-Benzo(a)anthracenes/Chrysenes	0.017	U		0.017	U		0.017	BU		0.017	B	U	0.017	U		0.017	U	
C4-Benzo(a)anthracenes/Chrysenes	0.024	BU		0.024	BU		0.024	B	U	0.024	B	U	0.024	B	U	0.024	BU	
Benzo(b)fluoranthene	0.024	U		0.024	U		0.024	U		0.024	U		0.024	U		0.024	U	
Benzo(k)fluoranthene	0.024	U		0.024	U		0.024	U		0.024	U		0.024	U		0.024	U	
Benzo(e)pyrene	0.024	U		0.024	U		0.024	U		0.024	U		0.024	U		0.024	U	
Benzo(a)pyrene	0.024	U		0.024	U		0.024	U		0.024	U		0.024	U		0.024	U	
Perylene	0.024	U		0.024	U		0.024	U		0.024	U		0.024	U		0.024	U	
Indeno(1,2,3-cd)pyrene	0.024	U		0.024	U		0.024	U		0.024	U		0.024	U		0.024	U	
Dibenz(a,h)anthracene	0.024	U		0.024	U		0.024	U		0.024	U		0.024	U		0.024	U	
Benzo(ghi)perylene	0.024	U		0.024	U		0.024	U		0.024	U		0.024	U		0.024	U	
Total Toxic Units	2.8			<0.1			<0.1			0.1			0.1			<0.1		

LQ - Laboratory qualifiers:

U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).

B = Analyte detected in the Method Blank

BU = Concentration less than Reporting Limit (RL) due to Method Blank subtraction.

VQ - Data validation qualifiers:

U - Sample concentrtation corrected (subtracted) for blank concentration, indicates analyte was not detected in chromatogram.

All toxic units calculated using porewater concentrations corrected for blanks

Chronic Value obtained from U.S. EPA. 2003. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures. EPA-600-R-02-013. Office of Research and Development. Washington, DC 20460

TABLE 7. Polychlorinated biphenyl (PCB) data as Aroclors on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

PCB Aroclor (ug/kg)	Lake Area #1															Lake Area #4														
	CLA1-1			CLA1-2			CLA1-3			CLA1-4			CLA1 Comp			CLA4-1			CLA4-2			CLA4-3			CLA4-4			CLA4 Comp		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
1016	17.2	U		17.5	U		14.4	U		17.2	U		14.6	U	J	15.5	U		15.8	U		15.7	U		15.4	U		14.2	U	
1221	18.0	U		18.2	U		15.1	U		17.9	U		15.2	U	J	16.2	U		16.5	U		16.4	U		16.0	U		14.9	U	
1232	18.0	U		18.2	U		15.1	U		17.9	U		15.2	U	J	16.2	U		16.5	U		16.4	U		16.0	U		14.9	U	
1242	18.0	U		18.2	U		15.1	U		17.9	U		15.2	U	J	16.2	U		16.5	U		16.4	U		16.0	U		14.9	U	
1248	61.3			54.6			63.1			61.9			60.4		J	61.3			69.7			53.9			52.7			57.1		
1254	83.5			52.5			86.9			62.1			64.5		J	51.7			87.6			50.9			51.5			54.3		
1260	17.8	U		18.1	U		14.9	U		17.7	U		15.1	U	J	16.3	U		16.3	U		16.3	U		15.9	U		14.7	U	
Total PCBs*	144.8			107.1			150.0			124.0			124.9			113.0			157.3			104.8			104.2			111.4		
Total organic carbon (TOC) (decimal %)	0.0260			0.0250			0.0250			0.0250			0.0250			0.0250			0.0250			0.0250			0.0190			0.0140		
TOC-normalized total PCBs (ug/kg-TOC)	5569			4284			6000			4960			4996			4520			6292			4192			5484			7957		

PCB Aroclor (ug/kg)	DMMU 1																	
	CH-1			CH-2			CH-3			CH-4			CH-5			DMMU1		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
1016	5.10	U		4.77	U		8.49	U		7.19	U		7.75	U		5.21	U	
1221	5.33	U		4.98	U		8.85	U		7.50	U		8.09	U		5.44	U	
1232	5.33	U		4.98	U		8.85	U		7.50	U		8.09	U		5.44	U	
1242	5.30	U		4.98	U		8.85	U		7.50	U		8.09	U		5.44	U	
1248	19.8			24.1			152			51.4			49.6			51.6		
1254	13.5			11.1			191			43.3			69.5			44		
1260	5.28	U		4.94	U		8.77	U		7.43	U		8.01	U		5.39	U	
Total PCBs*	33.3			35.2			343.0			94.7			119.1			95.6		
Total organic carbon (TOC) (decimal %)	0.0062			0.0022			0.0130			0.0160			0.0110			0.0150		
TOC-normalized total PCBs (ug/kg-TOC)	5371			16000			26385			5919			10827			6373		

PCB Aroclor (ug/kg)	DMMU 2a																	
	CH-6			CH-7			CH-8			CH-9			CH-10			DMMU2a		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
1016	7.02	U		7.07	U		7.48	U		7.83	U		6.76	U		6.67	U	
1221	7.33	U		7.38	U		7.80	U		8.17	U		7.05	U		6.96	U	
1232	7.33	U		7.38	U		7.80	U		8.17	U		7.05	U		6.96	U	
1242	7.33	U		7.38	U		7.80	U		8.17	U		7.05	U		6.96	U	
1248	53.7			52.4			45.2			39.9			56.3			47.4		
1254	46.2			85.3			34.8			9.94	J		40.6			34		
1260	7.26	U		7.31	U		7.73	U		8.10	U		6.99	U		6.89	U	
Total PCBs*	99.9			137.7			80.0			49.8			96.9			81.4		
Total organic carbon (TOC) (decimal %)	0.0160			0.0170			0.0210			0.0170			0.0150			0.0089		
TOC-normalized total PCBs (ug/kg-TOC)	6244			8100			3810			2932			6460			9146		

PCB Aroclor (ug/kg)	DMMU 2b																		CDF 10B		
	CH-11			CH-12			CH-13			CH-14			CH-15			DMMU2b			CDF Comp		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
1016	7.61	U		7.28	U		6.93	U		6.77	U		6.67	U		6.53	U		4.27	U	
1221	7.94	U		7.60	U		7.23	U		7.06	U		6.96	U		6.82	U		4.45	U	
1232	7.94	U		7.60	U		7.23	U		7.06	U		6.96	U		6.82	U		4.45	U	
1242	7.94	U		7.60	U		7.23	U		7.06	U		6.96	U		6.82	U		4.45	U	
1248	52.5			53.1			50.6			57.5			48.9			46.3			24.1		
1254	33.3			43.6			40.1			52			34.3			37.1			26.6		
1260	7.87	U		7.53	U		7.17	U		6.99	U		6.89	U		6.75	U		4.41	U	
Total PCBs*	85.8			96.7			90.7			109.5			83.2			83.4			50.7		
Total organic carbon (TOC) (decimal %)	0.0140			0.0240			0.0170			0.0130			0.0090			0.0130			0.0018		
TOC-normalized total PCBs (ug/kg-TOC)	6129			4029			5335			8423			9244			6415			28167		

PCB Aroclor (ug/kg)	Middle River Reach (MRR)															Lower River Reach (LRR)																	
	CH-16			CH-17			CH-18			CH-19			CH-20			CH-21			CH-22			CH-23			CH-24			CH-25			CH-26		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
1016	5.3	U		4.9	U		4.6	U		5.4	U		5.3	U		5.5	U		5.3	U		5.2	U		5.3	U		5.0	U		5.2	U	
1221	5.3	U		4.9	U		4.6	U		5.4	U		5.2	U		5.5	U		5.2	U		5.2	U		5.3	U		4.9	U		5.1	U	
1232	7.9	U		7.4	U		6.9	U		8.0	U		7.9	U		8.3	U		7.9	U		7.7	U		7.9	U		7.4	U		7.7	U	
1242	6.6	U		6.1	U		5.7	U		6.7	U		6.5	U		6.9	U		6.5	U		6.4	U		6.6	U		6.1	U		6.4	U	
1248	6.2	U		5.8	U		5.4	U		6.3	U		6.2	U		6.5	U		6.2	U		6.0	U		6.2	U		5.8	U		6.0	U	
1254	7.5	U		6.9	U		6.5	U		7.6	U		7.4	U		7.8	U		7.4	U		7.3	U		7.5	U		7.0	U		7.2	U	
1260	5.2	U		4.8	U		4.5	U		5.2	U		5.1	U		5.4	U		5.1	U		5.0	U		5.2	U		4.8	U		5.0	U	
Total PCBs*	13.7			12.7			11.9			13.9			13.6			14.3			13.6			13.3			13.7			12.8			13.2		

PCB Aroclor (ug/kg)	Old River Reach (ORR)									Outer Harbor Reach (OHR)																							
	CH-27			CH-28			CH-29			CH-30			CH-31			CH-32			CH-33			CH-34			CH-35			CH-36			CH-37		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
1016	4.7	U		4.7	U		5.1	U		6.1	U		5.4	U		5.0	U		5.9	U		6.8	U		7.6	U		7.2	U		6.9	U	
1221	4.7	U		4.7	U		5.1	U		6.1	U		5.4	U		5.0	U		5.9	U		6.7	U		7.6	U		7.2	U		6.9	U	
1232	7.1	U		7.1	U		7.6	U		9.1	U		8.1	U		7.5	U		8.8	U		10.0	U		11.0	U		11.0	U		10.0	U	
1242	5.9	U		5.9	U		6.3	U		7.6	U		6.7	U		6.2	U		7.3	U		8.4	U		9.4	U		8.9	U		8.5	U	
1248	5.5	U		5.5	U		5.9	U		7.2	U		6.3	U		5.9	U		6.9	U		7.9	U		8.9	U		8.4	U		8.1	U	
1254	6.7	U		6.7	U		21	J		8.6	U		7.6	U		24	J		8.3	U		9.5	U		25	J		71	J		81		
1260	4.6	U		4.6	U		4.9	U		6.0	U		5.3	U		4.9	U		5.8	U		6.6	U		7.4	U		7.0	U		6.7	U	
Total PCBs*	12.2			12.2			26.9			15.8			13.9			29.9			15.2			17.4			33.9			79.4			89.1		

LQ - Laboratory qualifiers:
U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).
J = Indicates values below the RL but greater than the MDL.
VQ - Data validation qualifiers:
J = Validator flagged PCB analysis (8082) for sample CLA1-Comp in batch B205033 as it was found to have low surrogate recoveries. The sample was reextracted outside of the holding time and the results were flagged with a J.
*Total PCBs represents the sum of the two commonly detected Aroclors 1248 and 1254; the MDL was used to assign a value to any non-detectable concentrations.

TABLE 8. PCB congener data on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

PCB Congener (ug/kg)	Lake Area						Harbor Management Unit									CDF 10B		
	CLA1 Comp			CLA4 Comp			DMMU 1			DMMU 2a			DMMU 2b			CDF Comp		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
1	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
3	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
5	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
6	0.31	U		0.31	U		3.29			0.14	U		0.14	U		0.09	U	
7	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
8	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
9	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
12/13	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
14	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
15/16	0.31	U		1.22			6.76			12.60			9.96			11.40		
17	0.31	U		0.31	U		1.89			1.52			0.80			0.09	U	
18	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
19	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
20	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
22	0.31	U		0.31	U		2.74			0.14	U		0.14	U		0.09	U	
24	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
25	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		1.84		
26	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
27	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
28/31	4.60			8.12			9.49			4.10			7.72			20.80		
29	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
32	0.31	U		0.31	U		3.75			2.81			0.14	U		0.09	U	
33	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
34	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
35	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
37																		
40	0.62			0.31	U		1.39			1.67			1.72			1.22		
41	2.61			0.31	U		0.77			0.14	U		0.14	U		1.62		
42	1.34			0.71			0.11	U		0.14	U		0.14	U		0.09	U	
44	2.60			0.94			5.14			9.08			13.40			9.49		
45	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
46	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
47																		
48	0.31	U		1.08			1.25			1.23			1.52			0.09	U	
49	2.08			1.54			2.95			2.26			2.32			7.36		
51	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
52	3.51			6.52			8.73			7.64			6.23			10.50		
53	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.87		
54	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
56	3.36			3.54			7.94			11.60			9.80			12.20		
59	0.31	U		0.31	U		0.73			0.79			0.51			0.09	U	
60	0.31	U		1.09			1.35			0.71			0.70			0.73		
63	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
64																		
66	3.33			3.22			3.42			2.43			2.39			5.14		
67	0.31	U		0.31	U		0.61			0.14	U		0.14	U		0.09	U	
69	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
70	4.40			3.88			4.16			5.73			3.86			7.61		
71																		
73	0.31	U		0.31	U		0.48			0.62			0.90			2.65		
74	1.98			2.24			1.34			4.60			4.62			2.99		
75	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
77	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
81	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
82	2.92			2.13			0.11	U		0.14	U		0.14	U		0.09	U	
83	0.31	U		0.31	U		0.79			1.07			1.07			0.09	U	
84	3.42			0.31	U		1.94			0.14	U		1.52			5.84		
85	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
87	2.83			2.36			2.88			1.60			1.47			8.07		
90/101	6.16			5.34			5.98			4.96			5.14			7.76		
91	1.08			0.70			1.19			1.14			1.44			2.94		
92	1.27			1.93			0.11	U		0.14	U		0.14	U		3.29		
93	0.31	U		0.31	U		1.55			1.59			1.32			0.09	U	
95	4.95			4.12			5.54			4.88			4.54			6.95		
97	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
99	2.71			0.31	U		2.25			2.72			1.73			2.68		
100	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
103	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
104	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
105	5.44			6.26			3.64			3.03			3.44			5.38		
107	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
110/115	7.78			6.61			6.15			4.59			4.78			9.16		
114	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
117	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
118	8.04			7.20			6.05			5.43			5.68			10.99		
119	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
122	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
123																		
124	0.31	U		0.31	U		1.14			0.14	U		0.14	U		0.09	U	
128	1.73			1.29			1.08			0.95			0.95			0.09	U	
129	0.75			0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
130	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
131	0.31	U		0.31	U		0.80			0.63			0.86			0.09	U	
132	3.07			2.25			1.75			1.12			1.57			3.04		
134	0.31	U		0.31	U		1.26			1.14			0.67			0.09	U	
135	1.94			0.31	U		0.86			1.23			1.18			2.31		
136	0.31	U		0.31	U		0.82			0.14	U		2.35			0.09	U	
137	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
138/163	8.29			7.07			5.62			4.63			5.12			6.37		
141	1.07			1.09			1.04			0.80			0.76			0.09	U	
144	0.31	U		0.31	U		1.35			0.14	U		0.14	U		0.09	U	
146	0.63			0.85			0.54			0.72			0.70			0.09	U	
147	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
149	5.43			4.58			5.05			5.44			5.21			9.63		
151	1.62			0.87			1.11			1.07			0.74			4.26		
153	5.48			5.32			4.07			3.76			4.01			3.88		
154	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
156	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
157	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
158	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
164	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
165	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
167	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
170	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
171	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
172	0.31	U		0.31	U		1.33			2.00			1.94			0.09	U	
173	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
174	2.08			1.64			1.05			1.63			2.07			0.09	U	
175	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
176	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
177	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
178	0.31	U		2.00			1.51			3.02			3.26			0.09	U	
179	0.31	U		1.05			0.66			0.74			0.65			0.09	U	
180	3.17			3.11			1.99			3.05			3.10			3.84		
183	0.65			0.58	J		0.54			0.71			0.14	U		0.09	U	
185	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
187	2.06			1.73			1.20			2.20			1.81			0.09	U	
189	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
190	1.63			0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
191	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
193	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
194	0.96			1.47			0.11	U		0.14	U		0.14	U		0.09	U	
195	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
196	1.04			0.72			0.11	U		0.14	U		0.14	U		0.09	U	
197	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
199	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
200	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
201	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
202	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
203	0.31	U		0.73			0.11	U		0.14	U		0.14	U		0.09	U	
205	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
206	1.45			0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
207	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
208	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
ΣPCBs*	**147.7**			**135.0**			**149.1**			**147.4**			**147.4**			**201.9**		

LQ - Laboratory qualifiers:
U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).
J = Indicates values below the RL but greater than the MDL.
with these results and data should be considered as estimated.

Blued shaded cells indicated congener can't be resolved due to multiple co-elutions.
*Sum of PCB congeners assigning non-detectable congeners a value of one-half the MDL.

TABLE 9. Estimated total PCB concentrations in Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

PCB Congener (ug/kg)	Lake Area						Harbor Management Unit									CDF 10B		
	CLA1 Comp			CLA4 Comp			DMMU 1			DMMU 2a			DMMU 2b			CDF Comp		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
8	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
18	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
28/31	4.60			8.12			9.49			4.10			7.72			20.80		
44	2.60			0.94			5.14			9.08			13.40			9.49		
49	2.08			1.54			2.95			2.26			2.32			7.36		
52	3.51			6.52			8.73			7.64			6.23			10.50		
66	3.33			3.22			3.42			2.43			2.39			5.14		
87	2.83			2.36			2.88			1.60			1.47			8.07		
90/101	6.16			5.34			5.98			4.96			5.14			7.76		
105	5.44			6.26			3.64			3.03			3.44			5.38		
118	8.04			7.20			6.05			5.43			5.68			10.99		
128	1.73			1.29			1.08			0.95			0.95			0.09	U	
138/163	8.29			7.07			5.62			4.63			5.12			6.37		
153	5.48			5.32			4.07			3.76			4.01			3.88		
170	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
180	3.17			3.11			1.99			3.05			3.10			3.84		
183	0.65			0.58	J		0.54			0.71			0.14	U		0.09	U	
184																		
187	2.06			1.73			1.20			2.20			1.81			0.09	U	
195	0.31	U		0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
206	1.45			0.31	U		0.11	U		0.14	U		0.14	U		0.09	U	
209																		
Total PCBs*	**124.1**			**122.7**			**126.1**			**112.4**			**126.4**			**199.9**		
Total organic carbon (TOC) (decimal %)	**0.025**			**0.024**			**0.015**			**0.0089**			**0.013**			**0.0018**		
TOC-normalized total PCBs (ug/kg-TOC)	**4962**			**5114**			**8407**			**12625**			**9723**			**111073**		

LQ - Laboratory qualifiers:

U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).

J = Indicates values below the RL but greater than the MDL.

Blue shaded cells indicated congener can't be resolved due to multiple co-elutions.

* Total PCBs estimated using methodology consistent with USEPA (2002) and assigning any non-detectable congeners a value of one-half the MDL.

TABLE 10. Pesticides data on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

Pesticide (ug/kg)	Lake Area #1										Lake Area #4									
	CLA1-1		CLA1-2		CLA1-3		CLA1-4		CLA1 Comp		CLA4-1		CLA4-2		CLA4-3		CLA4-4		CLA4 Comp	
	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ
4,4'-DDD	6.60		4.15		13.10		6.25		3.67	J	4.03		4.33		4.09		4.16		4.61	
4,4'-DDE	6.78		3.40		4.50		3.86		3.22	J	3.13		3.21		3.02		3.21		3.29	
4,4'-DDT	0.38	U	0.39	U	0.32	U	0.38	U	1.99	J	0.34	U	0.35	U	0.35	U	0.34	U	0.31	U
Aldrin	0.25	U	0.26	U	0.21	U	0.25	U	0.21	U J	0.23	U	0.23	U	0.23	U	0.23	U	0.21	U
alpha-BHC	0.38	U	0.38	U	0.32	U	0.37	U	0.32	U J	0.34	U	0.34	U	0.34	U	0.34	U	0.31	U
alpha-Chlordane	0.39	U	0.40	U	0.33	U	0.39	U	0.33	U J	0.35	U	0.36	U	0.36	U	0.35	U	0.32	U
beta-BHC	0.42	U	0.43	U	0.35	U	0.42	U	0.36	J	0.38	U	0.38	U	0.38	U	0.37	U	0.35	U
delta-BHC	0.36	U R	0.36	U R	0.30	U R	0.36	U R	0.30	U R	0.32	U R	0.33	U R	0.33	U R	0.32	U R	0.30	U R
Dieldrin	0.31	U	0.31	U	0.26	U	0.31	U	0.26	U J	0.28	U	0.28	U	0.28	U	0.28	U	0.26	U
Endosulfan-I	0.85	U	0.86	U	0.71	U	0.81	U	0.72	U J	0.77	U	0.78	U	0.78	U	0.76	U	0.70	U
Endosulfan-II	0.98	U	1.00	U	0.83	U	0.98	U	0.83	U J	0.89	U	0.90	U	0.90	U	0.88	U	0.81	U
Endosulfan-Sulfate	0.39	U	0.40	U	0.33	U	0.39	U	0.33	U J	0.35	U	0.36	U	0.36	U	0.35	U	0.32	U
Endrin	0.35	U	0.34	U	0.29	U	0.35	U	0.30	U J	0.31	U	0.32	U	0.32	U	0.31	U	0.29	U
Endrin Aldehyde	0.68	U	0.69	U	0.57	U	0.68	U	0.58	U J	0.61	U	0.63	U	0.62	U	0.61	U	0.56	U
Endrin Ketone	0.16	U	0.16	U	0.13	U	0.16	U	0.14	U J	0.14	U	0.15	U	0.15	U	0.14	U	0.13	U
gamma-BHC	0.43	U	0.44	U	0.36	U	0.43	U	0.36	U J	0.39	U	0.39	U	0.39	U	0.38	U	0.36	U
gamma-Chlordane	0.42	U	0.43	U	0.35	U	0.42	U	0.36	U J	0.38	U	0.39	U	0.39	U	0.38	U	0.35	U
Heptachlor	0.44	U	0.44	U	0.37	U	0.43	U	0.37	U J	0.39	U	0.40	U	0.40	U	0.39	U	0.36	U
Heptachlor Epoxide	0.47	U	0.48	U	0.40	U	0.47	U	0.40	U J	0.43	U	0.43	U	0.43	U	0.42	U	0.39	U
Methoxychlor	0.66	U	0.67	U	0.55	U	0.66	U	0.56	U J	0.60	U	0.61	U	0.60	U	0.59	U	0.55	U
Toxaphene	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U J	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U

Pesticide (ug/kg)	DMMU 1												DMMU 2a											
	CH-1		CH-2		CH-3		CH-4		CH-5		DMMU1		CH-6		CH-7		CH-8		CH-9		CH-10		DMMU2a	
	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ
4,4'-DDD	0.51		0.72		2.15		2.82		2.54		1.26		3.04		3.98		2.51		2.06		1.92		2.00	
4,4'-DDE	1.43	J	1.74	J	9.31	J	6.71	J	7.71	J	5.71		7.02	J	11.00	J	8.16	J	9.86	J	6.53	J	9.28	
4,4'-DDT	1.42		1.17		6.70		6.73		7.18		4.30		7.26		11.30		8.20		5.41		4.06		5.80	
Aldrin	0.07	U	0.07	U	0.12	U	42.90		0.11	U	0.08	U	0.10	U	0.10	U	0.11	U	0.12	U	0.10	U	0.10	U
alpha-BHC	0.11	U R	0.10	U R	0.19	U R	0.16	U R	0.17	U R	0.11	U	0.15	U R	0.15	U R	0.16	U R	0.17	U R	0.15	U R	0.15	U
alpha-Chlordane	0.12	U	0.11	U	0.19	U	0.16	U	0.18	U	0.12	U	0.16	U	5.74		0.17	U	0.18	U	0.15	U	0.15	U
beta-BHC	0.12	U R	0.12	U R	0.21	U R	0.17	U R	0.19	U R	0.13	U	0.17	U R	4.18	J	0.18	U R	0.19	U R	0.16	U R	0.16	U
delta-BHC	0.11	U R	0.10	U R	0.18	U R	0.15	U R	0.16	U R	0.11	U R	0.15	U R	0.15	U R	0.16	U R	0.16	U R	0.14	U R	0.14	U R
Dieldrin	0.09	U	0.09	U	8.96		0.13	U	0.14	U	0.09	U	0.13	U	0.13	U	1.30	U	0.14	U	0.12	U	0.12	U
Endosulfan-I	0.25	U	0.24	U	0.42	U	0.36	U	0.38	U	0.26	U	0.35	U	0.35	U	0.37	U	0.39	U	0.33	U	0.33	U
Endosulfan-II	0.29	U	0.27	U	0.49	U	0.41	U	0.44	U	0.30	U	0.40	U	0.40	U	0.43	U	0.45	U	0.39	U	0.38	U
Endosulfan-Sulfate	0.12	U	0.11	U	0.19	U	0.16	U	0.18	U	0.12	U	0.16	U	0.16	U	0.17	U	0.18	U	0.15	U	0.15	U
Endrin	0.10	U	0.10	U	0.17	U	0.15	U	0.16	U	0.11	U	0.14	U	0.14	U	0.15	U	0.16	U	0.14	U	0.14	U
Endrin Aldehyde	0.20	U	0.19	U	0.34	U	0.28	U	0.31	U	0.21	U	0.28	U	0.28	U	0.30	U	0.31	U	0.27	U	0.26	U
Endrin Ketone	0.05	U	0.04	U	0.08	U	0.07	U	0.07	U	0.05	U	0.07	U	0.07	U	0.07	U	0.07	U	0.06	U	0.06	U
gamma-BHC	0.13	U R	0.12	U R	0.21	U R	0.18	U R	0.19	U R	0.13	U	0.18	U R	0.18	U R	0.19	U R	0.20	U R	0.17	U R	0.17	U
gamma-Chlordane	0.13	U	0.12	U	0.21	U	0.18	U	3.45	U	0.13	U	2.62		3.98		0.17	U	3.56	U	2.40	U	0.16	U
Heptachlor	0.13	U	0.12	U	0.21	U	0.18	U	0.20	U	0.13	U	0.18	U	0.18	U	0.19	U	0.20	U	0.17	U	0.17	U
Heptachlor Epoxide	0.14	U R	0.13	U R	0.23	U R	0.20	U R	0.21	U R	0.14	U	0.19	U R	0.19	U R	0.21	U R	0.21	U R	0.19	U R	0.18	U
Methoxychlor	0.20	U	0.18	U	0.33	U	0.28	U	0.30	U	0.20	U	0.27	U	0.27	U	0.29	U	0.30	U	0.26	U	0.26	U
Toxaphene	0.00	U	0.00	U	0.01	U	0.00	U	0.00	U	0.00	U	0.00	U	0.00	U	0.00	U	0.01	U	0.00	U	0.00	U

Pesticide (ug/kg)	DMMU 2b														CDF 10B
	CH-11		CH-12		CH-13		CH-14		CH-15		DMMU2b				CDF Comp
	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ			Result LQ VQ
4,4'-DDD	2.86		2.51		2.60		3.66		2.61		2.43				0.52 J
4,4'-DDE	9.33	J	10.20	J	10.30	J	11.20	J	9.80	J	9.89				0.84 J
4,4'-DDT	7.02		7.53		7.54		6.74		7.85		5.51				2.57 J
Aldrin	0.11	U	0.11	U	0.10	U	8.80		0.10	U	0.10	U			0.06 U J
alpha-BHC	0.17	U R	0.16	U R	0.15	U R	0.15	U R	0.15	U R	0.14	U			0.09 U J
alpha-Chlordane	0.17	U	0.17	U	0.16	U	0.15	U	0.15	U	0.15	U			0.10 U J
beta-BHC	0.19	U R	0.18	U R	0.17	U R	0.16	U R	0.16	U R	0.16	U			0.10 U J
delta-BHC	0.16	U R	0.15	U R	0.14	U R	0.14	U R	0.14	U R	0.14	U R			0.09 U R
Dieldrin	0.14	U	0.13	U	0.12	U	0.12	U	0.12	U	0.12	U			0.08 U J
Endosulfan-I	0.38	U	0.36	U	0.34	U	0.33	U	0.33	U	0.32	U			0.21 U J
Endosulfan-II	0.44	U	0.42	U	0.40	U	0.39	U	0.38	U	0.37	U			0.24 U J
Endosulfan-Sulfate	0.17	U	0.16	U	0.16	U	0.15	U	0.15	U	0.15	U			0.10 U J
Endrin	0.15	U	0.15	U	0.14	U	0.14	U	0.14	U	0.13	U			0.09 U J
Endrin Aldehyde	0.30	U	0.29	U	0.27	U	0.27	U	0.26	U	0.26	U			0.17 U J
Endrin Ketone	0.07	U	0.07	U	0.06	U	0.06	U	0.06	U	0.06	U			0.04 U J
gamma-BHC	0.19	U R	0.18	U R	0.17	U R	0.17	U R	0.17	U R	0.16	U			0.11 U J
gamma-Chlordane	0.19	U	0.18	U	0.17	U	0.17	U	0.16	U	0.16	U			0.10 U J
Heptachlor	0.19	U	0.18	U	0.18	U	0.17	U	0.17	U	0.17	U			0.11 U J
Heptachlor Epoxide	0.21	U R	0.20	U R	0.19	U R	0.19	U R	0.18	U R	0.18	U			0.12 U J
Methoxychlor	0.29	U	0.28	U	0.27	U	0.26	U	0.26	U	0.25	U			0.16 U J
Toxaphene	0.00	U	0.00	U	0.00	U	0.00	U	0.00	U	0.00	U			0.00 U J

Pesticide (ug/kg)	Middle River Reach (MRR)										Lower River Reach (LRR)									
	CH-16		CH-17		CH-18		CH-19		CH-20		CH-21		CH-22		CH-23		CH-24		CH-25	
	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ
4,4'-DDD	0.96	U	0.89	U	0.83	U	0.97	U	0.95	U	1.00	U	0.95	U	0.93	U	0.96	U	0.90	U
4,4'-DDE	2.30		1.30	J	1.00	J	1.20	J	1.40	J	2.30		0.84	J	0.98	J	0.86	J	2.20	
4,4'-DDT	4.30		1.90		1.40		2.20		2.00		2.90		2.30		1.40	J	1.50	J	26.00	
Aldrin	1.90	m	4.20		0.52	U	0.60	U	0.59	U	1.60	m	2.10		0.69	J	0.60	U	0.56	U
alpha-BHC	0.52	U	0.48	U	0.45	U	0.52	U	0.51	U	0.54	U	0.51	U	0.50	U	0.52	U	0.48	U
alpha-Chlordane	0.93	J	0.61	U	0.57	U	0.67	U	0.65	U	0.98	J	0.65	U	0.64	U	0.66	U	0.62	U
beta-BHC	0.63	U	0.59	U	0.55	U	0.64	U	0.63	U	0.66	U	0.63	U	0.62	U	0.63	U	0.59	U
delta-BHC	0.52	U	0.48	U	0.45	U	0.52	U	0.51	U	0.54	U	0.51	U	0.50	U	0.52	U	0.48	U
Dieldrin	0.64	U	0.59	U	0.55	U	0.65	U	0.63	U	0.66	U	0.63	U	0.62	U	0.64	U	0.60	U
Endosulfan I	0.66	U	0.62	U	0.57	U	0.67	U	0.66	U	0.69	U	0.66	U	0.65	U	0.66	U	0.62	U
Endosulfan II	0.66	U	0.61	U	0.57	U	0.67	U	0.65	U	0.69	U	0.65	U	0.64	U	0.66	U	0.61	U
Endosulfan sulfate	0.66	U	0.62	U	0.57	U	0.67	U	0.66	U	0.69	U	0.66	U	0.65	U	0.66	U	0.62	U
Endrin	0.68	U	0.63	U	0.59	U	0.69	U	0.67	U	0.71	U	0.67	U	0.66	U	0.68	U	0.63	U
Endrin aldehyde	0.69	U	0.64	U	0.60	U	0.70	U	0.68	U	0.72	U	0.68	U	0.67	U	0.69	U	0.64	U
Endrin ketone	0.65	U	0.60	U	0.56	U	0.66	U	0.64	U	0.67	U	0.64	U	0.63	U	0.65	U	0.60	U
gamma-BHC	0.54	U	0.50	U	0.47	U	0.55	U	0.53	U	0.56	U	0.53	U	0.52	U	0.54	U	0.50	U
gamma-Chlordane	0.66	U	0.70	J	0.61	J	0.72	J	0.77	J	1.20	J	0.65	U	0.64	U	0.66	U	0.62	U
Heptachlor	0.65	U	0.60	U	0.56	U	0.66	U	0.64	U	0.67	U	0.64	U	0.63	U	0.65	U	0.60	U
Heptachlor epoxide	0.65	U	0.61	U	0.57	U	0.66	U	0.65	U	0.68	U	0.65	U	0.64	U	0.65	U	0.61	U
Methoxychlor	0.68	U	0.63	U	0.59	U	0.69	U	0.67	U	0.70	U	0.67	U	0.66	U	0.68	U	0.63	U

Pesticide (ug/kg)	Lower River Reach (LRR)		Old River Reach (ORR)										Outer Harbor Reach (OHR)											
	CH-26		CH-27		CH-28		CH-29		CH-30		CH-31		CH-32		CH-33		CH-34		CH-35		CH-36		CH-37	
	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ	Result	LQ VQ
4,4'-DDD	0.93	U	0.86	U	0.86	U	0.92	U	1.10	U	0.99	U	0.90	U	1.10	U	1.20	U	1.40	U	1.30	U	1.20	U
4,4'-DDE	2.70		1.40	m	0.94	J	1.50	m	0.90	J	1.00	J	1.80	m	2.40		1.70	J	1.10	J	3.70		3.90	
4,4'-DDT	1.10	J	0.55	U	0.55	U	0.59	U	0.72	U	0.64	U	0.58	U	0.69	U	0.79	U	0.89	U	0.84	U	0.81	U
Aldrin	0.58	U	0.53	U	0.53	U	0.57	U	0.69	U	0.61	U	0.56	U	0.66	U	0.76	U	0.85	U	0.81	U	0.77	U
alpha-BHC	0.50	U	0.46	U	0.46	U	0.49	U	0.60	U	0.53	U	0.48	U	0.58	U	0.66	U	0.74	U	0.70	U	0.67	U
alpha-Chlordane	0.80	J	0.59	U	0.59	U	0.63	U	0.76	U	0.68	U	0.62	U	0.74	U	0.84	U	0.94	U	1.10	J	0.86	U
beta-BHC	0.61	U	0.56	U	0.56	U	0.60	U	0.73	U	0.65	U	0.59	U	0.70	U	0.80	U	0.90	U	0.86	U	0.82	U
delta-BHC	0.50	U	0.46	U	0.46	U	0.49	U	0.60	U	0.53	U	0.48	U	0.58	U	0.66	U	0.74	U	0.70	U	0.67	U
Dieldrin	0.62	U	0.57	U	0.57	U	0.61	U	0.73	U	0.66	U	0.60	U	0.71	U	0.81	U	0.91	U	0.86	U	0.83	U
Endosulfan I	0.64	U	0.59	U	0.59	U	0.63	U	0.76	U	0.68	U	0.62	U	0.74	U	0.84	U	0.95	U	0.90	U	0.86	U
Endosulfan II	0.64	U	0.59	U	0.59	U	0.63	U	0.76	U	0.68	U	0.61	U	0.73	U	0.84	U	0.94	U	0.89	U	0.85	U
Endosulfan sulfate	0.64	U	0.59	U	0.59	U	0.63	U	0.76	U	0.68	U	0.62	U	0.74	U	0.84	U	0.95	U	0.90	U	0.86	U
Endrin	0.66	U	0.61	U	0.60	U	0.65	U	0.78	U	0.70	U	0.63	U	0.76	U	0.86	U	0.97	U	2.30		0.88	U
Endrin aldehyde	0.67	U	0.62	U	0.62	U	0.66	U	0.80	U	0.71	U	0.64	U	0.77	U	0.88	U	0.99	U	0.94	U	0.90	U
Endrin ketone	3.70		0.58	U	0.58	U	0.62	U	0.74	U	0.67	U	0.60	U	0.72	U	0.82	U	0.92	U	6.90		6.10	
gamma-BHC	0.52	U	0.48	U	0.48	U	0.51	U	0.62	U	0.55	U	0.50	U	0.60	U	0.69	U	0.77	U	0.73	U	0.70	U
gamma-Chlordane	0.64	U	0.59	U	0.59	U	0.63	U	0.76	U	0.68	U	0.62	U	0.74	U	0.84	U	0.94	U	0.90	U	0.86	U
Heptachlor	0.63	U	0.58	U	0.58	U	0.62	U	0.75	U	0.67	U	0.60	U	0.72	U	0.82	U	0.92	U	0.88	U	0.84	U
Heptachlor epoxide	0.63	U	0.58	U	0.58	U	0.63	U	0.75	U	0.67	U	0.61	U	0.73	U	0.83	U	0.93	U	0.89	U	0.85	U
Methoxychlor	0.66	U	0.60	U	0.60	U	0.65	U	0.78	U	0.70	U	0.63	U	0.75	U	0.86	U	0.97	U	0.92	U	0.88	U

LQ - Laboratory qualifiers:

U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).

J = Indicates values below the RL but greater than the MDL.

m = Manual integration used to determine area response.

VQ - Data validation qualifiers:

Pesticide analysis (8081) in batch B205034 for samples CLA1-Comp and CDF-Comp were found to have low surrogate recoveries. The sample was reextracted outside of the holding time and the results were flagged with a J value.

Pesticide analysis (8081) in batch B205007 for discrete samples CH1 to CH15 had recoveries of 4,4'-DDE, alpha BHC, beta BHC, delta BHC, gamma BHC (Lindane), and heptachlor epoxide that were below criteria. Associated sample results that were detected were flagged with a J. Non-detect results were rejected (R flagged).

Pesticide analysis (8081) in batch B205034 for samples CLA1-1 to CLA1-4; CLA4-1 to CLA4-4; CDF 10B, DMMU-1, DMMU-2a, DMMU-2b, CLA4 Comp, and CDF Comp had recoveries of delta BHC that were below criteria. Non-detect results were rejected (R flagged). Note that delta BHC had a very low recovery in samples and the standard. The calibration was determined to meet requirements ; therefore, it would have been detected if present in the sample.

TABLE 11. Volatile organic compound (VOC) data on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

VOC (ug/kg)	Lake Area #1										Lake Area #4										DMMU 1										DMMU 2a										DMMU 2b										CDF 10B	
	CLA1-1			CLA1-2			CLA1-3			CLA1-4			CLA1 Comp			CLA4-1			CLA4-2			CLA4-3			CLA4-4			CLA4 Comp			CH-1			CH-2			CH-3			CH-4			CH-5			DMMU1			CH-6			CH-7			CH-8			CH-9			CH-10			DMMU2a			CH-11			CH-12			CH-13			CH-14			CH-15			DMMU2b			CDF Comp		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Benzene	1.060	U		1.170	U		0.906	U		1.150	U					1.020	U		1.000	U		1.020	U		1.000	U					0.341	U		0.335	U		40.1	U		50.3	U		92.7	U					42.2	U		45.2	U		48.7	U		47.5	U		49.7	U					48.7	U		47.3	U		1.2	U		47.6	U		1.1	U							
Toluene	0.720	U		0.795	U		0.615	U		0.779	U					0.693	U		0.681	U		0.691	U		0.679	U					0.231	U		7.7			10,500			5,990			10,800						3,810			8,750			14,500			8,600			13,400						3,220			1,800			337			2,150			59								
Ethyl Benzene	0.292	U		0.322	U		0.249	U		0.316	U					0.281	U		0.276	U		0.280	U		0.275	U					0.094	U		0.092	U		11.0	U		13.8	U		25.5	U					11.6	U		12.4	U		13.4	U		13.1	U		13.7	U					13.4	U		13.0	U		0.3	U		13.1	U		0.3	U							
m,p-Xylene	0.985	U		1.090	U		0.841	U		1.070	U					0.949	U		0.932	U		0.945	U		0.929	U					0.316	U		0.311	U		37.2	U		46.7	U		86.1	U					39.2	U		42.0	U		45.2	U		44.1	U		46.2	U					45.2	U		43.9	U		1.1	U		44.2	U		1.1	U							
o-Xylene	0.644	U		0.711	U		0.550	U		0.697	U					0.620	U		0.609	U		0.618	U		0.607	U					0.207	U		0.204	U		24.3	U		30.5	U		56.3	U					25.6	U		27.5	U		29.6	U		28.9	U		30.2	U					29.6	U		28.7	U		0.7	U		28.9	U		0.7	U							

LQ - Laboratory qualifiers:
U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).

TABLE 12. Comparison of Cleveland Harbor DMMU-1, DMMU-2a and DMMU-2b bulk sediment toluene concentrations to equibrium partitioning sediment benchmarks (ESBs) relating to the narcotic mode of action (based on data from USACE 2013b).

Site	Narcosis ESB ($\mu g/g_{OC}$)	f_{OC}	ESB ($\mu g/g$)	Toluene ($\mu g/g$)
CH-1	810	0.0062	5.022	0.0002
CH-2	810	0.0022	1.782	0.007
CH-3	810	0.013	10.53	10.5
CH-4	810	0.016	12.96	5.99
CH-5	810	0.011	8.91	**10.8**
Composite Value/Geometric Mean*	810	0.015	12.15	0.248675834
CH-6	810	0.016	12.96	3.81
CH-7	810	0.017	13.77	8.75
CH-8	810	0.021	17.01	14.5
CH-9	810	0.017	13.77	8.6
CH-10	810	0.015	12.15	**13.4**
Composite Value/Geometric Mean*	810	0.0089	7.209	4.900679608
CH-11	810	0.014	11.34	3.22
CH-12	810	0.024	19.44	1.8
CH-13	810	0.017	13.77	0.337
CH-14	810	0.013	10.53	2.15
CH-15	810	0.009	7.29	0.059
Composite value/Geometric Mean*	810	0.013	10.53	0.756501424

*Excepting the narcosis ESB; f_{OC} is a composite measurement and toluene is a geometric mean due to the absence of a composite measurement.

TABLE 13. Hydrocarbon toxicity potential (HTP) analyses and associated *Hyalella azteca* and *Chironomus dilutus* toxic units (TUs) for Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (based on data from USACE 2013b).

Site	SPME Fiber Burden (mM PDMS)	Total Extractable Hydrocarbons (mM/kg)	*H. azteca* TUs*	*C. dilutus* TUs**
CH-1	0	0.063	0	0
CH-2	0	-	-	-
CH-3	0	-	0	0
CH-4	0	1.03	0	0
CH-5	1	0.43	0.1	0
DMMU-1	6	0.27±0.23***	0.3	0.1
CH-6	0	-	0	0
CH-7	0	0.094	0	0
CH-8	-	-	-	-
CH-9	0	0.11	0	0
CH-10	0	-	0	0
DMMU-2a	10	-	0.5	0.2
CH-11	0	-	0	0
CH-12	0	-	0	0
CH-13	3	-	0.2	0
CH-14	7	0	0.4	0.1
CH-15	-	0.28	-	-
DMMU-2b	9	-	0.5	0.1
CLA1-1	-	0.64	-	-
CLA1-2	-	ND	-	-
CLA1-3	-	6.27	-	-
CLA1-4	-	-	-	
CLA1-comp	26	ND	-	-
CLA4-1	5	ND	0.3	0.1
CLA4-2	5	ND	0.3	0.1
CLA4-3	5	ND	0.3	0.1
CLA4-4	6	ND	0.3	0.1
CLA4-comp	-	-	1.3	0.4
CDF	6	-	0.3	0.1

- No data
*1 TU=20 mM PDMS (Parkerton *et al.* 2007)
**1 TU=66 mM PDMS (Parkerton *et al.* 2009)
***Two replicate analysis performed

TABLE 14. Results of standard 10-day *Hyalella azteca* and *Chironomus dilutus* solid phase bioassays (±1 standard deviation [SD] from the mean) on Cleveland Harbor Federal navigation channel sediments (*Management Units 1, 2a and 2b only* ; Sites CH-1 through CH-15) and open-lake placement areas sediments (CLA-1 and CLA-4) (USAERDC 2012).

Test Species	Measurement Endpoint	Harbor			Lake		Control
		DMMU-1	DMMU-2a	DMMU-2b	CLA-1	CLA-4	
H. azteca	Survival (%)	94±6	94±6	82±25	84±15	92±11	90±7
C. dilutus	Survival (%)	80±7	86±13	90±10	90±10	88±5	94±6
	Growth (mass, mg DW)	3.513±0.116	2.311±0.282	2.171±0.299	1.699±0.142	1.720±0.156	2.069±0.237

TABLE 15. Results of 28-day *L. variegatus* PCB bioaccumulation experiments on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (highlighted values are non-detectable concentrations valued at one-half the MDL) (USAERDC 2012). For statistical comparison purposes, tissue residues are presented as ΣPCBs (see text).

PCB Congener (ug/kg)	Lake Area									Harbor Management Unit															CDF 10B				
	CLA 1 Comp replicate					CLA 4 Comp replicate				DMMU 1 replicate					DMMU 2a replicate					DMMU 2b replicate					CDF Comp replicate				
	1	2	3	4	5	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
44	0.64	0.69	0.82	0.74	1.00	0.16	0.15	0.16	0.15	2.81	2.21	2.05	2.02	2.90	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15	1.70	1.39	2.00	2.70	2.17
52	1.76	1.65	1.72	1.55	1.99	0.16	0.15	0.16	0.15	4.05	4.66	3.20	2.41	3.74	1.38	0.95	1.34	2.14	1.20	1.36	1.33	1.71	1.24	1.21	3.66	3.01	3.87	5.83	4.22
64	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	1.29	1.05	0.94	0.92	1.14	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.90	0.14	0.15	0.14	0.16	1.04	0.15	1.08
66	0.72	0.62	0.91	0.71	1.08	1.00	1.63	1.03	0.76	1.66	1.82	2.26	1.96	1.72	2.19	3.12	3.63	2.96	2.31	3.27	2.36	2.06	2.70	0.83	1.27	0.84	1.37	1.83	1.76
70	1.36	1.05	1.38	1.61	1.82	0.16	0.15	0.16	0.15	3.26	3.48	3.20	3.01	3.52	1.15	1.39	1.36	1.55	1.34	1.23	1.05	1.10	1.23	0.94	2.60	1.82	2.58	3.88	2.82
75	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	2.13	2.29	2.09	2.24	2.41	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15	0.14	0.16	0.16	0.15	0.16
81/87	3.09	2.71	3.22	3.22	3.78	0.16	0.15	0.16	0.53	9.16	4.79	4.78	4.53	8.68	3.76	4.51	4.83	6.18	5.02	5.92	4.80	5.77	5.82	4.77	7.97	6.06	8.53	12.79	9.85
90/101	3.52	3.91	4.23	3.71	4.36	2.83	1.90	2.31	1.33	4.88	4.76	5.45	5.12	5.36	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15	9.97	7.59	10.22	15.40	12.78
95	5.56	5.18	6.12	4.83	5.69	1.70	1.41	1.21	1.01	5.00	5.03	5.13	5.02	5.65	1.59	2.14	2.43	3.71	2.69	2.39	1.98	2.07	2.15	1.71	5.60	4.20	5.49	8.75	6.98
97	1.06	0.98	1.10	1.40	1.61	0.16	0.15	0.16	0.15	1.78	2.11	3.53	2.18	2.29	0.60	0.76	0.85	1.00	1.01	0.77	0.76	0.82	0.81	0.94	2.34	1.78	2.71	3.99	3.09
105	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.72	0.71	0.77	0.73	0.78	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15	1.16	0.92	1.42	2.15	1.53
107	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	1.11	0.75	0.61	0.64	0.54	0.63	2.04	0.63	0.70	0.88	2.70	1.10	0.95	0.65	0.48	1.65	0.89	1.06	1.08	1.17
110	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.17	0.17	0.17	0.16	0.15	0.17	0.16	0.16	0.14	0.15	1.61	2.80	3.19	4.11	3.14	9.52	7.18	10.21	15.15	11.71
118	2.26	2.12	2.57	2.45	3.01	0.16	0.15	0.16	0.15	3.45	3.37	3.51	3.37	3.67	1.16	1.30	1.41	1.73	1.50	1.25	1.32	1.27	1.29	1.17	5.81	4.46	6.69	10.17	7.71
122	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.17	0.99	0.17	0.17	1.15	0.61	0.72	0.78	1.13	0.89	0.94	0.85	1.02	0.96	0.82	0.14	0.16	0.16	0.15	0.16
138	3.20	3.61	3.94	3.22	3.88	1.80	2.33	1.97	1.73	3.95	4.00	5.83	4.60	4.93	1.56	1.85	1.93	2.45	2.08	2.20	2.00	2.18	2.70	1.90	7.69	6.21	8.80	13.38	10.48
149	0.14	0.13	0.16	0.15	0.16	1.52	2.28	1.94	1.62	2.65	2.35	2.86	2.73	2.70	1.00	1.33	1.40	1.55	1.46	1.50	1.49	1.56	1.65	1.45	3.90	2.95	4.13	6.57	5.35
151	1.18	1.22	1.75	1.52	1.60	0.16	0.15	0.16	0.15	1.18	1.07	1.70	1.55	0.15	0.50	0.16	0.16	0.71	0.15	0.17	0.65	0.16	0.14	0.15	1.77	1.48	1.82	1.88	1.89
153	2.39	2.35	2.78	2.41	2.96	1.41	1.20	1.20	1.05	2.26	1.99	2.50	2.33	2.30	0.80	0.95	1.07	1.36	1.14	1.20	1.20	1.28	1.30	1.08	4.40	3.17	4.82	6.83	5.60
163/164	0.14	0.13	2.13	0.15	2.14	0.16	0.15	0.16	0.59	1.68	1.39	1.90	1.76	1.67	0.84	0.65	0.89	0.85	0.87	0.92	0.90	0.95	1.04	0.88	2.47	1.89	2.67	4.24	2.97
170	0.14	0.13	3.85	2.83	0.16	0.16	0.15	0.16	0.15	0.17	0.17	0.17	4.78	5.15	7.00	7.28	9.51	8.08	8.05	4.64	9.86	8.38	8.81	8.59	0.91	0.76	1.03	1.25	1.13
187	0.14	0.13	0.16	0.15	0.16	0.79	1.13	0.99	0.75	2.17	1.74	2.04	1.78	2.00	1.52	1.62	1.90	1.73	1.95	2.14	2.13	2.18	2.31	2.09	1.90	1.30	1.98	3.12	2.84
ΣPCBs	28.14	27.39	37.76	31.51	36.36	13.38	14.13	12.98	11.26	55.69	50.89	54.85	54.00	62.60	27.28	31.70	35.05	38.67	33.44	35.03	37.36	38.17	39.61	32.90	76.71	58.37	82.75	121	97.45
Mean ΣPCBs	**32.2**					**12.9**				**55.6**					**33.2**					**36.6**					**87.3**				
Mean lipid	**1.6**					**1.3**				**1.2**					**1.2**					**1.2**					**1.3**				

TABLE 16. Estimated total PCB residues in *L. variegatus* tissues following 28-day exposure to Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (highlighted values are non-detectable concentrations valued at one-half the MDL) (USAERDC 2012).

PCB Congener (ug/kg)	Lake Area									Harbor Management Unit															CDF 10B				
	CLA 1 Comp replicate					CLA 4 Comp replicate				DMMU 1 replicate					DMMU 2a replicate					DMMU 2b replicate					CDF Comp replicate				
	1	2	3	4	5	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
8	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.17	0.17	0.17	0.16	0.15	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15	0.14	0.16	0.16	0.15	0.16
18	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.17	0.17	0.17	0.16	0.15	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15	0.14	0.16	0.16	0.15	0.16
28/31	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.17	0.17	0.17	0.16	0.15	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15	0.14	0.16	0.16	0.15	0.16
44	0.64	0.69	0.82	0.74	1.00	0.16	0.15	0.16	0.15	2.81	2.21	2.05	2.02	2.90	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15	1.70	1.39	2.00	2.70	2.17
49	0.14	1.81	2.33	0.15	1.38	0.16	0.15	0.16	0.15	0.17	0.17	0.17	0.16	0.15	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15	0.14	0.16	0.16	0.15	0.16
52	1.76	1.65	1.72	1.55	1.99	0.16	0.15	0.16	0.15	4.05	4.66	3.20	2.41	3.74	1.38	0.95	1.34	2.14	1.20	1.36	1.33	1.71	1.24	1.21	3.66	3.01	3.87	5.83	4.22
66	0.72	0.62	0.91	0.71	1.08	1.00	1.63	1.03	0.76	1.66	1.82	2.26	1.96	1.72	2.19	3.12	3.63	2.96	2.31	3.27	2.36	2.06	2.70	0.83	1.27	0.84	1.37	1.83	1.76
87	3.09	2.71	3.22	3.22	3.78	0.16	0.15	0.16	0.53	9.16	4.79	4.78	4.53	8.68	3.76	4.51	4.83	6.18	5.02	5.92	4.80	5.77	5.82	4.77	7.97	6.06	8.53	12.79	9.85
90/101	3.52	3.91	4.23	3.71	4.36	2.83	1.90	2.31	1.33	4.88	4.76	5.45	5.12	5.36	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15	9.97	7.59	10.22	15.40	12.78
105	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.72	0.71	0.77	0.73	0.78	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15	1.16	0.92	1.42	2.15	1.53
118	2.26	2.12	2.57	2.45	3.01	0.16	0.15	0.16	0.15	3.45	3.37	3.51	3.37	3.67	1.16	1.30	1.41	1.73	1.50	1.25	1.32	1.27	1.29	1.17	5.81	4.46	6.69	10.17	7.71
128	0.14	0.86	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.17	0.17	0.17	0.16	0.15	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15	0.14	0.16	0.16	0.15	0.16
138	3.20	3.61	3.94	3.22	3.88	1.80	2.88	1.97	1.73	3.95	4.00	5.83	4.60	4.93	1.56	1.85	1.93	2.45	2.08	2.20	2.00	2.18	2.70	1.90	7.69	6.21	8.80	13.38	10.48
153	2.39	2.35	2.78	2.41	2.96	1.41	1.20	1.20	1.05	2.26	1.99	2.50	2.33	2.30	0.80	0.95	1.07	1.36	1.14	1.20	1.20	1.28	1.30	1.08	4.40	3.17	4.82	6.83	5.60
170	0.14	0.13	3.85	2.83	0.16	0.16	0.15	0.16	0.15	0.17	0.17	0.17	4.78	5.15	7.00	7.28	9.51	8.08	8.05	4.64	9.86	8.38	8.81	8.59	0.91	0.76	1.03	1.25	1.13
180	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.17	0.17	0.17	0.16	0.15	0.17	0.16	0.16	0.14	0.43	0.17	0.16	0.16	0.58	0.15	0.14	0.16	0.16	0.15	0.16
183	0.14	0.74	1.21	0.15	0.16	0.16	0.15	0.16	0.15	0.17	0.17	0.17	0.16	0.15	0.17	0.16	0.16	0.45	0.54	0.17	0.86	0.16	0.14	0.15	0.14	0.16	0.16	0.70	0.54
184																													
187	0.14	0.13	0.16	0.15	0.16	0.79	1.13	0.99	0.17	2.17	1.74	2.04	1.78	2.00	1.52	1.62	1.90	1.73	1.95	2.14	2.13	2.18	2.31	2.09	1.90	1.30	1.98	3.12	2.84
195	0.14	0.13	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.17	0.17	0.17	0.16	0.15	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15	0.14	0.16	0.16	0.15	0.16
206	0.14	2.56	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.17	0.17	0.17	0.16	0.15	0.17	0.16	0.16	0.14	0.15	0.17	0.16	0.16	0.14	0.15	0.14	0.16	0.16	0.15	0.16
209																													
Subtotal PCBs	19.26	24.67	28.98	22.44	25.20	10.16	10.99	9.83	7.60	36.76	31.70	34.04	35.03	42.57	21.35	23.44	27.48	28.62	25.72	23.96	27.57	26.69	28.29	23.44	47.28	36.64	51.66	76.90	61.41
Mean subtotal PCBs	24.1					9.6				36.0					25.3					26.0					54.8				
Estimated mean total PCBs*	48.2					19.3				72.0					50.6					52.0					109.6				

* Total PCBs estimated using methodology consistent with USEPA (2002).

TABLE 17. Measured and modeled tissue residues of tPCBs in oligochaetes associated with open-lake reference and placement area sediments in the Central Basin of Lake Erie (based on data from various sources).

Lake area	Mean tPCB tissue concentration (μg/kg)	Measured/ predicted	Description	Data source
Cleveland Harbor proposed open-lake placement area	19.3	Predicted	Extrapolation based on subset of 22 congeners measured in tissue	USAERDC (2012)
Cleveland Harbor old open-lake placement area	48.2	Predicted	Extrapolation based on subset of 22 congeners measured in tissue	USAERDC (2012)
Cleveland Harbor open-lake reference area	19.1	Predicted	TBP prediction based on detected Aroclor 1254 measured in sediment	EEI (2007)
Ashtabula Harbor open-lake reference area	20	Measured	Sum of 209 congeners measured in tissue	USACE (2010)
Ashtabula Harbor open-lake reference area	29.5	Measured	Sum of 209 congeners measured in tissue	USACE (2010)
Ashtabula Harbor open-lake reference area	28.1	Measured	Sum of 209 congeners measured in tissue	USACE (2009)
Ashtabula Harbor open-lake placement area	57.8	Measured	Sum of 209 congeners measured in tissue	USACE (2009)
Ashtabula Harbor open-lake reference areas (two)	110	Predicted	TBP prediction based on sum of Aroclors 1248 and 1260 measured in sediment	USACE (2010)
Ashtabula Harbor open-lake reference area 1	43.4	Measured	Sum of Aroclors 1248 and 1260 measured in tissue	(ESE 1993)
Ashtabula Harbor open-lake reference area 2	94.6	Measured	Sum of Aroclors 1248 and 1260 measured in tissue	(ESE 1993)
Ashtabula Harbor open-lake reference area 3	168	Measured	Sum of Aroclors 1248 and 1260 measured in tissue	(ESE 1993)
Range (all areas)	**19.1 to 168**			
Average (all areas)	**58.0**			
Range (reference areas only)*	**19.1 to 168**			
Average (reference areas only)*	**59.1**			
Range (placement areas only)	**48.2 to 57.8**			
Average (placement areas only)	**53.0**			

*Also includes proposed ("unimpacted") Cleveland Harbor open-lake placement area.

TABLE 18. Home range estimates for *Perca flavescens* based on data from Glover *et al.* (2008).

		Distance moved in direction (degree range) relative to tagging location (km)				Distance (km)		Estimated home range	
		North	South	East	West				
Season	Tagging site	315°-45°	135°-225°	45°-135°	225°-315°	Average Y-distance for fish recapture from tagging site	Average X-distance for fish recapture from tagging site	Area (km^2) representing mean distance traveled	Area (mi^2) representing mean distance traveled
Summer	WI1	20.5	31.3			51.8	3.2	130.12	50.18
	IL1	10.7	11.1			22.1	3.2	55.52	21.41
	IL2	10.9	29.7			40.6	3.2	101.99	39.33
	IL3	19.1	39.6			58.7	3.2	147.45	56.86
	IL4	22.7	44.2			66.9	3.2	168.05	64.81
	IL5	24.4	35.1			59.5	3.2	149.46	57.64
	IN1		**1.1**	**9.1**	**40.5**	**1.1**	**49.6**	42.83	**16.52**
	MI1	38.8	1			39.8	3.2	99.98	38.56
	MI2	18.3	19.1			37.4	3.2	93.95	36.23
							Minimum	42.83	16.52
Non-summer	**WI1**	**6**	**0**			**6**	**3.2**	**15.07**	**5.81**
	IL1	23.2	64.1			87.3	3.2	**219.30**	84.57
	IL2	11.6	55.2			66.8	3.2	**167.80**	64.71
	IL3	33.9	50.6			84.5	3.2	**212.26**	81.86
	IL4	12.5	51.2			63.7	3.2	**160.01**	61.71
	IL5	27.1	50			77.1	3.2	**193.68**	74.69
	IN1				49	3.2	49	**123.09**	47.47
	MI1	62.1				62.1	3.2	**156.00**	60.16
	MI2	43.3				43.3	3.2	**108.77**	41.95
							Minimum	15.07	5.81
Cross-season	WI1	13.25	31.3			44.55	3.2	111.91	43.16
	IL1	16.95	38			54.95	3.2	138.03	53.23
	IL2	11.25	41.95			53.2	3.2	133.64	51.54
	IL3	26.5	45.1			71.6	3.2	179.86	69.36
	IL4	17.6	47.7			65.3	3.2	164.03	63.26
	IL5	25.75	42.55			68.3	3.2	171.57	66.16
	IN1		**1.1**	**9.1**	**44.75**	**1.1**	**53.9**	46.54	**17.95**
	MI1	50.45	1			51.45	3.2	129.24	49.84
	MI2	30.8	19.1			49.9	3.2	125.35	48.34
							Minimum	46.54	17.95

TABLE 19. Estimated PCB oligochaete tissue residues (C_o) to which receptor species would be exposed to within a home range that overlaps both open-lake placement areas CLA-1 and CLA-4.

Receptor species	Management unit	Home range (mi^2)*	Area of placement area (CLA-1) (mi^2)	Area of former placement area (CLA-4) (mi^2)	C_{tiREF} (µg/kg)**	C_{tiDM} (µg/kg)**	$C_{\Sigma tiDMFPA}$ (µg/kg)**	C_o (µg/kg)
Walleye	DMMU-1	51.8	1	1	12.9	55.6	32.2	**14.0969112**
	DMMU-2a	51.8	1	1	12.9	33.2	32.2	**13.66447876**
	DMMU-2b	51.8	1	1	12.9	36.6	32.2	**13.73011583**

*Home range estimate based on Wang *et al.* (2007) (minimum, male, 28.6 mi distance with assumed two mi width, yielding a HR of 28.6 mi^2 [conservative]).

*Sum of PCB congeners 44, 52, 64, 66, 70, 75, 81/87, 90/101, 95, 97, 105, 107, 110, 118, 122, 138, 149, 151, 153, 163/164, 170 and 187.

Receptor species	Management unit	Home range (mi^2)*	Area of placement area (CLA-1) (mi^2)	Area of former placement area (CLA-4) (mi^2)	C_{tiREF} (µg/kg)**	C_{tiDM} (µg/kg)**	$C_{\Sigma tiDMFPA}$ (µg/kg)**	C_o (µg/kg)
Yellow perch	DMMU-1	18	1	1	12.9	55.6	32.2	**16.34444444**
	DMMU-2a	18	1	1	12.9	33.2	32.2	**15.1**
	DMMU-2b	18	1	1	12.9	36.6	32.2	**15.28888889**

*Home range estimate based on data from Glover *et al.* (2008).

*Sum of PCB congeners 44, 52, 64, 66, 70, 75, 81/87, 90/101, 95, 97, 105, 107, 110, 118, 122, 138, 149, 151, 153, 163/164, 170 and 187.

TABLE 20. Receptor species' PCB bioaccumulation exposure factors (BEFs) for upper Cuyahoga River Channel dredged material placed at open-lake placement areas CLA-1 and CLA-4) (BEF > 1.2 signals excursion beyond 20% analytical variability alone).

Receptor species	Management unit	Area of placement area (CLA-4) (mi^2)	$C_{\Sigma tiDM}$ (µg/kg)*	$C_{\Sigma tiDMFPA}$ (µg/kg)*	Area of former placement area (CLA-1) (mi^2)	$C_{\Sigma tiREF}$ (µg/kg)*	HR (mi^2)**	BEF
Walleye	DMMU-1	1	55.6	32.2	1	12.9	51.8	**1.092783814**
	DMMU-2a	1	33.2	32.2	1	12.9	51.8	**1.05926192**
	DMMU-2b	1	36.6	32.2	1	12.9	51.8	**1.064350064**

*Sum of PCB congeners 44, 52, 64, 66, 70, 75, 81/87, 90/101, 95, 97, 105, 107, 110, 118, 122, 138, 149, 151, 153, 163/164, 170 and 187.
**Home range estimate based on Wang *et al.* (2007) (minimum, male, 28.6 mi distance with assumed two mi width, yielding a HR of 28.6 mi2 [conservative]).

Receptor species	Management unit	Area of placement area (CLA-4) (mi^2)	$C_{\Sigma tiDM}$ (µg/kg)*	$C_{\Sigma tiDMFPA}$ (µg/kg)*	Area of former placement area (CLA-1) (mi^2)	$C_{\Sigma tiREF}$ (µg/kg)*	HR (mi^2)**	BEF
Yellow perch	DMMU-1	1	55.6	32.2	1	12.9	18	**1.267011197**
	DMMU-1	0.663	55.6	32.2	1	12.9	18	**1.20503919**
	DMMU-2a	1	33.2	32.2	1	12.9	18	**1.170542636**
	DMMU-2b	1	36.6	32.2	1	12.9	18	**1.185185185**

*Sum of PCB congeners 44, 52, 64, 66, 70, 75, 81/87, 90/101, 95, 97, 105, 107, 110, 118, 122, 138, 149, 151, 153, 163/164, 170 and 187.
***Home range estimate based on data from Glover *et al.* (2008).

TABLE 21. Results of 28-day *L. variegatus* ΣDDT bioaccumulation experiments on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (highlighted values are non-detectable concentrations valued at one-half the MDL) (USAERDC 2012). For statistical comparison purposes, tissue residues are presented as ΣPCBs (see text).

DDT Isomer (ug/kg)	Lake Area										Harbor Management Unit															CDF 10B				
	CLA 1 Comp replicate					CLA 4 Comp replicate					DMMU 1 replicate					DMMU 2a replicate					DMMU 2b replicate					CDF Comp replicate				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
4,4'-DDD	1.990	2.300	2.500	3.090	2.540	0.748	0.679	2.420	0.587	0.693	1.390	1.810	1.200	1.200	1.330	0.894	0.873	0.934	0.993	0.950	1.340	1.580	1.380	1.560	1.390	0.936	0.604	0.829	1.460	1.070
4,4'-DDE	2.580	2.790	3.312	2.670	3.210	1.190	0.934	4.190	0.994	0.824	4.290	3.850	3.870	4.010	3.530	2.170	2.210	2.680	2.340	3.020	4.290	3.430	3.880	5.180	4.170	1.950	1.330	2.040	3.390	2.830
4,4'-DDT	0.048	0.051	0.053	0.051	0.055	0.054	0.052	0.051	0.053	0.051	0.057	0.056	0.057	0.052	0.051	0.056	0.053	0.054	0.047	0.051	0.056	0.051	0.056	0.049	0.051	0.048	0.053	0.053	0.052	0.055
2,4'-DDD	0.085	0.089	0.093	0.089	0.50*	0.094	0.092	0.090	0.092	0.089	0.100	0.099	0.099	0.092	0.089	0.098	0.093	0.094	0.083	0.090	0.097	0.089	0.097	0.086	0.089	0.085	0.092	0.093	0.091	0.096
2,4'-DDE	0.085	0.089	0.093	0.089	0.097	0.094	0.092	0.090	0.092	0.089	0.100	0.099	0.099	0.092	0.089	0.098	0.093	0.094	0.083	0.090	0.097	0.089	0.097	0.086	0.089	0.085	0.092	0.093	0.091	0.096
2,4'-DDT	0.085	0.089	0.093	0.089	0.097	0.094	0.092	0.090	0.092	0.089	0.100	0.099	0.099	0.092	0.089	0.098	0.093	0.094	0.083	0.090	0.097	0.089	0.097	0.086	0.089	0.085	0.092	0.093	0.091	0.096
ΣDDT	4.570	5.090	5.812	5.760	5.750	1.938	1.613	6.610	1.581	1.517	5.680	5.660	5.070	5.210	4.860	3.064	3.083	3.614	3.333	3.970	5.630	5.010	5.260	6.740	5.560	2.886	1.934	2.869	4.850	4.243
Mean ΣDDT	5.396					2.652					5.296					3.413					5.640					3.356				
Mean lipid	1.6					1.3					1.2					1.2					1.2					1.3				

TABLE 22. Estimated ΣDDT oligochaete tissue residues (C_o) to which receptor species would be exposed to within a home range that overlaps both open-lake placement areas CLA-1 and CLA-4.

Receptor species	Management unit	Home range (mi^2)*	Area of placement area (CLA-1) (mi^2)	Area of former placement area (CLA-4) (mi^2)	C_{tlREF} (µg/kg)**	C_{tlDM} (µg/kg)**	$C_{\Sigma tlDMFPA}$ (µg/kg)**	C_o (µg/kg)
Walleye	DMMU-1	51.8	1	1	2.65	5.3	5.4	**2.754247104**
	DMMU-2a	51.8	1	1	2.65	3.41	5.4	**2.717760618**
	DMMU-2b	51.8	1	1	2.65	5.64	5.4	**2.760810811**

*Home range estimate based on Wang *et al.* (2007) (minimum, male, 28.6 mi distance with assumed two mi width, yielding a HR of 28.6 mi^2 [conservative]).

**Sum of DDD and DDE.

Receptor species	Management unit	Home range (mi^2)*	Area of placement area (CLA-1) (mi^2)	Area of former placement area (CLA-4) (mi^2)	C_{tlREF} (µg/kg)**	C_{tlDM} (µg/kg)**	$C_{\Sigma tlDMFPA}$ (µg/kg)**	C_o (µg/kg)
Yellow perch	DMMU-1	18	1	1	2.65	5.3	5.4	**2.95**
	DMMU-2a	18	1	1	2.65	3.41	5.4	**2.845**
	DMMU-2b	18	1	1	2.65	5.64	5.4	**2.968888889**

*Home range estimate based on data from Glover *et al.* (2008).

**Sum of DDD and DDE.

TABLE 23. Receptor species' ΣDDT bioaccumulation exposure factors (BEFs) for upper Cuyahoga River Channel dredged material placed at open-lake placement areas CLA-1 and CLA-4 (BEF > 1.2 signals excursion beyond 20% analytical variability alone).

Receptor species	Management unit	Area of placement area (CLA-4) (mi^2)	$C_{\Sigma tIDM}$ (µg/kg)*	$C_{\Sigma tIDMFPA}$ (µg/kg)*	Area of former placement area (CLA-1) (mi^2)	$C_{\Sigma tIREF}$ (µg/kg)*	HR (mi^2)**	BEF
Walleye	DMMU-1	1	5.3	5.4	1	2.65	51.8	**1.03933853**
	DMMU-2a	1	3.41	5.4	1	2.65	51.8	**1.025570044**
	DMMU-2b	1	5.64	5.4	1	2.65	51.8	**1.0418154**

*Sum of DDD and DDE.

**Home range estimate based on Wang *et al.* (2007) (minimum, male, 28.6 mi distance with assumed two mi width, yielding a HR of 28.6 mi2 [conservative]).

Receptor species	Management unit	Area of placement area (CLA-4) (mi^2)	$C_{\Sigma tIDM}$ (µg/kg)*	$C_{\Sigma tIDMFPA}$ (µg/kg)*	Area of former placement area (CLA-1) (mi^2)	$C_{\Sigma tIREF}$ (µg/kg)*	HR (mi^2)**	BEF
Yellow perch	DMMU-1	1	5.3	5.4	1	2.65	18	**1.113207547**
	DMMU-2a	1	3.41	5.4	1	2.65	18	**1.073584906**
	DMMU-2b	1	5.64	5.4	1	2.65	18	**1.12033543**

*Sum of DDD and DDE.

***Home range estimate based on data from Glover *et al.* (2008).

TABLE 24. Metals SET/MET data on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

Metal (mg/L)	Cleveland Lake Water (CL)	Lake Area #1 (CLA1)		Lake Area #4 (CLA4)		DMMU 1				DMMU 2a				DMMU 2b				CDF 10B
		SET-UF*	SET-F**	SET-UF	SET-F	SET-UF	SET-F	MET-UF	MET-F	SET-UF	SET-F	MET-UF	MET-F	SET-UF	SET-F	MET-UF	MET-F	SET-F
	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ
Aluminum	0.154	7.3	0.559	3.98	0.0303 J	7.51	0.02 U	4.64	0.02 U	3.47	0.02 U	3.48	0.02 U	10	0.02 U	3.28	0.02 U	0.02 U
Antimony	0.0005 U	0.0011	0.0009 J	0.0005 U	0.0005 U	0.0016	0.0018	0.0016	0.0014	0.002	0.002	0.002	0.002	0.001	0.0016	0.002	0.0017	0.0005 U
Arsenic	0.0005 U	0.0099	0.0016	0.0025	0.0007 J	0.0206	0.0075	0.0162	0.0027	0.018	0.01	0.019	0.011	0.036	0.0124	0.017	0.0105	0.0009 J
Barium	0.0038	0.153	0.0346	0.0959	0.0273	0.21	0.0429	0.137	0.0345	0.136	0.067	0.122	0.06	0.302	0.0712	0.116	0.0611	0.072
Beryllium	0.0005 U	0.0007 J	0.0005 U	0.0005 U	0.0005 U	0.0008 J	0.0005 U	0.0005 J	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.001	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Cadmium	0.0005 U	0.0027	0.0005 U	0.0005 U	0.0005 U	0.0027	0.0005 U	0.0018	0.0005 U	0.0009 J	0.0005 U	0.0009 J	0.0005 U	0.003	0.0005 U	0.0008 J	0.0005 U	0.0005 U
Calcium	33.1	25.4	19.8	23.7	21.3	60.6	46.9	46.1	39.2	61	61.8	55.8	52.9	93.6	70.4	63.6	59.9	60.4
Chromium	0.0012	0.0266	0.0008	0.0088	0.0005 U	0.0148	0.0011	0.0101	0.0006 J	0.007	0.001	0.006	0.001	0.023	0.0013	0.008	0.001 J	0.0005 J
Cobalt	0.0005 U	0.0057	0.0005 U	0.0028	0.0005 U	0.0125	0.0005 J	0.0075	0.0005 U	0.005	0.0007 J	0.004	0.0007 J	0.014	0.0006 J	0.003	0.0006 J	0.0005 U
Copper	0.0005 U	0.0331	0.0011	0.01	0.0005 U	0.0712	0.0049	0.0496	0.0027	0.028	0.004	0.028	0.002	0.073	0.0027	0.021	0.0013	0.003
Iron	0.134	16.6	0.312	7.38	0.02 U	22.7	0.0487	13.9	0.0575	8.18	0.065	8.17	0.05	34.2	0.0714	7.47	0.0646	0.02 U
Lead	0.0005 U	0.0707	0.0006 J	0.0151	0.0005 U	0.113	0.0005 U	0.0743	0.0005 U	0.04	0.0005 U	0.04	0.0007 J	0.124	0.0005 U	0.03	0.0005 U	0.0005 U
Magnesium	8.97	8.32	5.21	7.1	5.67	18.1	14.1	13.5	11.4	15.3	14.7	14	12.9	20.8	15.4	14.3	12.7	10
Manganese	0.0005 U	0.254	0.0022	0.142	0.0005 U	2	0.706	1.41	0.383	1.46	1.21	1.26	0.987	2.41	1.01	0.981	0.796	0.0005 U
Mercury	0.0005 U					0.0002	0.0001		0.00003	0.0001	0.0001		0.0000	0.0002	0.00003		0.00004	0.0000
Molybdenum	0.0005 U	0.0071	0.0103	0.0077	0.0102	0.0038	0.0114	0.0034	0.0072	0.009	0.016	0.012	0.018	0.004	0.0164	0.011	0.0166	0.002
Nickel	0.0005 U	0.0254	0.0026	0.0124	0.0017	0.0431	0.0064	0.0276	0.0054	0.017	0.007	0.017	0.007	0.035	0.0062	0.013	0.006	0.006
Potassium	1.54	3.38	2.33	2.87	2.19	5.9	5.08	4.12	3.5	8.59	8.37	8.18	7.63	8.72	8.73	8.51	7.61	1.88
Selenium	0.0005 U	0.0012	0.0007 J	0.0008 J	0.0005 U	0.0017	0.0011	0.0012	0.001 J	0.002	0.001	0.002	0.002	0.002	0.0013	0.002	0.0013	0.0007 J
Silver	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Sodium	10.5	10.1	9.97	9.94	9.94	24.6	25.2	17.7	17.8	28.6	30.5	27.1	27.4	29.9	32.8	27.5	27.4	11.2
Thallium	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Vanadium	0.0005 U	0.0115	0.0009 J	0.006	0.0005 U	0.0146	0.0009 J	0.011	0.0005 U	0.008	0.0005 U	0.007	0.0005 U	0.015	0.0007 J	0.007	0.0005 U	0.0005 U
Zinc	0.0005 U	0.288	0.0055	0.0632	0.001 J	0.386	0.0076	0.235	0.0043	0.13	0.005	0.12	0.003	0.559	0.005	0.129	0.0035	0.002

Metal (mg/L)	Middle River Reach (MRR)		Lower River Reach (LRR)		Old River Reach (ORR)		Outer Harbor Reach (OHR)	
	MET-UF	MET-F	MET-UF	MET-F	MET-UF	MET-F	MET-UF	MET-F
	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ
Aluminum	1.0	0.061	0.92	0.085	0.57	0.06	0.24	0.015 J
Antimony	0.0011 J	0.0015 J	0.00097 J	0.0008 J	0.00088 J	0.00059 J	0.00076 J	0.0006 J
Arsenic	0.023	0.015	0.017	0.011	0.0033	0.0014 J	0.0036	0.0012 J
Barium	0.093	0.25	0.077	0.25	0.04	0.17	0.042	0.18
Beryllium	0.00028 J	0.001 U	0.00100 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium	0.0009 J	0.001 U	0.0007 J	0.001 U	0.0003 J	0.001 U	0.001 U	0.001 U
Calcium	64	56	52	47	38	39	39	37
Chromium	0.0055 J	0.0016 J	0.0056 J	0.0013 J	0.0036 J	0.00073 J	0.0021 J	0.00097 J
Cobalt	0.0025 J	0.00049 J	0.002 J	0.00046 J	0.00069 J	0.00022 J	0.00072 J	0.00034 J
Copper	0.015	0.0035 J	0.02	0.01	0.0087	0.0032 J	0.0042 J	0.0014 J
Iron	7.1	0.87	5.3	0.48	1.4	0.069 J	1.1	0.2 U
Lead	0.035	0.0036	0.028	0.0042	11	0.0008 J	0.0048	0.00041 J
Magnesium	11	11	8.8	9.2	7.3	8.6	7.7	8.8
Manganese	1.3	1.0	1.2	0.9	0.23	0.16	0.54	0.48
Mercury	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Nickel	0.0081 J	0.0041 J	0.0071 J	0.0049 J	0.0059 J	0.0024 J	0.004 J	0.0029 J
Potassium	5.1	4.7	4.7	4.2	2.8	2.6	2.4	2.4
Selenium	5.0 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Silver	0.0015 U	0.0029	0.0015 U	0.00099 J	0.0015 U	0.00032 J	0.0015 U	0.00034 J
Sodium	19	24	19	24	17	21	12	16
Thallium	0.0002 J	0.005 U	0.002 U	0.005 U	0.002 U	0.005 U	0.002 U	0.005 U
Vanadium	0.0031	0.0009 U	0.003	0.001 J	0.0014 J	0.004 U	0.0009 J	0.00078 J
Zinc	0.15	0.069	0.12	0.078	0.051	0.045 J	0.033 J	0.038 J

*Unfiltered water.
**Filtered water.
LQ - Laboratory qualifiers:
U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).
J = Indicates values below the RL but greater than the established MDL.

TABLE 25. Inorganic standard and modified elutriate test (SET/MET) data on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

Inorganic Parameter (mg/L)	Cleveland Lake Water (CL)	Lake Area #1 (CLA1)		Lake Area #4 (CLA4)		DMMU 1				DMMU 2a				DMMU 2b				CDF 10B
		SET-UF*	SET-F**	SET-UF	SET-F	SET-UF	SET-F	MET-UF	MET-F	SET-UF	SET-F	MET-UF	MET-F	SET-UF	SET-F	MET-UF	MET-F	SET-F
	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ
Ammonia-N	0.03					7.2	7.1		3.7	15.8	16.8		11.7	11.4	10.6		10.5	0.078
Cyanide, Total	0.01					0.01	0.01	0.01	0.01	0.01	0.01	0.011	0.012	0.01	0.01	0.01	0.01	0.01
Hardness (mg equil CaCO3)	120					226	175		145	216	215		185	319	239		202	207
Phosphorus, Total (As P)	0.0313 J	0.453	0.0319 J	0.225	0.0316 J	0.997	0.0653	0.637	0.0602	0.503	0.11	0.458	0.105	1.51	0.124	0.464	0.1170	0.0569
Total Organic Carbon	2.0					10.9	12.6	6.9	5.9	47.7	53.2	40.7	40.4	75.4	74.3	64.6	64.6	3.4
Total Suspended Solids	3.0 J	640	3.0 J	458	2.0 J	1,450	53.3	725	10	760	52.8	217	17.5	2,080	40	265	22.7	500
Turbidity (NTU)	6.1	2,900	76	74	950	1,300	66	775	28	825	40	500	16.4	1,850	34	400	21	400

Inorganic Parameter (mg/L)	Middle River Reach (MRR)		Lower River Reach (LRR)		Old River Reach (ORR)		Outer Harbor Reach (OHR)	
	MET-UF	MET-F	MET-UF	MET-F	MET-UF	MET-F	MET-UF	MET-F
	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ	Result LQ VQ
Cyanide, Total	0.0088 J	0.0072 J	0.0073 J	0.0230	0.0058 J	0.0080 J	0.0063 J	0.0100 U
Phosphorus, Total (As P)	0.71	0.15	0.66	0.1	0.15	0.024	0.052	0.0058 J
Turbidity (NTU)	40	12	96	14	77	6.3	15	1.4
Total Suspended Solids	140 J	2.0 J	54 J	3.0 J	41	1.0 U J	42 J	1.0 U J
Ammonia-N	7.1	5.7	4.8	4.6	2.2	1.9	3.1	2.9
Total Organic Carbon	19	14	6.6	7.0	2.9	2.7	2.5	2.5

*Unfiltered water.

**Filtered water.

LQ - Laboratory qualifiers:

U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).

J = Indicates values below the RL but greater than the MDL.

VQ - Data validation qualifiers:

RTI (samples MRR, LRR, ORR, and OHR) TSS analysis (SM 2540D) exceeded the analysis holding time. The samples were flagged with a J.

TABLE 26. PAH SET/MET data on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

PAH (ug/L)	Cleveland Lake Water (CL)			Lake Area #1 (CLA1)						Lake Area #4 (CLA4)						DMMU 1											
				SET-UF			SET-F			SET-UF			SET-F			SET-UF			SET-F			MET-UF			MET-F		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
1-Methylnaphthalene	1.6	U														1.6	U		1.6	U		1.6	U				
2-Methylnaphthalene	1.6	U														1.6	U		1.6	U		1.6	U				
Acenaphthene	0.04	U														0.08	J		0.04	U		0.04	U				
Acenaphthylene	0.04	U														0.08	J		0.04	U		0.04	U				
Anthracene	0.04	U														0.32			0.04	U		0.04	J				
Benz(a)anthracene	0.04	U														2.0			0.04	J		0.24					
Benzo(a)pyrene	0.04	U														2.4			0.08	J		0.44					
Benzo(b)fluoranthene	0.04	U														2.8		J	0.12		J	0.64		J			
Benzo(g,h,i)perylene	0.04	U	R													2.68			0.08	J		0.48					
Benzo(k)fluoranthene	0.04	U														2.56		J	0.08		J	0.6		J			
Chrysene	0.04	U														3.36			0.08	J		0.52					
Dibenz(a,h)anthracene	0.04	U	R													0.36			0.04	U		0.08	J				
Fluoranthene	0.04	U														6.76			0.16	J		0.64					
Fluorene	0.04	U														0.16	J		0.04	U		0.04	J				
Indeno(1,2,3-cd)pyrene	0.04	U														2.72			0.08	J		0.44					
Naphthalene	0.04	U														0.12	J		0.04	U		0.04	J				
Phenanthrene	0.04	U														1.48			0.04	J		0.2					
Pyrene	0.04	U														2.44			0.12	J		0.8					
Total PAHs*	0.64															30.32			1.12			5.28					

PAH (ug/L)	DMMU 2a												DMMU 2b												CDF 10B		
	SET-UF			SET-F			MET-UF			MET-F			SET-UF			SET-F			MET-UF			MET-F			SET-F		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
1-Methylnaphthalene	1.6	U		1.6	U		1.6	U					1.6	U		1.6	U		1.6	U					1.6	U	
2-Methylnaphthalene	1.6	U		1.6	U		1.6	U					1.6	U		1.6	U		1.6	U					1.6	U	
Acenaphthene	0.04	U		0.04	U		0.04	U					0.04	J		0.04	U		0.04	J					0.04	U	
Acenaphthylene	0.04	U		0.04	U		0.04	U					0.04	U		0.04	U		0.04	U					0.04	U	
Anthracene	0.04	J		0.04	U		0.04	J					0.16	J		0.04	U		0.04	J					0.04	U	
Benz(a)anthracene	0.28			0.04	J		0.16	J					0.72			0.04	J		0.2						0.04	J	
Benzo(a)pyrene	0.44			0.04	J		0.28						0.88			0.04	J		0.32						0.04	U	
Benzo(b)fluoranthene	0.76		J	0.08		J	0.44		J				1.24		J	0.04		J	0.48		J				0.04	U	
Benzo(g,h,i)perylene	0.56			0.08	J		0.32						1.04			0.04	J		0.36						0.04	U	
Benzo(k)fluoranthene	0.6		J	0.08		J	0.4		J				1.12		J	0.04		J	0.4		J				0.04		J
Chrysene	0.52			0.08	J		0.32						1.12			0.04	J		0.36						0.04	J	
Dibenz(a,h)anthracene	0.08	J		0.04	U		0.04	J					0.12	J		0.04	U		0.04	J					0.04	U	
Fluoranthene	1.12			0.16	J		0.68						3.0			0.08	J		0.8						0.04	U	
Fluorene	0.04	J		0.04	U		0.04	U					0.08	J		0.04	U		0.04	J					0.04	U	
Indeno(1,2,3-cd)pyrene	0.48			0.08	J		0.32						1.04			0.04	J		0.32						0.04	U	
Naphthalene	0.04	J		0.04	J		0.04	J					0.04	J		0.04	J		0.08	J					0.04	U	
Phenanthrene	0.28			0.04	J		0.16	J					0.72			0.04	J		0.24						0.04	U	
Pyrene	0.6			0.08	J		0.36						1.04			0.08	J		0.44						0.04	U	
Total PAHs*	5.92			1.00			3.68						12.4			0.72			4.20						0.64		

PAH (ug/L)	Middle River Reach (MRR)						Lower River Reach (LRR)						Old River Reach (ORR)						Outer Harbor Reach (OHR)					
	MET-UF*			MET-F**			MET-UF			MET-F			MET-UF			MET-F			MET-UF			MET-F		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
2-Methylnaphthalene	0.27	U	J	0.25	U	J	0.26	U	J	0.26	U	J	0.27	U	J	0.25	U	J	0.26	U	J	0.25	U	J
Acenaphthene	0.21	U	J	0.19	U	J	0.20	U	J	0.20	U	J	0.20	U	J	0.19	U	J	0.20	U	J	0.19	U	J
Acenaphthylene	0.20	U	J	0.18	U	J	0.19	U	J	0.19	U	J	0.19	U	J	0.18	U	J	0.19	U	J	0.18	U	J
Anthracene	0.20	U	J	0.18	U	J	0.19	U	J	0.19	U	J	0.19	U	J	0.18	U	J	0.19	U	J	0.18	U	J
Benz(a)anthracene	0.20	U	J	0.19	U	J	0.19	U	J	0.19	U	J	0.20	U	J	0.18	U	J	0.19	U	J	0.19	U	J
Benzo(a)pyrene	0.18	U	J	0.17	U	J	0.17	U	J	0.17	U	J	0.18	U	J	0.16	U	J	0.17	U	J	0.17	U	J
Benzo(b)fluoranthene	0.25	U	J	0.23	U	J	0.24	U	J	0.23	U	J	0.24	U	J	0.23	U	J	0.24	U	J	0.23	U	J
Benzo(g,h,i)perylene	0.27	U	J	0.25	U	J	0.26	U	J	0.25	U	J	0.26	U	J	0.24	U	J	0.26	U	J	0.25	U	J
Benzo(k)fluoranthene	0.22	U	J	0.20	U	J	0.21	U	J	0.20	U	J	0.21	U	J	0.2	U	J	0.21	U	J	0.20	U	J
Chrysene	0.21	U	J	0.19	U	J	0.20	U	J	0.20	U	J	0.20	U	J	0.19	U	J	0.20	U	J	0.19	U	J
Dibenz(a,h)anthracene	0.29	U	J	0.26	U	J	0.27	U	J	0.27	U	J	0.28	U	J	0.26	U	J	0.28	U	J	0.26	U	J
Fluoranthene	0.40		J	0.19	U	J	0.36		J	0.19	U	J	0.20	U	J	0.18	U	J	0.19	U	J	0.19	U	J
Fluorene	0.18	U	J	0.17	U	J	0.18	U	J	0.17	U	J	0.18	U	J	0.17	U	J	0.18	U	J	0.17	U	J
Indeno(1,2,3-cd)pyrene	0.28	U	J	0.26	U	J	0.27	U	J	0.27	U	J	0.27	U	J	0.26	U	J	0.27	U	J	0.26	U	J
Naphthalene	0.25	U	J	0.23	U	J	0.24	U	J	0.23	U	J	0.24	U	J	0.23	U	J	0.24	U	J	0.23	U	J
Phenanthrene	0.15	U	J	0.20		J	0.22		J	0.14	U	J	0.15	U	J	0.14	U	J	0.15	U	J	0.14	U	J
Pyrene	0.23	U	J	0.21	U	J	0.28		J	0.22	U	J	0.23	U	J	0.21	U	J	0.22	U	J	0.21	U	J
Total PAHs*	3.72			3.30			3.67			3.31			3.42			3.20			3.38			3.24		

*Unfiltered water.
**Filtered water.
LQ - Laboratory qualifiers:
U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).
J = Indicates values below the RL but greater than the MDL.
VQ - Data validation qualifiers:
PAH analysis (8270) in batch B205032 (CL-Site Water) had recoveries of dibenz(a,h)anthracene and benzo(g,h,i)perylene that were below criteria. Non-detect results were rejected (R flagged).
PAH analysis (8270) in batch B205068 for all eluriate samples (except CL-Site Water) had recoveries of benzo(b)fluoranthene and benzo(k)fluoranthene that were above criteria. Associated sample results that were detected were flagged with a J. Non-detect results did not require further qualification.
RTI (MRR, LRR, ORR, AND OHR samples) PAH analysis (8082) exceeded the extraction to analysis holding time. The samples were flagged with a J.
*Total PAHs represents the sum of the 16 priority pollutant PAHs (excluding 1- and 2-Methylnaphthalene). MDL used as value for undetected analytes.

TABLE 27. PCB (Aroclor) SET/MET data on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

Aroclor (ug/L)	Cleveland Lake Water (CL)			Lake Area #1 (CLA1)						Lake Area #4 (CLA4)						DMMU 1									DMMU 2a									DMMU 2b									CDF 10B		
				SET-UF*			SET-F**			SET-UF			SET-F			SET-UF			SET-F			MET-UF			MET-F			SET-UF			SET-F			MET-UF			MET-F			SET-UF			SET-F			MET-UF			MET-F			SET-F		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
1016	0.03	U														0.03	U		0.03	U		0.03	U			0.03	U		0.03	U		0.03	U		0.03	U			0.03	U		0.03	U		0.03	U			0.03	U	
1221	0.03	U														0.03	U		0.03	U		0.03	U			0.03	U		0.03	U		0.03	U		0.03	U			0.03	U		0.03	U		0.03	U			0.03	U	
1232	0.03	U														0.03	U		0.03	U		0.03	U			0.03	U		0.03	U		0.03	U		0.03	U			0.03	U		0.03	U		0.03	U			0.03	U	
1242	0.03	U														0.03	U		0.03	U		0.03	U			0.03	U		0.03	U		0.03	U		0.03	U			0.03	U		0.03	U		0.03	U			0.03	U	
1248	0.03	U														0.03	U		0.03	U		0.03	U			0.03	U		0.03	U		0.03	U		0.03	U			0.03	U		0.03	U		0.03	U			0.03	U	
1254	0.03	U														0.03	U		0.03	U		0.03	U			0.03	U		0.03	U		0.03	U		0.03	U			0.03	U		0.03	U		0.03	U			0.03	U	
1260	0.03	U														0.03	U		0.03	U		0.03	U			0.03	U		0.03	U		0.03	U		0.03	U			0.03	U		0.03	U		0.03	U			0.03	U	

Aroclor (ug/L)	Middle River Reach (MRR)						Lower River Reach (LRR)						Old River Reach (ORR)						Outer Harbor Reach (OHR)					
	MET-UF						MET-UF						MET-UF						MET-UF					
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
1016	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J
1221	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J
1232	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J
1242	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J
1248	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J	0.03	U	J
1254	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J
1260	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J	0.04	U	J

*Unfiltered water.
**Filtered water.
LQ - Laboratory qualifiers:
U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).
J = Indicates values below the RL but greater than the MDL.
VQ - Data validation qualifiers:
RTI (samples MRR, LRR, ORR, and OHR) PCB analysis (8082) exceeded the extraction to analysis holding time. The samples were flagged with a J.

TABLE 28. Pesticides SET/MET data on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USACE 2013b).

Pesticide (ug/kg)	Cleveland Lake Water (CL)			Lake Area #1 (CLA1)						Lake Area #4 (CLA4)						DMMU 1											
				SET-UF*			SET-F**			SET-UF			SET-F			SET-UF			SET-F			MET-UF			MET-F		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
4,4'-DDD	0.001	U	J													0.001	U		0.001	U		0.001	U				
4,4'-DDE	0.001	U	J													0.001	U		0.001	U		0.003	J				
4,4'-DDT	0.001	U	R													0.001	U		0.001	U		0.003	J				
Aldrin	0.001	U	J													0.001	U		0.001	U		0.001	U				
alpha-BHC	0.001	U	J													0.001	U		0.001	U		0.001	U				
alpha-Chlordane	0.001	U	J													0.001	U		0.001	U		0.001	U				
beta-BHC	0.001	U	J													0.001	U		0.001	U		0.001	U				
delta-BHC	0.001	U	R													0.001	U	R	0.001	U	R	0.001	U	R			
Dieldrin	0.001	U	J													0.001	U		0.001	U		0.001	U				
Endosulfan-I	0.001	U	J													0.001	U		0.001	U		0.001	U				
Endosulfan-II	0.001	U	J													0.001	U		0.001	U		0.001	U				
Endosulfan-Sulfate	0.001	U	J													0.001	U		0.001	U		0.001	U				
Endrin	0.001	U	J													0.001	U		0.001	U		0.001	U				
Endrin Aldehyde	0.001	U	J													0.001	U		0.001	U		0.001	U				
Endrin Ketone	0.001	U	R													0.001	U	R	0.001	U	R	0.001	U	R			
gamma-BHC	0.001	U	J													0.001	U		0.001	U		0.001	U				
gamma-Chlordane	0.001	U	J													0.001	U		0.001	U		0.001	U				
Heptachlor	0.001	U	J													0.001	U		0.001	U		0.001	U				
Heptachlor Epoxide	0.001	U	J													0.001	U		0.001	U		0.001	U				
Methoxychlor	0.001	U	J													0.001	U		0.001	U		0.001	U				
Toxaphene	0.001	U	J													0.001	U		0.001	U		0.001	U				

Pesticide (ug/kg)	DMMU 2a												DMMU 2b												CDF 10B		
	SET-UF			SET-F			MET-UF			MET-F			SET-UF			SET-F			MET-UF			MET-F			SET-F		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
4,4'-DDD	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
4,4'-DDE	0.003	J		0.001	U		0.002	J					0.001	U		0.001	U		0.003	J					0.001	U	
4,4'-DDT	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
Aldrin	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
alpha-BHC	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
alpha-Chlordane	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
beta-BHC	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
delta-BHC	0.001	U	R	0.001	U	R	0.001	U	R				0.001	U	R	0.001	U	R	0.001	U	R				0.001	U	R
Dieldrin	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
Endosulfan-I	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
Endosulfan-II	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
Endosulfan-Sulfate	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
Endrin	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
Endrin Aldehyde	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
Endrin Ketone	0.001	U	R	0.001	U	R	0.001	U	R				0.001	U	R	0.001	U	R	0.001	U	R				0.001	U	R
gamma-BHC	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
gamma-Chlordane	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
Heptachlor	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
Heptachlor Epoxide	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
Methoxychlor	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	
Toxaphene	0.001	U		0.001	U		0.001	U					0.001	U		0.001	U		0.001	U					0.001	U	

Pesticide (ug/kg)	Middle River Reach (MRR)						Lower River Reach (LRR)						Old River Reach (ORR)						Outer Harbor Reach (OHR)					
	MET-UF			MET-F			MET-UF			MET-F			MET-UF			MET-F			MET-UF			MET-F		
	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
4,4'-DDD	0.0031	U	J	0.0030	U	J	0.0031	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J
4,4'-DDE	0.0260	J		0.0180	J		0.0210	J		0.0150	J		0.0140	J		0.0110	J		0.0110	J		0.0075	J	
4,4'-DDT	0.0032	U	J	0.0031	U	J	0.0032	U	J	0.0031	U	J	0.0031	U	J	0.0031	U	J	0.0031	U	J	0.0031	U	J
Aldrin	0.0031	U	J	0.0030	U	J	0.0031	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J
alpha-BHC	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J
alpha-Chlordane	0.0032	U	J	0.0031	U	J	0.0032	U	J	0.0031	U	J	0.0031	U	J	0.0031	U	J	0.0031	U	J	0.0031	U	J
beta-BHC	0.0031	U	J	0.0030	U	J	0.0031	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J
delta-BHC	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J
Dieldrin	0.0031	U	J	0.0030	U	J	0.0031	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J
Endosulfan I	0.0032	U	J	0.0031	U	J	0.0032	U	J	0.0031	U	J	0.0031	U	J	0.0031	U	J	0.0031	U	J	0.0031	U	J
Endosulfan II	0.0031	U	J	0.0030	U	J	0.0031	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J
Endosulfan sulfate	0.0031	U	J	0.0030	U	J	0.0031	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J
Endrin	0.0028	U	J	0.0027	U	J	0.0028	U	J	0.0110	J		0.0090	J		0.0027	U	J	0.0027	U	J	0.0027	U	J
Endrin aldehyde	0.0036	U	J	0.0035	U	J	0.0036	U	J	0.0035	U	J	0.0035	U	J	0.0035	U	J	0.0035	U	J	0.0035	U	J
Endrin ketone	0.0032	U	J	0.0120	J		0.0032	U	J	0.0031	U	J	0.0074	J		0.0031	U	J	0.0031	U	J	0.0031	U	J
gamma-BHC	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J	0.0020	U	J
gamma-Chlordane	0.0032	U	J	0.0031	U	J	0.0032	U	J	0.0031	U	J	0.0031	U	J	0.0031	U	J	0.0031	U	J	0.0031	U	J
Heptachlor	0.0029	U	J	0.0028	U	J	0.0029	U	J	0.0028	U	J	0.0028	U	J	0.0028	U	J	0.0028	U	J	0.0028	U	J
Heptachlor epoxide	0.0033	U	J	0.0032	U	J	0.0033	U	J	0.0032	U	J	0.0032	U	J	0.0032	U	J	0.0032	U	J	0.0032	U	J
Methoxychlor	0.0031	U	J	0.0030	U	J	0.0031	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J	0.0030	U	J

*Unfiltered water.
**Filtered water.
LQ - Laboratory qualifiers:
U = Indicates the compound was analyzed for but not detected at or above the method detection limit (MDL).
J = Indicates values below the RL but greater than the MDL.
VQ - Data validation qualifiers:
Pesticide analysis (8081) in batches B205032 and B205068 for elutriate samples and CLSite Water had recoveries of delta BHC that were below criteria. Non-detect results were rejected (R flagged).
Pesticide analysis (8081) in batch B205032 for sample CL-Site water exceeded the extraction to analysis holding time. The results have been qualified with a UJ value.
Pesticide analysis (8081) in batch B205032 for sample CL-Site Water had recoveries of 4,4'-DDT that were below criteria. Non-detect results were rejected (R flagged).
RTI (MRR, LRR, ORR, AND OHR samples) pesticides analysis (8081) exceeded the extraction to analysis holding time. The samples were flagged with a J.

TABLE 29. Results of 48-hour *Ceriodaphnia dubia* and 96-hour *Pimephales promelas* elutriate bioassays on Cleveland Harbor Federal navigation channel, CDF and Lake Erie vicinity sediments (USAERDC 2012).

Sample	Elutriate concentration (%)	Species							
		C. dubia				*P. promelas*			
		Measurement Endpoint				Measurement Endpoint			
		Survival (%)	NOEC (%)	LOEC (%)	LC50 (%)	Survival (%)	NOEC (%)	LOEC (%)	LC50 (%)
DMMU-1	6	100	100	N/A	N/A	98±4	100	N/A	N/A
	13	96±9				98±4			
	25	92±18				100			
	50	100				96±9			
	100	100				98±4			
DMMU-2a	6	100	100	N/A	NC	100	50	100	67 (63-71)
	13	96±9				96±5			
	25	92±18				100			
	50	84±17				96±5			
	100	84±17				**0**			
DMMU-2b	6	92±18	100	N/A	NC	100	50	100	67 (63-71)
	13	100				100			
	25	100				96±5			
	50	92±11				96±5			
	100	76±17				**0**			
CDF	6	84±17	100	N/A	N/A	100	100	N/A	N/A
	13	96±9				100			
	25	92±11				100			
	50	92±11				100			
	100	88±18				100			
Control	N/A	92±18	N/A	N/A	N/A	100	N/A	N/A	N/A
Lake Site Water	0	80±28	N/A	N/A	N/A	100	N/A	N/A	N/A

TABLE 30. Cleveland Harbor upper Cuyahoga River Channel sediment management units and sampling sites among 2007, 2010 and 2012 investigations, as keyed to 2012 sampling event.

Management unit		Year/sampling site		
		2007	2010	2012
		Site	Site	Site
DMMU-1		1	1	1
		2	2	2
		3	3	3
		4	4*	4
				5
DMMU-2**	a	5	5	6
		6	6a	7
				8
			6b	9
		7	7a	10
	b			11
			7b	12
				13
		8	8	14
				15

*This site is captured under DMMU-2 because DMMU-1 in this investigation was somewhat smaller in comparison to the 2012 sampling event.
**Under the 2012 investigation, this management unit was subdivided into a and b; also, this management unit (including 2a and 2b) was not explicit in 2007.

Enclosure 8

Preliminary Information toward USACE Response to OEPA Comments in October 4, 2013 letter and from November 4, 2013 Meeting

PRELIMINARY INFORMATION TOWARD USACE RESPONSE TO OEPA COMMENTS IN OCTOBER 4, 2013 LETTER AND FROM NOVEMBER 4, 2013 MEETING

1. Recent net improvements in upper Cuyahoga River Channel sediment quality. We believe it is important to highlight that data collected on the sediments within the upper Cuyahoga River Channel indicate a net improvement in quality since 2007. At the November 4 meeting, Mr. Kurt Princic inquired as to the change in the quality of these sediments between 2007 and 2012. This topic is specifically addressed as "Sediment Quality Assessment with Trends Over Time" in Section 3.3 of the dredged material evaluation. Note that trend assessment did not specifically address total polycyclic aromatic hydrocarbon (PAH) contamination because total PAHs were not identified as a sediment contaminant of concern (COC) due to no evidence of acute or sublethal toxicity as gauged via the standard bioassays (please see discussion on the technical rationale for biological testing below). For indicator metals, the only increase between 2007 and 2012 on an averaged basis was for organic carbon (OC)-normalized lead concentrations, but this increase was not of toxicological significance. On average, a decline or overall uniformity in sediment-associated OC-normalized polychlorinated biphenyls (PCB) and DDT concentrations was evidenced between 2007 and 2012. For PAHs on average, an increase in sediment-associated OC-normalized concentrations occurred between 2007 (181 mg/kg-OC) and 2012 (765 mg/kg-OC); however, this increase was not toxicologically significant. With respect to the three biological measurement endpoints (i.e., *Hyelella azteca* survival, and *Chironomus dilutus* survival and growth), the bioassay data show that the toxicity of the sediments has either declined or shown no biologically meaningful increase between 2007 and 2012, and/or 2010 and 2012. This positive change is certainly advantageous to the health of the river and can be used to support beneficial use impairment (BUI) delisting efforts for the Area of Concern (AOC).

2. Differences among 2007 and 2012 sediment sampling/testing efforts and data interpretation. Mr. Princic also inquired at our November 4 meeting as to why the dredged material did not meet Federal guidelines for open-lake placement using the 2007 data, but now meets Federal guidelines using the 2013 data. There are several reasons for that. In 2007, material within dredged material management unit (DMMU)-1 in the upper Cuyahoga River Channel showed statistically significant reduced survivals relative to open-lake reference area sediments using standard *H. azteca* and *C.dilutus* bioassays; in 2013, these same bioassays yielded survivals that were not statistically different relative to the open-lake reference area sediments. Note that the survivals of these test species for sediments across all open-lake reference and placement areas used in the 2007 and 2013 sampling events were quite comparable. In 2007, total PCBs and sum dichlorodiphenyltrichloroethane (DDT)/dichlorodiphenyldichloroethane (DDD)/dichlorodiphenyldichloroethylene (DDE) (ΣDDT) were identified as sediment COCs at Tier 2 of the Great Lakes Testing and Evaluation Manual (GLTM) and no bioaccumulation testing was employed at Tier 3; total PCB and ΣDDT bioaccumulation testing was applied in 2013. Just two biological tests were used in 2007 and these were only applied to the DMMU-1 material. In 2013, there were more biological tests applied, the suite of tests was more advanced and this more rigorous testing was expanded to

include DMMU-2a and DMMU-2b, as well as DMMU-1. In summary, in comparison to the 2007 testing program, the 2013 effort was much more advanced and was applied to material from additional reaches of the upper Cuyahoga River Channel.

3. Importance of biological testing in dredged material evaluations. It is important to understand that USACE evaluations of proposed dredged material discharges pursuant to Clean Water Act Section 404(b)(1) Guidelines and associated Federal guidance emphasize a biological effects-based and sediment elutriate testing over evaluation of bulk sediment chemistry (i.e., concentrations). The rationale is that field sediments characteristically contain mixtures of contaminants and other constituents, such as OC, hard carbon, oxides and other adsorbents and reactants that can potentially interact and influence bioavailability and toxicity. Biological tests and exposure modeling provide the most biologically meaningful and relevant information to assess their potential adverse toxicological impacts, and characterize risk.

4. Sufficiently protective toxicological endpoints. We believe that acute toxicity is the primary biological measurement endpoint for dredged material evaluations. With regard to chronic toxicity of sediments, the application of chronic tests is not recommended in existing ITM or GLTM guidance. That stated, when considering the true bioavailability of sediment contaminants such as cationic metals and PAHs, weight-of-the-evidence indicates that the dredged material is not chronically toxic. For example, cationic metal acid volatile sulfide/simultaneously extracted metals (AVS/SEM), PAH sediment pore water and hydrocarbon toxicity potential (HTP) data on the dredged material consistently suggest low chronic toxicity associated with the DMMU material. Also note that with respect to *H. azteca* and PAH toxicity, equilibrium partitioning sediment benchmark toxic units final acute chronic values ($ESBTU_{FAV}$) based on 13.9 µmol/gm lipid are protective of acute as well as chronic toxicity. With respect to *C. dilutus*, the sublethal growth endpoint is a precursor to chronic toxicity, and the acceptable test results on the DMMU material offer additional empirical evidence of low potential for chronic toxicity.

5. Tiered Approach to Dredged Material Testing and Evaluation. To evaluate suitability of the dredged material for open-lake placement, USACE used a “tiered approach” according to existing 1998 U.S. Environmental Protection Agency (USEPA)/USACE Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.—Testing Manual (ITM) and 1998 USEPA/USACE GLTM. As discussed at our November 4 meeting, the benthic and pelagic bioaccumulation of PCBs was addressed in Tier 4 of the GLTM and/or Tier 3 of the ITM. The Tier 3 results showed with statistical significance that the mean bioaccumulation of PCBs from the dredged material was greater than that associated with the open-lake reference/placement area sediments. Therefore, this Tier 3 information alone was insufficient to show that the dredged material was suitable for open-lake placement in accordance with Tier 3 of the GLTM or ITM. Consequently, further evaluation was performed under Tier 4 of the GLTM and/or Tier 3/4 of the ITM. Note that 40 CFR 230.10(c) implies that statistically significant effects indicated by laboratory test results do not necessarily mean that they will be significantly adverse in the field, which in this case provides for further evaluation of the laboratory benthic bioaccumulation data. Therefore, use of the bioaccumulation/biomagnification factors of

consideration to further evaluate statistically significant bioaccumulation under Tier 3 of the ITM, as well as the Section 404(b)(1) Guidelines, is appropriate. The use of these factors of consideration were the basis of the bioaccumulation exposure factor (BEF) model for receptors (in this case, yellow perch and walleye), which is designed to determine the ecological significance of bioaccumulation of PCBs from the dredged material in fish tissue.

6. Sediment Contamination at CLA-1 and CLA-4. As discussed at our November 4 meeting, we do not believe past dredged material placement at CLA-1 and CLA-4 significantly affected the dredged material evaluation (it did not occur at CLA-4). This is based on three main reasons. First, average OC-normalized concentrations of total PAHs at CLA-1/CLA-4 sediments (excluding the CLA4-3 outlier) of 77.6 to 193 mg/kg-OC are lower or within the range of those recently measured at nearby open-lake reference areas offshore of Rocky River, Fairport and Ashtabula (140 to 289 mg/kg-OC). Second, average OC-normalized concentrations of total PCBs in CLA-1/CLA-4 sediments of 5204 to 5118 µg/kg-OC are within the range of those measured at the same open-lake reference areas (1276 to 11917 µg/kg-OC). Most importantly from a biologically meaningful perspective, the toxicity of bottom sediments at CLA-1/CLA-4 as measured through survival and/or growth in the *H. azteca* and *C. dilutus* bioassays were acceptable. We conclude that the sediments sampled from CLA-1 and CLA-4 are toxicologically similar to bottom sediments in the Lake Erie environs unimpacted by dredged material discharges.

7. Sediment-associated PCB contamination and bioaccumulation. OEPA's major concern with respect to open-lake placement of the dredged material appears to relate to sediment-associated PCBs. We offer the following additional information regarding PCB contamination and bioaccumulation of PCBs from the dredged material:

a. *Concentrations of PCBs in the dredged material*

(1) Bulk concentrations of total PCBs (congener total) alone in material within the three DMMUs on a composite samples basis range from 112 to 126 µg/kg, and were comparable to those at CLA-1 (124 µg/kg) and CLA-4 (123 µg/kg). However, the bioaccumulation of total PCBs from the dredged material in the laboratory was often statistically greater than that associated with CLA-1 and CLA-4 sediments. Lower total OC content in the dredged material (composite sample average 1.23%) relative to CLA-1/CLA-4 (2.4 to 2.5%) was a significant factor in the difference in PCB bioavailability and bioaccumulation.

(2) Average OC-normalized total PCB concentrations in DMMU material across the 2007, 2010 and 2013 Cleveland Harbor sampling events show that the concentrations of 4675 to 7350 µg/kg-OC approach that at CLA-1/CLA-4 (5204 and 5118 µg/kg-OC, respectively).

b. *Concentrations of PCBs in bottom sediments at CLA-1 and CLA-4 relative to other open-lake reference areas*—Bulk concentrations of total PCBs in Lake Erie bottom

sediments vary spatially and temporally, and are related to OC content in sediment. Average bulk (or composite) and OC-normalized sediment concentrations at CLA-1/CLA-4 of 132 µg/kg (5204 µg/kg-OC) to 125 µg/kg (5118 µg/kg-OC) were within the general range of those measured offshore of Toledo Harbor (13 µg/kg [1354 µg/kg-OC] to 154 µg/kg [5082 µg/kg-OC]) and Ashtabula Harbor (43 [2443 µg/kg-OC] to 143 µg/kg [11917 µg/kg-OC]). As noted previously, average OC-normalized concentrations of total PCBs in CLA-1/CLA-4 sediments were also within the range of those measured at same open-lake reference areas offshore of the nearby Rocky River, Fairport and Ashtabula Harbors. Therefore, PCB contamination at CLA-1/CLA-4 is not inconsistent with that observed at other areas of Lake Erie situated offshore of urban and industrial areas along the southern shore.

c. *Benthic bioaccumulation of PCBs from the DMMU material*

(1) On a lipid-normalized basis, the range of benthic bioaccumulation of total PCBs from the DMMU material of 4345 to 5920 µg/kg-lipid was often statistically greater than that measured at CLA-1 and/or CLA-4. However, it within the range of that predicted and/or measured from open-lake reference area sediments offshore of Toledo Harbor (2000 to 7620 µg/kg-lipid) and Ashtabula Harbor (1726 to 16800 µg/kg-lipid) between 2004 and 2011. It was also within the range of that predicted and/or measured from open-lake reference area sediments offshore of Rocky River, Fairport and Ashtabula (1391 to 16800 µg/kg-lipid) between 2004 and 2011.

(2) Recent USACE dredged material evaluations for Toledo and Ashtabula Harbors determined that benthic tissue residues of total PCBs from the dredged material acceptable for open-lake placement at 100 µg/kg, and 63.8 to 87 µg/kg, respectively. Acknowledging that these harbors are located at other areas of Lake Erie, these total PCB tissue residues are nevertheless comparable or greater in comparison to the 50.6 to 70.2 µg/kg range (average 58.2 µg/kg) measured across the Cleveland Harbor DMMU material which is proposed for open-lake placement. OEPA granted Section 401 WQC for the open-lake discharge of material dredged from these other harbors.

d. *Bioaccumulation exposure of PCBs to fish*

(a) If the benthic bioaccumulation were inconsistent with other open-lake reference areas in Lake Erie, the increase in bioaccumulation relative to the Cleveland Harbor open-lake reference areas is not ecologically significant as demonstrated by the spatially-explicit screening level exposure comparison (SESLEC) model approach used to address direct and indirect exposure of receptors to the dredged material relative to the remaining bottom sediments within their home range. The model predictions were highly conservative, yet fell within the general range of analytical variability.

(b) Statistically significant differences in the concentration of PCBs in oligochaetes among the dredged material and CLA-1/CLA-4 are trivial when considered in an ecological context of potential for bioaccumulation in yellow perch and walleye, and ultimately, exposure to pisciverous wildlife and humans. A statistical analysis of

variance (Student's T or Fisher's Least Significant Difference [LSD] test) for the predicted pre- and post-dredged material placement exposure estimates of the bioaccumulation exposure factors (BEFs) to yellow perch and walleye demonstrates how such a small increase in oligochaete tissue concentrations measured in laboratory tests cannot translate into a significant impact through bioaccumulation in predatory fish.

e. *PCB sediment elutriate data and water quality standards (WQSs)*. Compliance of the dredged material discharge with respect to applicable Ohio WQSs was addressed as follows, as agreed to by OEPA with respect to other Lake Erie dredging projects:

(1) Neither the protection of wildlife WQS of 0.12 ng/L or protection of human health WQS of 23 pg/L apply to this proposed discharge of dredged material. These WQSs are chronic, and intended to apply to fixed and continuous discharges. Exposures to PCBs in the water column resulting from the open-lake placement of dredged material are acute and discontinuous.

(2) Recently measured PCB concentrations in Lake Erie water (i.e., representing background water quality concentrations) of 0.22 ng/L exceed the two above WQS, suggesting that the WQSs are currently impossible to achieve in Lake Erie.

(3) PCBs (as Aroclors) in the sediment elutriates were all non-detectable at maximum detection limits of 0.04 µg/L, which are below Ohio's practical quantitation limit (PQL) of 0.5 µg/L.

8. <u>Potential impact of open-lake placement of dredged material on the quality of water at potable water intakes (PWIs)</u>. Modeling was completed in 2013 to address the potential transport of total suspended solids (TSS) to the Crown, Morgan, Baldwin and Nottingham PWI structures following the placement of Cleveland Harbor dredged material at open-lake areas #1 and #4. Solids losses resulting from dredged material placement at these two areas are not expected to have any significant impact on water column TSS concentrations at these PWIs. Under the worst-case scenario modeled, TSS contributions of up to 1 mg/L from dredged material placement at only open-lake area #4 would occur at only the Morgan PWI only about 1% of the time. During this time period, water column TSS would increase 20% from 5 mg/L (background) to 6 mg/L. No measurable TSS contributions are expected to occur from placement at either open-lake area #1 or #2 at any of the other PWIs. Additional modeling was employed to ascertain dissolved contaminant contributions at the PWIs from fine-grained and organic matter attributable to the open-lake placement of dredged material. As a worst-case scenario, this effort used the maximum increased water column TSS concentration that may occur at the Morgan PWI from placement of dredged material at open-lake area #4, along with the highest measured, normalized bulk contaminant concentrations associated with fine-grained and organic matter. All calculated dissolved phase contaminant concentrations were below Ohio and Federal drinking water quality standards/criteria. The very conservative approach used in these modeling efforts indicate that no meaningful contribution of suspended solids or contaminants from dredged material placement operations at open-lake areas #1 or #4 would be expected at any PWI.

OPERATIONS AND MAINTENANCE

OPEN-LAKE PLACEMENT OF MATERIAL DREDGED FROM CLEVELAND HARBOR FEDERAL NAVIGATION CHANNELS IN THE UPPER CUYAHOGA RIVER

CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

• COMMENTS RECEIVED ON USACE EVALUATION (UNIVERSITY OF AKRON [2]; OEPA)

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Review of Cleveland Harbor (Upper Cuyahoga River Channel) Dredged Material Evaluation – 2013

This report presents a wide-range of measurements and interpretations leading to the conclusion that sediment dredged from the Cuyahoga River shipping channel are suitable for disposal in open-water sites in Lake Erie. A range of sediment and elutriate parameters were measured, accompanied by follow-on analyses of bioassay and bioaccumulation studies. As potential contaminants of concern were identified, each one was further assessed to determine it's potential impact should the dredged sediment be disposed of in open-water. Although the report appears to be carefully compiled, there are items not clearly addressed that leave me with the following questions/concerns:

1. A major concern I have is with the sediment sampling method used in the study. I assume that clamshell bucket dredging will remove a substantial thickness (feet) of sediment. However, in assessing the sediment present in the channel only surficial sediment (inches) was collected by a grab sampler. Why weren't sediment cores collected to the depth of the proposed dredging? In 2011 the Cuyahoga River experience intense flooding and sediment movement. Could these flood events produce an upper layer of sediment having contaminant concentrations quite different than the sediment at depth? Variations in the number of floods per year are likely responsible for the "much less coarse-grained" (page 44) sediment sampled in 2010 as compared to 2007 and 2012.

In addition to measuring sediment characteristics to the full depth of dredging, it seems to me that samples should target all parts of the channel, especially channel margin areas. On page 13, the report does address spatial differences between sites. The report takes a wider view (scow load) and places the high values at site 2 in context with nearby sites 1 and 3. A similar approach is used for toluene at sites 4, 5, 6, 9, 10, 11 (page 22). More samples, especially along the margins of the dredged area, would help assess if site 2 is an isolated case or not.

2. The answers to the following concerns might be present in the USACE (2013b) reference but that draft report was unavailable to me. During the field sampling were field blanks also employed and measured? Were samples from any of the sites run in replicate? Discussion of QC/QA (beyond what is on page 4) would be welcomed in the report. The exact method of creating composite samples for each DMMU (page 5) is unclear to me. Were composites created by combining discrete samples in equal amounts or based on a dredge-volume weighted basis?

3. Page 3, last paragraph, states “Sediment data from 2002, 2007 and 2012 sampling events ….”. Later in the report data from years 2007, 2010 and 2012 are shown. Both lists can not be correct.

4. It appears that the sediment data from the years 2007, 2010 and 2012 came from surficial sediment samples. Therefore, do changes in bottom water conditions at the time of individual sampling events (i.e., temperature, dissolved oxygen (DO)) result in measurable differences in sediment components subjected to changing REDOX conditions?

5. Section 3.1 (Site Conceptual Model) could be expanded to evaluate the potential for dredged material to be remobilized and moved from the disposal areas by considering the coarser-grained nature of the dredged material and especially wave-climate data to assess the impact of large storms on the bottom.

6. Section 3.2.1.a ends by stating that “most of the sand present in the management units sediments was fine and was not much different in size than silt particles”. In addition to using the vague term “not much different”, an alternative interpretation could be that the open-water composite samples have slightly more than 30% clay (often cohesive after deposition) whereas DMMU-1 only has about 2% clay. These grain size differences may influence the behavior of the sediment on the bottom at the disposal site.

7. From the data and references presented in section 2 on page 29 it appears that mean sum PCB residues in *L. variegates* tissues should be a concern in placing the dredged material in an open water site.

8. On pages 45-46 I was surprised that Cu and Ni concentration showed an inverse relationship to clay whereas Pb and Zn showed significant positive relationships. Was the inverse relationship significant? No r^2 value was provided for Cu and Ni. Because the grain size was finer in 2010 compared to 2007 and 2012, I would suspect it had a role in the slightly higher bulk Ni concentrations in 2010 compared to 2007 and 2012. Also, the sentence on page 46 for Ni states “For DMMU-1, there was a small decrease between 2007 (geometric mean 29.6 mg/kg) and 2012 (geometric mean 35.1 mg/kg).” Do you mean increase?

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September 9, 2013

To the Environmental Analysis Team at the US Army Corps of Engineers, Buffalo District:

At the request of the Port of Cleveland, I have reviewed your report on Cleveland Harbor (Upper Cuyahoga River Channel) Dredge Material Evaluation – 2013. The report details the United States Army Corps of Engineers (USACE) plan for open lake placement of dredged sediment from the upper portion of the navigation channel, which appears to be approximately 6300 ft. from the head of navigation to the turning basin. The upper portion of the channel was divided into three dredge material management units (i.e., DMMU-1, DMMU-2a, and DMMU-2b). Sediment samples were taken from various sections of each DMMU as well as the rest of the navigation channel, the old river channel, and the harbor. These sediment samples were physically and chemically characterized and then compared to sediment samples taken from two proposed open lake disposal sites (i.e., CLA-1 and CLA-4). The chemical characterization was to determine potential contaminants of concern (COC) as well as nutrient load. The USACE has determined that dredged sediment from DMMU-1 and DMMU-2a/b are suitable for open lake placement in CLA-1 and CLA-4.

USACE came to this conclusion after sampling sediment in the navigation channel 2007, 2010, and the latest sampling 2012. Based on the results of these sediment sampling events, the sediment that is deposited in the navigation channel has become less contaminated and does not elicit acute toxicity. However, the USACE does not appear to have sufficient data or analyzed the current data correctly to make informed decisions on the quality of the sediment for open lake placement or the disposal location. This review will address the USACE sampling protocols, determination of contaminants of concern (COC), and locations chosen for open lake disposal of the dredged material.

Sampling Protocols: USACE took 37 bottom sediment samples from the upper, middle, lower portions of the navigation channel, the old river channel, the harbor, as well as collected additional samples from the two proposed disposal sites. It can only be assumed that USACE used a ponar sampler, which was not discussed in the report. Then, samples were composited for channel segments CH-1 through CH-5 (i.e., DMMU-1), CH-6 through CH-10 (i.e., DMMU-2a), CH-11 through CH-15 (i.e., DMMU-2b), CH-16 through CH-20 (i.e., MRR or middle reach), CH-21 through CH-26 (i.e., LRR or lower reach), the CH-27 through CH-29 (i.e., ORR the old river channel) and CH-30 through CH-37 (i.e.,OHR the harbor). However, samples in the main areas of concern DMMU-1 and DMMU-2a/b were only taken in the center of the channel. Samples were not acquired near the edges of the river channel and composited with the sediment samples taken from the center of the channel. This method of sampling would have better characterized the deposited sediment in each segment (i.e., CH-1 through CH-26) of the river

channel. Also, discrete samples were also withdrawn from the two proposed disposal sites and composited; however, the location of these discrete sites were not disclosed in the report or shown in Figure 4. Samples composited to represent DMMU-1 and DMMU-2a/b only represent sediment sampled from the center of the channel. These composited samples may not fully characterize the type and concentrations of contaminants in these areas of concern.

USACE needed to collect a composite sample from each segment of the navigation channel. This composite sample needed to include sediment collected from the center and the edges of each navigation channel segment. This type of composite samples would have better characterized each segment of the navigation channel. Sediment deposited in the center of the navigation channel could be less contaminated then sediment deposited as well as re-deposited at the edge of the navigation channel due to maritime activities, or the sediment at the edge of the navigation channel could be less contaminated due to re-suspension and the fine sediment, known to contain high concentrations of PCBs/PAHs/pesticides, being deposited further down the navigation channel. The USACE sampling methodology does not appear to be adequate to full characterize the sediment deposited in the dredge material management units (DMMUs).

Contaminants of Concern (COC): The USACE perform numerous analytical methods to identify contaminants of concern (COCs) as well as the nutrient load in the sediments from the DMMUs and the rest of the navigation channel, harbor, and old river channel. USACE identified ammonia (NH_3), legacy pesticides (i.e., DDT/DDD/DDE), nickel (Ni), and polychlorinated biphenyls (PCBs) to be COCs. The USACE determined that the concentrations of these contaminants are not significant greater than in the proposed disposal areas and will not elicit acute toxic effects. This agrees with a bedload sediment characterization performed at the University of Akron. This study monitored contaminant concentrations in bedload sediments from October 2012 to May 2013. PCB and pesticide concentrations were below United States Environmental Protection Agency (USEPA) residential regional screen levels (RSLs). Since the concentrations of the COCs identified by the USACE are below residential RSLs, dredge material can be directly used without remediation for beneficial uses (i.e., fill for demolished homes in Cleveland Metropolitan Area). However, USACE did not include polycyclic aromatic hydrocarbons (PAHs) as a contaminant of concern. Fluorene was found to exceed residential RSL in he CH-4 sample. Indeno(1, 2, 3-cd)pyrene, dibenz(a,h)anthracene, benzo(b)fluoranthene, and benz(a)anthracene exceeded residential RSLs in samples taken from CH-3 through CH-37. Benzo(a)pyrene exceeds residential RSLs in every sample taken from CH-1 through CH-37. However, only benzo(a)pyrene and dibenz(a,h)anthracene exceed industrial RSLs. Benzo(a)pyrene exceeds USEPA industrial RSLs in every sample except for CH-1 and CH-2. While benzo(a)pyrene is a suspected carcinogen, the metabolism of benzo(a)pyrene yields known genotoxic epoxide metabolites. However, concentrations of PAHs do not significantly exceed the reported concentrations bound to the sediment or pore water in the proposed disposal areas, or sediment bound PAH concentrations from samples taken from the harbor (Tables 5 and 6).

Something to note was the lack of replicate samples for each navigation channel segment or composited channel sections. This was very apparent in the chemical characterization of CH-1 and CH-2, which CH-2 was considered and outlier in Figure 5. There is no question that a tremendous amount of effort was exerted to attain the current set of data; however, replicate

analysis for each segment and composite sample would have yielded a more robust data set supporting USACE's decision that the dredge material in the DMMUs is now suitable for open lake placement.

Disposal Locations: The USACE has chosen two potential locations for open lake placement of dredge materials: CLA-1 and CLA-4. CLA-1 was used previously for open lake placement of contaminated dredge materials from the mid twentieth century, and CLA-4 is closer to the shoreline just west of the intakes for the municipal drinking water treatment plants that service Cleveland and the Greater Cleveland Metropolitan Area. I would recommend that CLA-4 not be considered as a dredge material disposal site due to its proximity to the drinking water treatment plant intakes. Due to wind driven currents in Lake Erie, fine sediment particles could potentially stay suspended in the water column and reach the drinking water plant intakes. This could increase the turbidity of the source water at the intakes, which will increase the City of Cleveland's coagulant usage and potentially expose residents to dredge material contaminants. Also, the dredge material contains significant concentrations of ammonia. In the NH_3 form, ammonia is known to be toxic to aquatic species. The pH of the lake should promote the ammonium species (NH_4^+) to be the dominant ammonia species. However, ammonia is very soluble and reacts rapidly with aqueous chlorine added to disinfect drinking water resulting in the formation of chloramines, which do not possess the same disinfection efficacy as does aqueous chlorine (i.e., $HOCl/OCl^-$). The increased bulk ammonia concentration in the water column during disposal of the dredge materials could create issues for the drinking water plants. If breakpoint chlorination is achieved to oxidize elevated ammonia concentrations to nitrate, this could lead elevated concentrations disinfection byproducts (DBPs) being formed in the drinking water distribution system. DBPs are known carcinogens regulated by the US EPA in finished drinking water. Nitrate concentrations are also regulated by the US EPA. If breakpoint chlorination is not achieved, the water treatment plants may not achieve the appropriate level of disinfection potentially exposing residents to water-borne pathogens. Therefore, CLA-4 is not recommended to be used for disposal of dredge materials. CLA-1 is the only recommended site to dispose of dredged materials.

Conclusions and Recommendations:
After reading the USACE report on open lake placement of dredged materials from the Cuyahoga River navigation channel, the USACE does not appear to have sufficient information to determine if the dredge materials are suitable for open lake placement. The USACE sediment collection methodology does not collect representative composite samples from each channel segment (i.e., CH-1 through CH-26). Sediment samples in the DMMUs were only collected in the center of the channel, for each channel segment, and composited with respect to each DMMU. Sediment samples were not collected from edges of each navigation channel segment and composited with a sediment samples taken from the center of the channel to more accurately characterize the contaminant concentrations in each channel segment. The contaminants of concern (COCs) were all below USEPA residential RSLs making the dredge materials suitable for both residential and industrial beneficial uses. However, certain PAHs were above residential RSLs and benzo(a)pyrene was consistently above industrial RSLs. Toxicity tests were performed and found that the sediment did not elicit an acute toxic response; however, chronic toxicity cannot be inferred from these data. Finally, CLA-1 is the only recommended

site to dispose of dredged materials due to CLA-4 being too close to the drinking water treatment plant intakes for the Cleveland Metropolitan Area.

Recommendations for the USACE would be to take composite samples in each of the DMMU channel segment to build a larger body of knowledge of contaminant concentrations in the dredge materials. These composite samples would be more representative of each channel segment and better characterize contaminant concentrations in each channel segment, and sample collection should happen this fall prior to the fall dredging to confirm USACE's decision for open lake placement in Spring 2014. Also, replicate analysis to determine contaminant concentrations would have greatly increased confidence in the current data set considering samples from CH-1 and CH-2 were basically considered outliers. This would not have been an issue if replicate/triplicate analysis was performed on composited samples from each channel segment.

Also, it appears that concentrations of contaminants in the harbor were similar to the proposed disposal sites. This is does not infer that sediment contaminant concentrations would be similar on the north side of the break wall; however, sediment samples should be taken from the north side of the break wall for comparison. If the contaminant concentrations in the sediment samples north of the break wall are comparable to the dredge material from the navigation channel, dredge sediments could be used beneficially to reinforce the lake side of the break wall as well as provide additional habitat for near-shore aquatic species.

If there are any questions about this review of the USACE report on the Cleveland Harbor Dredge Material Evaluation, please feel free to contact me.

Sincerely,

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Ohio EPA
40 years and moving forward
John R. Kasich, Governor
Mary Taylor, Lt. Governor
Scott J. Nally, Director

October 4, 2013

Dave Romano
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York, 14207-3199

Dear Mr. Romano

On August 1, 2013 Ohio EPA received the Cleveland Harbor (Upper Cuyahoga River Channel) Dredged Material Evaluation – 2013 document. This document was submitted by US ACE for the purposes of demonstrating the sediments generated from the dredging of the Cuyahoga River Navigation Channel met open lake disposal requirements. We appreciate the submittal of the document prior to formal submission of your 401 permit application for dredging.

My staff has reviewed the documents and additional data you have submitted throughout our review process. In Attachments 1 and 2 of this letter, you will find our detailed review and comment rational. At this time Ohio EPA does not feel that the sediments quality is sufficient to meet the open water placement criteria. In addition, Ohio EPA has concerns regarding the potential impact of open lake disposal on the City of Cleveland drinking water intakes.

It is my understanding that your team is scheduling a meeting with my staff to discuss the comments. I encourage you to schedule that meeting as soon as possible. If you have any questions do not hesitate to contact Kurt Princic at 33-963-1204.

Sincerely

Scott Nally
Director
Ohio EPA

Cc: Will Friedman – Cleveland Port Authority
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Appendix 1: An Assessment of U.S. Army Corps of Engineers' Report, Cleveland Harbor (Upper Cuyahoga River Channel) Dredged Material Evaluation—2013

Ohio EPA

Division of Surface Water

Standards and Technical Support

October 3, 2013

Contents

1. Executive summary 2
2. Summary of the 2013 Cleveland Harbor evaluation 5
3. 2013 Cleveland Harbor methodology 6
3.1 Use of contaminated reference sites 6
3.2 Inconsistent selection, interpretation of federal guidance 8
3.3 Insufficiently protective toxicological endpoints 9
3.4 Summary 11
4. 2013 Cleveland Harbor contaminant data 11
4.1 Polychlorinated Biphenyls (PCBs) 12
4.1.1 2013 PCB results 13
4.1.2 Assessment of PCB contamination 14
4.2 Polycyclic Aromatic Hydrocarbons (PAHs) 19
4.2.1 2013 PAH results 19
4.2.2 Equilibrium partitioning sediment benchmarks 20
4.2.3 Consensus-based PAH thresholds 22
4.2.4 PAH summary 23
4.3 DDT and DDE 24
4.3.1 2013 DDT + DDE results 25
4.3.2 Assessment of DDT + DDE contamination 25
5. Conclusions 26
References 28
Appendix A: Comparison of 2007 and 2013 reference sites 32
Appendix B: Ohio EPA fish tissue PCB data 33
Appendix C: Equilibrium Partitioning Sediment Benchmarks (PAHs) 34
Appendix D: Comparison of individual and total PAHs to TECs and PECs 35

1. Executive summary

Ohio EPA has reviewed the U.S. Army Corps of Engineers' (U.S. ACE) report, Evaluation of Cleveland Harbor Federal Navigation Channel (Upper Cuyahoga River) Dredged Material with Respect to Suitability for Open-lake Placement ("2013 Cleveland Harbor evaluation") (U.S. ACE 2013a). U.S. ACE evaluated sediment from Cleveland Harbor for suitability for open-lake placement in Lake Erie, pursuant to federal 404(b)(1) Guidelines for the disposal of dredged material under the Clean Water Act. Ohio EPA has reviewed the U.S. ACE report according to both Section 404 and Section 401 requirements for the protection of the aquatic ecosystem, wildlife, and human health.

Ohio EPA's assessment of the 2013 Cleveland Harbor evaluation has revealed a number of technical, methodological flaws that compromise the conclusions reported by U.S. ACE. The methodology used by U.S. ACE was contrary to the best available science and guidance, as evident by the selection of contaminated sediment reference sites, the omission of important ecological data and key guidance specific to the Great Lakes, and the selection of under-protective toxicological endpoints which artificially reduced the apparent toxicity of the Cleveland Harbor sediments. The data provided by U.S. ACE show that several classes of contaminants are above thresholds of concern, indicating that the proposed open-lake disposal poses a risk of toxicity to the Lake Erie ecosystem and to human and animal consumers of fish. These data provide evidence that the proposed open-lake disposal is not consistent with state or federal regulations; however, these findings were not adequately addressed by U.S. ACE in the 2013 Cleveland Harbor evaluation.

The primary contaminants of concern in the dredged material are polychlorinated biphenyls (PCBs). PCBs are longstanding contaminants of concern in the Great Lakes, and PCB contamination of fish tissue remains an ongoing problem in Lake Erie with important human health, ecological, and economic ramifications. Testing by U.S. ACE indicates that the proposed open-lake sediment disposal would lead to increases in PCB contamination of sediment-dwelling organisms, which would transfer through the aquatic food web, increasing an already-present toxicity hazard to consumers of fish, including humans, wildlife, and birds. U.S. ACE data indicates that aquatic organisms exposed to the Cleveland Harbor sediments bioaccumulated up to 330% more PCBs than organisms exposed to the reference sediments (U.S. ACE 2013a). U.S. ACE's model estimates a worst-case scenario of a 10% increase in tissue PCB concentrations for walleye and a 27% increase in tissue PCB concentrations for perch in the vicinity of the disposal site; however, these estimates would have been higher if uncontaminated reference sediments were used for the comparison.

The following facts are central to determining the permissibility of an increase in PCB bioaccumulation in the lake:

- Lake Erie fish tissue PCB concentrations currently exceed established state, federal, and international human health and wildlife protection criteria, including the Ohio EPA 303(d) human health beneficial use impairment threshold, the Ohio EPA fish consumption advisory threshold, the Great Lakes Water Quality Agreement wildlife protection threshold, and the U.S. Environmental Protection Agency (U.S. EPA) wildlife threshold (see section 4.1.2);

- PCBs are responsible for approximately 65% of Lake Erie fish consumption advisories. Beyond the health concerns indicated by fish consumption advisories, they also pose a negative impact to the region's fishing and tourism industries (Lake Erie LaMP Work Group 2000);

- PCBs are classified as a Level I Substance under the Great Lakes Binational Toxics Strategy and have been targeted for virtual elimination from the Great Lakes' ecosystem. PCBs are also targeted for virtual elimination under the North American Regional Action Plan (Environment Canada/U.S. EPA N.D.; Lake Erie LaMP Work Group 2000);

- PCBs are identified as a critical pollutant under the Lake Erie Lakewide Management Plan (Lake Erie LaMP Work Group 2000);

- Increases in PCB bioaccumulation in waters of the Great Lakes system constitute a significant lowering of water quality under Ohio Administrative Code 3745-1-05(F)(2)(a)(v); and,

- Sediment discharges leading to increases in PCB bioaccumulation are not permissible under Great Lakes 404(b)(1) sediment guidance published by U.S. EPA and U.S. ACE (U.S. EPA/U.S. ACE 1998a).

In the 2013 Cleveland Harbor evaluation, U.S. ACE interprets the national 404(b)(1) sediment testing guidance to indicate that the increase in PCB bioaccumulation would be permissible according to federal regulations; however, this interpretation does not incorporate available data regarding the current status of PCBs in Lake Erie fish tissue, which is the primary concern regarding PCBs in the lake. This assessment is also in conflict with the Great Lakes Dredged Material Testing and Evaluation Manual (U.S. EPA/U.S. ACE 1998a), the Great Lakes Binational Toxics

Strategy, the North American Regional Action Plan, and the Lake Erie Lakewide Management Plan. Ohio EPA interprets the federal 404(b)(1) Guidelines to indicate that the Cleveland Harbor dredged material is not suitable for open-lake disposal regarding PCB contamination, nor does it meet Ohio EPA Section 401 guidelines.

In addition to the bioaccumulation of PCBs, the 2013 Cleveland Harbor evaluation also indicates high levels of polyaromatic hydrocarbons (PAHs) in the dredged material, which present an additional hazard to the aquatic ecosystem. This risk was not sufficiently investigated by U.S. ACE in the 2013 Cleveland Harbor evaluation; Ohio EPA has reevaluated the data provided by U.S. ACE and concluded that the Cleveland Harbor sediments are likely to be toxic to aquatic organisms in contact with the sediments. Additionally, the PAH benzo[a]pyrene was detected at high levels in the Cleveland Harbor sediments. Benzo[a]pyrene is classified as a Level I Substance under the Great Lakes Binational Toxics Strategy and is targeted for virtual elimination from the Great Lakes (Environment Canada/U.S. EPA, N.D.).

Two additional Level I Substances, the pesticide DDT and its metabolite DDE, were also detected in the Cleveland Harbor sediments and were found to bioaccumulate to higher levels in organisms exposed to the harbor sediments compared to organisms exposed to the reference sediments. While the concentrations of DDT and DDE found in the sediments may not pose an immediate risk to consumers of fish, there is some indication of potential toxicity to aquatic organisms. Further, the Great Lakes 404(b)(1) guidance, the Great Lakes Binational Toxics Strategy, and Ohio EPA 401 guidelines all seek to eliminate discharges of DDT and DDE to Lake Erie.

Given the weight-of-evidence regarding the risks posed by PCBs, PAHs, DDT, and DDE, and existing restrictions on the discharge of these contaminants to the Great Lakes, Ohio EPA interprets the federal 404(b)(1) Guidelines and Ohio EPA 401 guidelines to indicate that the Cleveland Harbor dredged material is not suitable for open-lake disposal. The data presented in the 2013 Cleveland Harbor evaluation indicate that the contaminants in the harbor sediment would pose an unacceptable risk of toxicity to aquatic organisms and to human, wildlife, and avian consumers of fish, and would also further exacerbate the persistent economic effects of Lake Erie fish consumption advisories.

2. Summary of the 2013 Cleveland Harbor evaluation

The disposal of dredged material into waters of the United States is regulated under Section 404(b)(1) Guidelines of the Clean Water Act, as detailed in 40 CFR 230, with the intent to "restore and maintain the chemical, physical, and biological integrity of waters of the United States." These federal standards were developed, "that dredged or fill material should not be discharged into the aquatic ecosystem, unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact either individually or in combination with known and/or probable impacts of other activities affecting the ecosystem of concern."

Methods for assessing dredged material for compliance with the 404(b)(1) Guidelines were jointly developed by the U.S. Environmental Protection Agency (U.S. EPA) and U.S. Army Corps of Engineers (U.S. ACE), and published as Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.—Testing Manual ("Inland Testing Manual") (U.S. EPA/U.S. ACE 1998b), providing guidance which is general to all waters of the U.S. Guidance specific to the Great Lakes is given in a parallel document, Great Lakes Dredged Material Testing and Evaluation Manual ("Great Lakes testing manual") (U.S. EPA/U.S. ACE 1998a).

The 2013 Cleveland Harbor evaluation (U.S. ACE 2013a) assesses the suitability of Cleveland Harbor dredged material for open-lake placement in Lake Erie pursuant to 404(b)(1) Guidelines. U.S. ACE indicates that the evaluation is consistent with both the regional Great Lakes testing manual and the national Inland Testing Manual. This is consistent with the directive in the Great Lakes testing manual (U.S. EPA/U.S. ACE 1998a, pp. 3-5) which indicates that both manuals should be used in conjunction to evaluate a proposed discharge to the Great Lakes; Ohio EPA agrees with this directive and we reiterate that sediment evaluations for discharge to Lake Erie should be consistent with the criteria established in both testing manuals.

In the 2013 Cleveland Harbor evaluation, U.S. ACE proposes to dredge sediment from three contiguous reaches of Cleveland Harbor, management units DMMU-1, DMMU-2a, and DMMU-2b. These materials are proposed to be placed in either of two open-lake placement sites, CLA-1 and CLA-4. Both placement sites are two square miles in area with depths of between 50 and 60 feet. Placement site CLA-1 was previously used for open-lake disposal of dredged material more than 40 years ago. Each proposed disposal site was sampled at four locations, each dredging management unit was sampled at five locations, and one composite sample was mixed for each disposal site and dredging management unit.

Sediment material at all locations were analyzed for various metals, inorganic compounds, and a range of organic compounds including polychlorinated biphenyls (PCBs), pesticides, polycyclic aromatic hydrocarbons (PAHs), and benzene-toluene-ethylbenzene-xylenes (BTEX). Determinations of the acceptability of contamination concentrations found in dredged material were made according to the tiered evaluation procedure described in the national and Great Lakes 404(b)(1) guidance documents. Where additional testing was necessary, biological testing was conducted to evaluate sediment material for acute sediment toxicity, acute water-column toxicity, and for potential bioaccumulation of toxic substances.

3. 2013 Cleveland Harbor methodology

Ohio EPA has concerns regarding a number of methodologies used by U.S. ACE as presented in the 2013 Cleveland Harbor evaluation, which compromise the findings presented therein. These include the selection of inappropriate sediment reference locations, a failure to address the most appropriate available guidance for a Great Lake, and the selection of insufficiently protective screening values and toxicological endpoints using a limited amount of sampling data. Furthermore, since each dredging management unit was only sampled at five discrete locations, and only one composite sample was mixed for each disposal site and dredging management unit, the data and results provided are limited and do not fully characterize the potential extent and temporal variation of contamination in this dynamic system that receives contaminants from multiple industrial and urban sources.

3.1 Use of contaminated reference sites

The selection of reference sediments is critical to the success of a dredged material evaluation. Reference sediments are used as a benchmark for comparing the dredged material to the *in situ* sediments at the disposal site, to estimate what effects could be expected by the proposed disposal activities. The text of the federal 404(b)(1) legislation does not explicitly direct the choice of reference locations for sediment evaluations; however, the federal guidance documents provides two important guidelines for the selection of reference sediments.

First, the reference sites should not be impacted by contamination that is not representative of the disposal area as a whole. In particular, the use of prior sediment disposal sites as reference locations is strongly discouraged. The Inland Testing

Manual (U.S. EPA/U.S. ACE 1998b) recommends choosing a reference site similar in location and characteristics to the proposed disposal site, but unimpacted by previous sediment discharges, noting that, "adoption of a reference sediment that is unimpacted by previous discharges of dredged material will result in a more scientifically sound evaluation of potential individual and cumulative contaminant-related impacts (p. 3-6)."

Second, the Great Lakes testing manual (U.S. EPA/U.S. ACE 1998a) warns against a too-literal interpretation of the phrase "disposal site" to mean strictly the location where the dredged material is discharged. Reasoning that dredged material may erode and migrate from the discharge location, potential impacts to the surrounding environment must be considered, stating that, "the existing Guidelines specify that dredged material are evaluated compared to sediment from the disposal site. As most open water disposal sites in the Great Lakes are dispersive in nature, this manual will encourage a broad interpretation of 'disposal site' (p. vi)."

These guidelines were not sufficiently incorporated into the 2013 Cleveland Harbor evaluation. According to the U.S. ACE report, reference location CLA-1 was previously used for sediment disposal, and is described by U.S. ACE as impacted as a result. There was no discussion in the U.S. ACE report regarding reference location CLA-4, so Ohio EPA can offer no opinion regarding the history of CLA-4; however, the total PAH concentration of 33.4 mg/kg for sample CLA4-3 is indicative of highly contaminated sediments. Total PAH concentrations in the other reference sediment samples were lower than in CLA4-3, and this outlier value suggests that site CLA-4 has been exposed to some contamination source substantially beyond background levels and is not appropriate for use as a reference site.

Additionally, both reference locations in the 2013 Cleveland Harbor evaluation show substantially higher levels of PCB and PAH contamination than the nearby reference locations used in the 2007 Cleveland Harbor evaluation. On average, the PCB concentrations in the 2013 reference sediments were 60% higher than at the reference sites used in 2007[1], and PAH concentrations in the 2013 reference sediments were 25 times higher than at the reference sites used in 2007 (Appendix A). These data indicate that the reference sediments used in the 2013 Cleveland Harbor evaluation substantially overestimate the contamination levels found in the vicinity of the

[1] Because of differences in detection limits between the 2007 and 2013 reports, comparison of reported total PCB concentrations may present unintended bias. The comparison in this report is based on sediment concentrations of Aroclor 1254, as this was the only Aroclor above detection limits in both Cleveland Harbor evaluations.

disposal sites, affecting the comparison of the reference and dredged material contamination data.

Ohio EPA will make use of the 2013 reference sediment data in this review, for the reason that it is the most detailed information available for comparison. Using this contaminated reference sediment for comparison, it is still apparent that the Cleveland Harbor dredged material does not meet federal or state guidelines for open lake disposal. The use of contaminated reference data will have the effect of masking the relative magnitude of contamination in the Cleveland Harbor dredged material, and it should not be construed to indicate that Ohio EPA accepts the use of these reference sites.

3.2 Inconsistent selection, interpretation of federal guidance

In prior evaluations of dredged material for discharge to Lake Erie (U.S. ACE N.D., U.S. ACE 2007, U.S. ACE 2010, U.S. ACE 2011a, U.S. ACE 2011b, U.S. ACE 2013b), U.S. ACE used the Great Lakes testing manual (U.S. EPA/U.S. ACE 1998a) as its basis for assessment. Evaluating the 2013 Cleveland Harbor data, it is clear that the dredged material does not meet federal guidelines for open lake disposal as described in the Great Lakes testing manual regarding the presence of unacceptable levels of bioaccumulative contaminants DDT and PCBs (see sections 4.1.2 and 4.3.2); however, U.S. ACE does not address this conclusion in the 2013 Cleveland Harbor evaluation. In this respect, the conclusions reached in the 2013 Cleveland Harbor evaluation are inconsistent with the criteria given in the Great Lakes testing manual; Ohio EPA does not accept data evaluated contrary to the Great Lakes testing manual and subsequent publications.

In place of the Great Lakes testing manual criteria, U.S. ACE based its evaluation of bioaccumulative contaminants on criteria given in the national Inland Testing Manual. This alternative evaluation was conducted without the consideration of essential information, including the current status of PCB contamination in Lake Erie fish tissue, the ubiquity of fish consumption advisories for Lake Erie as a consequence of PCB contamination, and national and international goals for the elimination of PCB discharges to the Great Lakes (see section 4.1.2).

Ohio EPA has evaluated U.S. ACE's data in regards to each of these issues and has determined that the Cleveland Harbor dredged material does not meet federal guidelines for open lake disposal according to the most appropriate guidance as

outlined in the Great Lakes testing manual. Further, Ohio EPA has found that the Cleveland Harbor dredged material also does not meet federal guidelines for open lake disposal according to the generic national guidance as outlined in the Inland Testing Manual when the available data is considered.

3.3 Insufficiently protective toxicological endpoints

In the current Cleveland Harbor evaluation, U.S. ACE has selected acute (short-term) toxicity as the most relevant toxicological endpoint of concern. The 2013 Cleveland Harbor evaluation notes that federal guidelines, "emphasize acute toxicity tests for dredged material evaluations (U.S. ACE 2013a, p. 16)," however the original context of this citation does not support the selection of acute toxicity as the only screening or testing endpoint. U.S. ACE appears to be citing text in the Inland Testing Manual (U.S. EPA/U.S. ACE 1998b) which states, "Presently, Tier III toxicity tests primarily use lethality as the endpoint. Chronic/sublethal tests for sediments are under development; none are considered to be currently suitable for wide-spread national use and hence are not included in this manual although regional use is allowed (p. 6-1)." The Inland Testing Manual later states, "When methods are suitable for wide-spread national use, sediment chronic/sublethal testing will be part of Tier III [toxicity tests] (p. 7-1)."

This express written intent of the authors of the Inland Testing Manual indicates that chronic (long-term) toxicity is a relevant ecological concern for sediment evaluation, but that standardized bioassay procedures for chronic testing were not sufficiently developed at the time of publication in order to be included in the manual. These chronic bioassays were subsequently published two years later by U.S. EPA (2000) with the express intent that they be included as part of the sediment evaluation process for dredged material disposal (p. iii). U.S. ACE's citation of federal guidelines to emphasize acute toxicity was taken out of context; the federal guidance does not support the selection of acute toxicity as the primary toxicological endpoint of concern. U.S. ACE focused its screening and testing on acute toxicity risks, but chronic toxicity should be the primary endpoint of concern for sediment evaluation (see below). At issue is the fact that contaminant concentrations below the threshold necessary to directly kill organisms (acute toxicity) may still exert toxic effects related to growth, behavior, and reproduction (chronic toxicity). These effects may substantially impact sediment-dwelling organisms and violate state and federal guidelines for the discharge of contaminated sediments.

The need for chronic toxicity testing to assess dredged sediment is indicated in federal guidance, industry sediment testing manuals, and in the primary literature. Citing (Sibley *et al.*, 1996; Sibley *et al.*, 1997; Sibley *et al.*, 1998, Benoit *et al.*, 1997; Ingersoll *et al.*, 1998; Kemble *et al.*, 1994), U.S. EPA (2000, p. 2) indicates that "these [acute toxicity tests] which only measure effects on survival can be used to identify high levels of contamination, but may not be able to identify moderately contaminated sediments. Sublethal [chronic] endpoints in sediment tests may also prove to be better estimates of responses of benthic communities to contaminants in the field." The Interstate Technology Regulatory Council (ITRC), a state-led, national coalition of personnel from the environmental regulatory agencies of all 50 states and the District of Columbia, three federal agencies, tribes, and public and industry stakeholders, indicates that, "acute tests can be used to demonstrate a significant exposure and effect at a site but cannot account for sublethal exposure and effects. Concentrations of [contaminants] in sediments may not cause mortality but may interfere with the ability of an organism to develop, grow, or reproduce. Chronic toxicity test exposures more closely approximate the types of endpoints of concern for organisms in natural environments and can be used to better evaluate potential impacts to benthic communities in moderately contaminated areas (ITRC 2011, p. 50)." Burton and Landrum (2003) add that, "unfortunately, most sediment toxicity test methods are focused on acute (short-term exposure) and not chronic (long-term exposure) toxicity. The measures of acute toxicity are not often adequate to detect the impacts on benthic communities.... In reality, chronic toxicity is the more pervasive problem and it is the chronic responses, such as changes in reproduction that lead to population level responses (p. 2)."

The risk of chronic toxicity should be accounted for during the sediment evaluation process, which was neglected in the 2013 Cleveland Harbor evaluation. Chronic toxicity should have been, but was not, accounted for at two stages of the 2013 evaluation. During Tier 2 of the evaluation (the screening of chemistry data for toxicity risks), PAHs were evaluated for toxicity using equilibrium partitioning sediment benchmark procedures, as recommended by Ohio EPA (2010) and U.S. EPA (2003a, 2008). However, in place of the chronic toxicity thresholds (final chronic values, FCVs) recommended by both agencies, U.S. ACE calculated its own thresholds for the estimation of acute toxicity risks (final acute values, FAVs), which served to reduce the estimated toxic risk of the Cleveland Harbor sediments by raising the screening thresholds substantially. Using this method, U.S. ACE estimated that the Cleveland Harbor sediments should not be acutely toxic to benthic organisms. Ohio EPA has reevaluated the 2013 Cleveland Harbor data using the more-appropriate FCVs and

found that the Cleveland Harbor sediments present a clear risk of chronic toxicity to the aquatic ecosystem (see section 4.2.2 and Appendix C).

Chronic toxicity should also have been accounted for during Tier 3 of the evaluation (biological testing). U.S. ACE conducted short-term bioassays using two different sediment-dwelling organisms to evaluate the toxicity of the Cleveland Harbor sediments. These tests included a 10-day toxicity test using the amphipod *Hyalella azteca*, measuring lethality as the endpoint, and a 10-day toxicity test using the midge *Chironomus dilutus*, measuring lethality and growth as the endpoints. MacDonald and Ingersoll (2002) discuss the potential for false negative results using these short-term acute tests, *i.e.*, "erroneous concluding that contaminated sediments are unlikely to adversely affect sediment-dwelling organisms (p. 26)," and recommend the use of a 28-day chronic test instead. U.S. EPA methods (2000) also include procedures for chronic tests lasting 42 days and longer than 60 days. There is a strong scientific consensus indicating the importance of chronic toxicity tests to ensure adequate protection of the lake ecosystem and in light of the prevailing guidance and availability of chronic testing procedures, Ohio EPA does not interpret the results of short-term acute toxicity tests as demonstrating a sufficient lack of sediment toxicity. Chronic toxicity testing is needed to understand potential long-term effects from exposure to the sediments.

3.4 Summary

Ohio EPA considers the methodology used in the 2013 Cleveland Harbor insufficient. U.S. ACE did not incorporate the best scientific and most appropriate guidance into the evaluation process. The 2013 report concludes that the Cleveland Harbor dredged material meets federal 404(b)(1) guidelines for disposal in Lake Erie, but key federal guidance and prevailing scientific consensus was not incorporated in the production of that analysis. Ohio EPA disagrees with the conclusions of the report; Ohio EPA has evaluated the data provided according to the best available guidance, and reports these findings in section 4.

4. 2013 Cleveland Harbor contaminant data

The data presented by U.S. ACE indicate that several classes of contaminants in the Cleveland Harbor sediments are above thresholds of concern and are likely to cause toxicity to aquatic organisms and increase already existing risks to human, avian, and wildlife consumers of fish. The major contaminants of concern in the Cleveland

Harbor sediments are polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs). Ohio EPA has compared contamination levels to established guidelines and has determined that both classes of substances exceed tolerable limits for open lake disposal.

4.1 Polychlorinated Biphenyls (PCBs)

According to the 2013 Cleveland Harbor evaluation data, the proposed disposal would lead to an increase in PCB bioaccumulation in the aquatic food web, beginning with benthic organisms in direct contact with the sediment and transferring to higher trophic levels, including sport fish, and human, wildlife, and avian consumers of fish. To permit this increase in PCB bioaccumulation would be contrary to established Lake Erie goals and to federal 404(b)(1) Guidelines and Ohio EPA 401 guidelines (see below).

PCBs have a substantial history as toxic substances of concern in the Great Lakes. The Great Lakes Binational Toxic Strategy, ratified by U.S. EPA and Environment Canada, classifies PCBs as Level I Substances indicating the highest degree of concern (Environment Canada/U.S. EPA N.D.). With this designation, the Strategy indicates that current levels of these contaminants are exhibiting toxic effects to aquatic, animal, or human life, and, "represent the primary focus around which the governments will concentrate and lead actions and effort. Since these Level I substances have been associated with or have the potential to cause deleterious environmental impacts... they represent an immediate priority and are targeted for virtual elimination (p.5)," noting that, "unacceptable levels of PCBs... require the continued issuance of fish consumption advisories, suppressing the economic potential of the region's fisheries industries and presenting a continued human health risk (p. 2)." PCBs have also been targeted for virtual elimination by the North American Regional Action Plan, which sets the goal of no measurable release of PCBs to the environment across the continent (Lake Erie LaMP Workgroup 2000). Similarly, the Lake Erie Lakewide Management Plan (LaMP) Management Committee has designated PCBs as a critical pollutant for priority action, as defined by the Great Lakes Water Quality Agreement (GLWQA), citing the presence of PCBs in open lake waters, the ability for PCBs to cause or contribute to a failure to meet GLWQA objectives, and the ability to bioaccumulate. The committee further notes that PCBs account for 65% of all fish consumption advisories.

In the 2013 Cleveland Harbor evaluation, U.S. ACE concludes that the estimated increases in PCB bioaccumulation in the aquatic food web meet federal guidelines for open lake disposal. However this assessment does not consider current PCB contamination levels in Lake Erie or the status of PCBs as a critical pollutant in the Great Lakes. Furthermore, Ohio EPA maintains that guidance provided in the Great Lakes testing manual should be adhered to as closely as practical. Under this guidance the dredged material does not meet federal guidelines for open-lake disposal because it would noticeably increase the bioaccumulation of PCBs in aquatic organisms. Ohio EPA believes this proposed discharge would violate federal 404(b)(1) guidelines for the Great Lakes as well as Ohio 401 guidelines, and would be contrary to the goals of the Great Lakes Binational Toxic Strategy, the North American Regional Action Plan, the Lake Erie LaMP, and the Great Lakes Water Quality Agreement.

4.1.1 2013 PCB results

According to the methods given in U.S. EPA and U.S. ACE guidelines (U.S. EPA/U.S. ACE 1998a, 1998b) U.S. ACE conducted Tier III bioaccumulation tests using populations of the benthic oligochaete, *Lumbriculus variegatus,* to assess the potential for toxic substances to bioaccumulate in the tissue of benthic organisms. Populations of *L. variegatus* were exposed to sediment from the reference locations (proposed disposal sites CLA-1 and CLA-4) or from the dredging locations (DMMU-1, DMMU-2a, DMMU-2b) for a period of 28 days. The tissue of the organisms was analyzed for concentrations of a subset of PCB congeners and tissue concentrations of total PCBs were estimated. These tests demonstrated that organisms exposed to the dredged material generally bioaccumulated greater concentrations of PCBs than organisms exposed to the reference sediments[2].

U.S. ACE calculated ratios of PCB bioaccumulation in organisms exposed to the dredged material compared to organisms exposed to the reference sediments and

[2] Tissue PCB concentrations for organisms exposed to the reference sediments ranged from approximately 19 parts per billion (ppb) (CLA-4) to 48 ppb (CLA-1), while organisms exposed to the dredged material had predicted mean total PCB residues from approximately 51 ppb (DMMU-2a) to 72 ppb (DMMU-1). Statistical tests indicated that tissue concentrations associated with all three dredging sites were significantly greater than tissues associated with the disposal site CLA-4, and tissue concentrations associated with dredging location DMMU-1 was significantly greater than tissue associated with the disposal site CLA-1. There was no statistical difference between tissues associated with dredging locations DMMU-2a or DMMU-2b compared to disposal site CLA-1.

found that organisms exposed to sediment from the three dredging units (DMMU-1, DMMU-2a, and DMMU-2b) respectively bioaccumulated 330%, 160%, and 180% more tissue PCB contamination than organisms exposed to sediment from disposal site CLA-4. U.S. ACE also found that organisms exposed to sediment from dredging location DMMU-1 bioaccumulated 70% more tissue PCB contamination than organisms exposed to sediment from disposal site CLA-1.

These results were additionally used to estimate the effect of the proposed open-lake disposal on concentrations of PCBs in fish tissue for two different fish species, yellow perch (*Perca flavescens*) and walleye (*Sander vitreus*). Using worst-case scenario assumptions for placement of material at CLA-4, U.S. ACE estimated a 27% increase in total PCB concentrations in *P. flavescens* tissues for those individuals where the sediment disposal site is within their home range, and a 10% increase in total PCB concentrations in *S. vitreus* tissue for those individuals where the disposal site is within their home range. U.S. ACE proposed modifications to the disposal operations to limit tissue PCB increases for *S. vitreus* to 20% as a conservative measure (U.S. ACE 2013, p. 34), but Ohio EPA does not consider a 20% increase in fish tissue PCB concentrations to be a conservative measure given that existing fish tissue concentrations already exceed levels of human health and ecological concern as described further below.

4.1.2 Assessment of PCB contamination

According to the 2013 Cleveland Harbor evaluation, benthic organisms exposed to the harbor sediments showed statistically significant increases in bioaccumulation of PCBs when compared to organisms exposed to the reference sediments. The Great Lakes testing manual states that, "Dredged material is considered **not** to meet the Guidelines when the mean concentration of bioaccumulative contaminant(s) in test organisms exposed to the dredged material is statistically greater than the concentration of these contaminant(s) in test organisms exposed to the disposal site sediments (U.S. EPA/U.S. ACE 1998a, p. 43) [emphasis in the original]," however U.S. ACE did not discuss this as part of their conclusion in the 2013 Cleveland Harbor evaluation. According to the Great Lakes testing manual the dredged material from Cleveland Harbor does not meet federal guidelines for open lake disposal, even when using these contaminated reference sediments for comparison. If appropriate uncontaminated reference sediments had been used in the evaluation, it is likely that the reported relative increases in PCB bioaccumulation would have been considerably higher.

The 2013 Cleveland Harbor report does not address the above cited guidance or conclusion from the Great Lakes testing manual. In place of the Great Lakes testing manual, U.S. ACE refers to guidance given in the Inland Testing Manual to evaluate PCB contamination in the Cleveland Harbor sediments. Ohio EPA does not agree that the criteria outlined in the Inland Testing Manual are an appropriate substitute for the Great Lakes testing manual when evaluating proposed disposal to Lake Erie. Both manuals should be used in conjunction; the generic Inland Testing Manual criteria should not supersede the region-specific Great Lakes testing manual criteria when evaluating a sediment discharge to Lake Erie. Further, U.S. ACE did not incorporate important ecological data when applying the Inland Testing Manual criteria (see below).

The primary data U.S. ACE did not address was the current status of Lake Erie fish tissue PCB contamination. As discussed below, PCB contamination in the Great Lakes exceeds thresholds of concern established by Ohio EPA, U.S. EPA, and the Great Lakes Water Quality Agreement. PCBs are present in Great Lakes fish tissue at levels believed to present toxic risks to human, avian, and wildlife consumers of fish, as indicated by exceedances of the following thresholds in Lake Erie fish tissue:

- 23 ppb, Ohio EPA's Clean Water Act 303(d) human health beneficial use impairment (BUI) threshold for the Lake Erie Basin (Ohio EPA 2012),
- 50 ppb, Ohio EPA's fish consumption advisory threshold for "eat no more than one meal per week" advisories (Ohio EPA 2013),
- 100 ppb, the binationally-ratified GLWQA threshold for the protection of avian and wildlife consumers of fish (U.S. EPA 2013),
- 160 ppb, the U.S. EPA wildlife protection value (U.S. EPA 2013).

U.S. ACE cites data from (Rowan and Rasmussen 1992) regarding DDT contamination in Lake Erie fish (see section 4.3), but did not address fish tissue PCB data found in the same source. Rowan and Rasmussen show 25 tissue concentration data points representing 1,974 individual fish collected from Lake Erie. One hundred percent of the data points show lake fish tissue PCB concentrations exceeding both Ohio EPA human health protection criteria as well as the 100 ppb GLWQA criterion, with tissue concentrations ranging from 1.25 to 27 times the GLWQA 100 ppb avian and wildlife protection threshold. Ninety-six percent of the data points, representing 98.5% of the individual fish, show tissue concentrations above the U.S. EPA 160 ppb wildlife protection value.

U.S. EPA (2013) states that PCB concentrations in top predator fish currently exceed all of the fish tissue thresholds noted above. U.S. EPA gives an example of Lake Erie walleye, which contain tissue PCB concentrations greater than 1200 ppb, a concentration which is 7.5 times the wildlife-protection criterion noted above, and 52 times the Ohio EPA 303(d) human health criterion. Giving an example of negative wildlife outcomes as a result of contaminated fish tissue, U.S. EPA (2013) notes that Great Lakes shoreline populations of bald eagles are currently experiencing reduced reproductive success compared to inland eagle populations, likely as the result of elevated levels of bioaccumulative contaminants in their diet from Great Lakes fish.

For the production of annual fish consumption advisories, Ohio EPA has analyzed fish tissue samples from the vicinity of Cleveland Harbor on three occasions in the past 10 years, at open water locations in 2005 and 2009, and near-shore in 2008 (Appendix B). Nineteen composite samples were analyzed, representing 53 individual fish. Ohio EPA's weighted average PCB concentrations of the composite samples show a mean fish tissue concentration of 326 ppb, greater than twice the U.S. EPA wildlife criterion of 160 ppb, and 14 times Ohio EPA's 303(d) impairment criterion of 23 ppb for the Lake Erie Basin. A weighted average considering only fish caught in the open water habitat in the vicinity of the proposed disposal sites shows a mean tissue PCB concentration of 234 ppb, which is 1.5 times the U.S. EPA wildlife criterion and 10 times the Ohio EPA 303(d) human health criterion for the basin.

The Great Lakes testing manual (U.S. EPA/U.S. ACE 1998a, p. 30) directs sediment evaluators to specifically consider the effects of proposed discharges on bioaccumulation for species with an existing consumption advisory; this guidance was not incorporated into the 2013 Cleveland Harbor evaluation. Ten species of fish have Ohio EPA consumption advisories in place for Lake Erie as a consequence of fish tissue PCB contamination; nine advisories at the "eat no more than one meal per month" advisory level, and one at the "eat no more than six meals per year" advisory level. Three additional species of fish have generic fish consumption advisories for the Lake Erie basin at the once-per-month advisory level. This weight-of-evidence clearly indicates that PCB concentrations are above established levels of concern for Lake Erie, and Ohio EPA's data supports fish consumption advisories specifically in the vicinity of Cleveland Harbor and the proposed disposal sites. However, the impact of the proposed discharge on existing fish consumption advisories was not evaluated by U.S. ACE as directed by the Great Lakes testing manual. U.S. ACE did evaluate the impact of the proposed discharge on two species of fish (see below), however neither of

these are among the ten species with Lake Erie-specific consumption advisories in place.

In the 2013 Cleveland Harbor evaluation, U.S. ACE estimated that in the vicinity around the disposal sites increases in fish tissue PCB concentrations would be no more than 10% for walleye and 27% for yellow perch. U.S. ACE indicates that increases less than 100% are ecologically benign and concludes that these PCB increases are permissible under federal guidelines. However, this conclusion is contrary to the weight-of-evidence, as detailed below:

- These estimates of 10% and 27% are dependent on the choice of reference sediments used in testing. The use of uncontaminated reference sediment would have shown a greater relative increase in bioaccumulation, and these estimates would be larger.

- U.S. ACE indicates that bioaccumulation increases less than 100% are acceptable (U.S. ACE 2013a, p. 33); however this criterion, from (ASTM 2010), is not specific to PCBs, does not take into account the current status of PCB contamination in Lake Erie fish, and does not appear to be based on specific ecological indicators. Given that fish tissue PCB levels in the vicinity of Cleveland Harbor are estimated at 10 times the Ohio EPA 303(d) human health criterion, the U.S. ACE criterion would set a permissible fish tissue PCB threshold of up to 20 times the human health criterion. This is contradictory to the national goals of no discharge of PCBs.

- Data presented in the 2013 Cleveland Harbor evaluation show that aquatic organisms exposed to the Cleveland Harbor sediment had PCB bioaccumulation levels up to 330% greater than organisms exposed to the reference sediments, considerably exceeding U.S. ACE's 100% threshold indicating ecological risk. U.S. ACE presents these data but does not address these exceedances in the text of the evaluation. The U.S. ACE data, as presented, indicates that there is an expectation of ecological harm under the proposed disposal scenario which was not discussed by U.S. ACE.

- The U.S. ACE conclusion does not account for the Great Lakes testing manual restriction of any increase in PCB bioaccumulation in Lake Erie, the national strategies and international accords that call for the elimination of PCB discharges to the Great Lakes, or the human health and economic impacts of fish consumption advisories to the Lake Erie region.

For all of these reasons, Ohio EPA interprets guidance in both the Great Lakes testing manual and the Inland Testing Manual to indicate that the Cleveland Harbor dredged material does **not** meet federal 404(b)(1) Guidelines for disposal to Lake Erie. Further, these proposed increases in PCB bioaccumulation should be considered in the context of 401 certification, as detailed below:

- Ohio Administrative Code (OAC) 3745-1-04(D) states that the waters of the state shall be free from substances entering the waters as a result of human activity in concentrations that are toxic or harmful to human, animal or aquatic life.

- OAC 3745-1-05(C)(5) directs the director to consider the following impacts which are expected to result from the proposed disposal:
    - (b) The anticipated impact of the proposed lowering of water quality on aquatic life and wildlife, including important commercial or recreational sport fish species, other individual species and the overall aquatic community structure and function.
    - (c) The anticipated impact of the proposed lowering of water quality on human health and the overall quality and value of the water resource.
    - (d) The degree to which water quality may be lowered in superior high quality waters (such as Lake Erie).
    - (e) The effects of lower water quality on the economic value of the water body for recreation, tourism and other commercial activities, aesthetics, or other use and enjoyment by humans.

- OAC 3745-1-05(F)(2)(a)(v) states deliberate activities that, based on the information available, could be reasonably expected to result in an increased loading of any bioaccumulative chemical of concern (BCC) to any waters of the Great Lakes system shall constitute a significant lowering of water quality. BCCs, as defined in 3745-1-02(B)(13), include PCBs.
    - Any significant lowering of water quality as described above shall require the applicant to submit the information required by paragraph (B)(3) of OAC 3745-1-05 and to complete the demonstration required by paragraph (F)(3). The director shall establish conditions in the control document that meet the requirements of paragraph (F)(4).

Additionally, the risk of violating Ohio's water quality standard remains unknown. U.S. ACE analyzed sediment elutriate to estimate the release of PCBs during sediment discharge, however the detection limit was three orders of magnitude above Ohio's

water quality standard for total PCBs. Ohio's human health water quality standard for total PCBs is 26 pg/L; U.S. ACE analytical methods could only detect individual PCB Aroclors down to 30,000 pg/L (U.S. ACE 2013a). Further evaluation may be necessary to demonstrate that the proposed sediment discharge will not violate Ohio EPA's human health water quality standard for PCBs.

4.2 Polycyclic Aromatic Hydrocarbons (PAHs)

The data presented in the 2013 Cleveland Harbor evaluation show high levels of PAHs in the dredged material, which present a risk of toxicity to the aquatic ecosystem. These risks are not sufficiently evaluated in U.S. ACE's 2013 Cleveland Harbor report; U.S. ACE estimated and measured acute toxicity risks to show that the sediments would not cause direct mortality to aquatic organisms in Lake Erie, but the risk of chronic toxicity was not addressed in the report. Ohio EPA's evaluation of the data suggests that the sediments from Cleveland Harbor are most likely toxic to sediment-dwelling organisms and do not meet state or federal guidelines for open-lake disposal. PAHs as a class of compounds are classified as Level II Substances under the Great Lakes Binational Toxics Strategy and their discharge to the environment is discouraged under that accord. The Cleveland Harbor sediments contain high levels of the PAH benzo[a]pyrene, which is classified as a Level I Substance under the Great Lakes Binational Toxics Strategy and is targeted for virtual elimination from the Great Lakes' ecosystem (Environment Canada/U.S. EPA N.D.).

4.2.1 2013 PAH results

On average, the sediments from Cleveland Harbor were contaminated with 11.0 parts per million (ppm) PAHs. The 2013 reference sediments were found to contain an outlier in the data (33.4 ppm at site CLA4-3); excluding this outlier, PAHs in the reference sediments were on average 3.2 ppm. PAHs were measured in the 2007 reference sediments at 0.2 ppm. This data indicates that PAH contamination in the Cleveland Harbor sediments is 3.5 times as high as the 2013 reference sediment contamination, and 45 times as high as the 2007 reference sediment contamination[3].

Benzo[a]pyrene was measured in the Cleveland Harbor sediments at 1.1 ppm, in the 2013 reference sediments at 0.3 ppm (excluding the outlier at CLA4-3), and in the

[3] Unlike with PCBs (footnote 1, section 3.1), detection limits for PAHs were similar between 2007 and 2013, allowing for reasonable comparison of the reported total PAH values.

2007 reference sediments at 0.025 ppm. This data indicates that benzo[a]pyrene contamination in the Cleveland Harbor sediments is 4 times as high as the 2013 reference sediment contamination, and 39 times as high as the 2007 reference sediment contamination.

In the 2013 Cleveland Harbor evaluation, U.S. ACE estimated the toxicity risk of PAHs in the harbor sediments using equilibrium partitioning sediment benchmark protocols, outlined by U.S. EPA (2003a, 2008) and recommended by Ohio EPA (2010). U.S. ACE modified the recommended protocol, substituting acute toxicity thresholds in place of the chronic toxicity thresholds recommended by both agencies, contrary to the scientific consensus on the use of chronic toxicity endpoints for sediment evaluations (see section 3.3). Using this modification, U.S. ACE estimated that the Cleveland Harbor sediments do not present an acute toxicity risk to the aquatic ecosystem. This conclusion was supported by U.S. ACE's sediment bioassays, which demonstrated a lack of acute toxicity to sediment-dwelling organisms. Ohio EPA has reevaluated the PAH contamination data presented by U.S. ACE by incorporating chronic toxicity thresholds into the equilibrium partitioning protocols, as outlined by U.S. EPA (2003a, 2008) and recommended by Ohio EPA (2010), and also by comparing the concentrations of total PAHs and nine individual PAHs to toxicity effect levels described by MacDonald *et al.* (2000). Ohio EPA found that the sediments exceed screening thresholds for chronic toxicity risks which were not addressed in the 2013 Cleveland Harbor evaluation. Benzo[a]pyrene contamination was also not adequately evaluated and discussed in the Cleveland Harbor report, but is included in Ohio EPA's analysis.

4.2.2 Equilibrium partitioning sediment benchmarks

U.S. EPA (2003a, 2008) outlines procedures for the use of equilibrium partitioning sediment benchmark (ESB) methodology to estimate the risk of toxicity for certain classes of compounds in contaminated sediments[4]. This procedure takes into

[4] Using this procedure, the concentrations of individual PAHs are measured in the sediment, normalized for total organic carbon (TOC), and compared to the chronic toxicity threshold (final chronic value, FCV) for that compound. Dividing the TOC-normalized concentration by the FCV estimates the toxicity risk of the individual PAH, represented as a number of ESB toxic units ($ESBTU_{FCV}$). $ESBTU_{FCV}$ values greater than 1 indicate that the given PAH is likely to be toxic to aquatic life. These risks are additive; $ESBTU_{FCV}$ values are summed for 34 PAHs to estimate the risk from total PAHs in the sediments. If less than 34 PAHs are measured in the sediments, then the $\sum ESBTU_{FCV}$ values from less than 34 PAHs are multiplied by an uncertainty factor given in (U.S. EPA 2003a) to estimate the combined risk of the known and unknown PAH contamination.

account the total organic content (TOC) of the sediment and the estimated toxicity thresholds of the compounds analyzed. Ohio EPA (2010) recommends the use of this methodology as a screening tool for PAHs during sediment evaluation.

U.S. ACE carried out this procedure to estimate the risk of PAHs in the sediments from Cleveland Harbor, but substituted the use of acute toxicity thresholds (final acute values, FAVs) for FCVs, and a smaller uncertainty factor than the default provided by U.S. EPA (2003a). Both modifications had the effect of reducing the estimated toxic units of the Cleveland Harbor sediment. U.S. ACE's use of FAVs to estimate the risk of acute toxicity was contrary to Ohio EPA's established recommendations for sediment evaluations (Ohio EPA 2010). The use of acute thresholds in place of chronic thresholds most likely underestimated the risk posed by contaminated sediments (U.S. EPA 2000, ITRC 2011, MacDonald and Ingersoll 2002, Burton and Landrum 2003), and is not sufficiently protective of the aquatic ecosystem. Ohio EPA has reanalyzed the PAH data presented by U.S. ACE using the recommended FCVs to estimate the risk of chronic toxicity of the Cleveland Harbor sediments.

U.S. ACE's selection of a smaller uncertainty factor is based on U.S. ACE's conclusion that the PAHs in the Cleveland Harbor sediments were predominately pyrogenic in origin (*i.e.*, primarily from combustion, not petroleum, sources), and is supported by (Hawthorne *et al.* 2006) cited by U.S. ACE. However, Burgess (2009) recommends against the use of uncertainty factors, instead recommending the measurement of all 34 PAHs in the sediment. In cases when measuring all 34 PAHs for every sample is not practical, Burgess recommends validating the uncertainty factor by measuring 34 PAHs in a subset of samples. This validation step was not performed by U.S. ACE, and could have reduced the uncertainty associated with the final estimation of sediment toxicity[5].

Ohio EPA has evaluated the PAH data presented by U.S. ACE in the 2013 Cleveland Harbor evaluation by incorporating chronic toxicity thresholds into the equilibrium partitioning sediment benchmark protocol; the results of this analysis indicate that the contamination in the Cleveland Harbor sediments pose a considerable

[5] In reevaluating U.S. ACE's data, Ohio EPA has used U.S. ACE's published reduced uncertainty factor from (Hawthorne et al. 2006), but this value should be validated with site-specific data before it can be considered reliable. In this regard, U.S. ACE and Ohio EPA's ESBTU values should be considered lower-bound estimates.

risk of chronic toxicity to aquatic organisms[6]. Based on this analysis, these sediments require further evaluation prior to open-lake disposal. This further evaluation will require chronic toxicity bioassays, which have not yet been performed by U.S. ACE. Lacking the results of the chronic toxicity bioassays, and based on the weight of evidence of the available data, Ohio EPA assumes the concentrations of PAHs found in Cleveland Harbor sediments to be toxic to benthic life.

4.2.3 Consensus-based PAH thresholds

An alternative method to evaluate the PAH contamination of the Cleveland Harbor sediments is to compare PAH concentrations to the consensus-based sediment guidelines given by MacDonald *et al.* (2000). For ten individual PAHs and for total PAHs, the authors developed threshold effects concentrations (TECs, concentrations below which no toxic effects are expected). For nine individual PAHs and for total PAHs, the authors developed probable effects concentrations (PECs, concentrations above which toxic effects are almost certain). Between these concentrations, sediment toxicity is uncertain. Exceedances of the TECs indicate the potential for ecological toxicity and indicate the need for further evaluation. Exceedances of the PECs indicate a very high probability of toxic effects.

Ohio EPA has compared the concentrations of individual and total PAHs presented in the 2013 Cleveland Harbor evaluation to the TECs and PECs developed by MacDonald *et al.* (2000), with results given in Appendix D. In the Cleveland Harbor sediments, eight of ten individual PAH average concentrations and the total PAH average concentration were above the TECs, indicating a risk of toxicity in the sediments. None of the average values for individual PAHs exceed the PECs given by MacDonald *et al.*, so the risk of toxicity from these PAHs is not certain. However, the average concentrations of several PAHs approach the PEC value suggesting that the

[6] U.S. ACE calculated $\sum ESBTU_{FAV}$ values for the three dredging locations considered to pose the highest risk of toxicity, which ranged from 0.63 to 0.77 toxic units; these values were less than the screening threshold of 1, and considered not to be acutely toxic. Ohio EPA calculated $\sum ESTBU_{FCV}$ for all of the dredging and reference sites, summarized in Appendix C. It was found that, on average and excluding the outlier at CLA4-3, the $\sum ESTBU_{FCV}$ of the reference sediments was 0.57 toxic units (ranging from 0.30 to 1.35; outlier 5.85); the average and most individual values were greater than 1, indicating that the risk of PAH toxicity is low to moderate in the reference sediments. The average $\sum ESTBU_{FCV}$ of the Cleveland Harbor sediments was 3.24 toxic units (ranging from 0.83 to 6.96); the average value and 17 of 18 individual values were greater than 1, indicating that the risk of PAH toxicity in the dredged material is high.

risk of toxicity is considerable in the Cleveland Harbor sediments. Average PEC quotients for individual and total PAHs are summarized below:

- 0.11 (Naphthalene)
- 0.12 (Fluorene)
- 0.15 (Anthracene)
- 0.48 (Total PAHs; borderline toxic)
- 0.55 (Pyrene)
- 0.62 (Phenanthrene)
- 0.64 (Chrysene)
- 0.72 (Benz[a]anthracene)
- 0.76 (Benzo[a]pyrene)
- 0.78 (Fluoranthene)

Further, several discrete sediment samples exceeded the PECs for the PAHs benzo[a]pyrene, benz[a]anthracene, phenanthrene, and fluoranthene, indicating that these sediments have a very high probability of toxicity to aquatic organisms. Of the 18 sediment samples analyzed, seven samples exceeded the PEC for at least one PAH, and two additional sediment samples exceeded 95% of the PEC for at least one PAH. Two sediment samples, CH-4 and CH-8, each exceeded the PECs for three separate PAH compounds. These data support Ohio EPA's conclusion that the PAH contamination in the Cleveland Harbor sediments poses a high toxicity risk to the aquatic ecosystem that was not sufficiently assessed in the 2013 Cleveland Harbor evaluation.

4.2.4 PAH summary

Given the available data and the lack of chronic toxicity bioassays, Ohio EPA concludes that the Cleveland Harbor sediments do not meet federal 404(b)(1) Guidelines in regards to sediment toxicity. In addition, the Cleveland Harbor sediments do not meet Ohio EPA 401 guidelines in regards to sediment toxicity in light of the following sections of the Ohio Administrative Code (OAC):

- OAC 3745-1-04(D) states that the waters of the state shall be free from substances entering the waters as a result of human activity in concentrations that are toxic or harmful to aquatic life.

- OAC 3745-1-05(C)(5) directs the director to consider the following regarding proposed activities that lower water quality:
    - (b) The anticipated impact of the proposed lowering of water quality on aquatic life.
    - (d) The degree to which water quality may be lowered in superior high quality waters (such as Lake Erie).

Additionally, PAHs as a class of compounds are classified as Level II Substances under the Great Lakes Binational Toxics Strategy, indicating that their discharge to the Great Lakes are discouraged under international accord. The PAH benzo[a]pyrene is classified as a Level I Substance under this Strategy, and as such is targeted for virtual elimination from the Great Lakes' ecosystem. Considering that both PAHs as a group and benzo[a]pyrene are present in the Cleveland Harbor sediments above thresholds of concern, this proposed open-lake disposal would be inconsistent with the goals of the United States as outlined in the Great Lakes Binational Toxics Strategy.

4.3 DDT and DDE

The data presented in the 2013 Cleveland Harbor evaluation show that the proposed disposal would lead to an increase in the bioaccumulation of the legacy pesticide DDT and its metabolite DDE. U.S. ACE interprets the data to suggest that the increase in these chemicals meets federal guidelines because current Lake Erie fish tissue concentrations of DDT and DDE are well below established thresholds of concern. The proposed sediment disposal would increase these fish tissue levels only slightly, and therefore would not lead to substantial adverse ecological or human health effects. Ohio EPA generally agrees with this human health risk assessment, however there is some indication of potential toxicity to the aquatic ecosystem. It should also be considered if the discharge of these substances are permissible in terms of the Great Lakes testing manual (which indicates that no increase in the bioaccumulation of these contaminants is permissible), the Great Lakes Binational Toxics Strategy (which seeks to eliminate discharges of DDT and DDE to the environment), and OAC 3745-1-05(F)(2)(a)(v) (under which proposed discharges of bioaccumulative contaminants of concern to the waters of the Great Lakes would constitute a significant lowering of water quality).

4.3.1 2013 DDT + DDE results

Concentrations of DDT and DDE in the Cleveland Harbor sediments exceeded the TECs (threshold effect concentrations, see section 4.2.3) established by MacDonald *et al.* (2000), indicating that the DDT and DDE contamination of the harbor sediments may pose some risk of toxicity to the aquatic ecosystem. The average concentration of DDT in the harbor sediments was 6.2 ppb, exceeding the TEC of 4.2 ppb by a factor of 1.5. The average concentration DDE in the harbor sediments was 8.1 ppb, exceeding the TEC of 3.2 by a factor of 2.5. These exceedances of the TEC values do not indicate that the DDT and DDE in the harbor sediments are necessarily toxic. Instead, these exceedances indicate that the DDT and DDE contamination is potentially toxic.

Regarding possible bioaccumulation hazards, the results of U.S. ACE bioassays show that DDT and DDE (∑DDT) bioaccumulation did not differ significantly for organisms exposed to the Cleveland Harbor sediments compared to those exposed to the contaminated reference sediment from proposed disposal site CLA-1. Increases in bioaccumulation were noted for organisms exposed to sediment from two of the three Cleveland Harbor reaches (DMMU-1 and DMMU-2b) compared to organisms exposed to the sediments from contaminated reference site CLA-4 (100% and 120% increases, respectively). These increases meet or exceed U.S. ACE's 100% threshold indicating ecological concern (U.S. ACE 2013a), which was not sufficiently addressed in the 2013 Cleveland Harbor evaluation.

U.S. ACE also estimated increases in fish tissue ∑DDT concentrations, based on disposal at site CLA-4 and using worst-case assumptions. U.S. ACE estimates that tissue ∑DDT would increase 12% for yellow perch and 4% for walleye, for those fish whose home range includes the disposal site. These estimates are based on worst-case assumptions, except that they are dependent on the choice of reference sediments used in testing; the use of contaminated reference sediments has likely lowered these estimates substantially, so that they no longer reflect the worst case.

4.3.2 Assessment of DDT + DDE contamination

U.S. ACE notes that data (U.S. EPA 2013, Rowan and Rasmussen 1992) indicate that fish tissue ∑DDT concentrations are generally below the GLWQA wildlife protection threshold of 1 ppm. Additionally, there are no Ohio fish consumption advisories in place for Lake Erie for DDT. Ohio EPA data (Ohio EPA unpublished data) collected for the production of fish consumption advisories shows an average fish tissue ∑DDT concentration of 0.021 ppm in the vicinity of Cleveland Harbor and the proposed

disposal sites. A majority of those fish analyzed (approximately 70%) had ∑DDT concentrations below the limits of detection. These data suggest that DDT is not a pressing human health concern in Lake Erie or the vicinity of Cleveland Harbor. In this regard, Ohio EPA agrees with U.S. ACE. However, the exceedances of TEC values published by MacDonald *et al.* indicate that there is some risk of toxicity to aquatic organisms from DDT and DDE.

U.S. ACE did not address the proposed discharge of DDT in terms of the Great Lakes testing manual or the Great Lakes Binational Toxics Strategy. The Great Lakes testing manual indicates that no increase in bioaccumulative contaminants, including DDT and DDE, are permissible under federal guidelines. The Great Lakes Binational Toxics Strategy classifies both DDT and DDE as Level I Substances, and as such their discharge is targeted for virtual elimination from the Great Lakes. Additionally, OAC 3745-1-05(F)(2)(a)(v) states deliberate activities that could be reasonably expected to result in an increased loading of any bioaccumulative chemical of concern (BCC) to any waters of the Great Lakes system shall constitute a significant lowering of water quality, requiring additional antidegradation review. BCCs, as defined in 3745-1-02(B)(13), include DDT and its metabolite DDE (in addition to PCBs, see section 4.1.2). For these reasons, while the DDT and DDE found in the Cleveland Harbor sediments do not appear to present an immediate risk to consumers of fish, Ohio EPA interprets the data to indicate that the Cleveland Harbor sediments do not meet state or federal guidelines for reason of DDT and DDE contamination.

5. Conclusions

Throughout the review of U.S. ACE's 2013 Cleveland Harbor evaluation, Ohio EPA has determined that the methodology used by U.S. ACE was not consistent with federal guidance or sufficiently protective of the Lake Erie ecosystem. The selection of contaminated reference sites, inconsistent application of federal guidance, and the selection of acute toxicity endpoints for the 2013 Cleveland Harbor evaluation have resulted in the U.S. ACE conclusion that the proposed dredged material is suitable for open-lake disposal, contrary to the best available science and guidance. Reassessing the data provided by U.S. ACE, Ohio EPA has concluded that the proposed sediment disposal would cause unacceptable impacts to the aquatic ecosystem and to human and wildlife health, and would exacerbate existing impairment to the Lake Erie region's commercial and recreational fisheries and tourism industries.

Ohio EPA interprets the data provided to indicate that the Cleveland Harbor sediments do not meet state or federal guidelines for disposal to Lake Erie. The sediment disposal would be contrary to national goals for the reduction or elimination of discharges of specific pollutants (including PCBs, benzo[a]pyrene, DDT, and DDE), as outlined in the Great Lakes Binational Toxics Strategy, the North American Regional Action Plan, the Lake Erie Lakewide Management Plan, Ohio EPA's antidegradation regulations, and federal 404(b)(1) Guidelines. The sediment disposal would also substantially increase fish tissue PCB contamination, which already exceeds human health thresholds established by Ohio EPA and wildlife protection thresholds established by the Great Lakes Water Quality Agreement and U.S. EPA.

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Appendix A: Comparison of 2007 and 2013 reference sites

Comparison of 2007 and 2013 reference site data for PCB Aroclor 1254
(Due to differences in detection limits, Aroclor 1254 was the only Aroclor detected at reference sites in both years.)

2007 Evaluation		2013 Evaluation	
Site	PCB 1254 (ppb)	Sample	PCB 1254 (ppb)
CL-1	37	CLA1-1	84
CL-2	43	CLA1-2	53
CL-3	35	CLA1-3	87
CL-4	38	CLA1-4	62
Average	**38**	CLA1 Comp	65
		CLA1 Average	**70**
		Ratio 2013 CLA1 to 2007	**1.83**
		CLA4-1	52
		CLA4-2	58
		CLA4-3	51
		CLA4-4	52
		CLA4 Comp	54
		CLA4 Average	**53**
		Ratio 2013 CLA4 to 2007	**1.39**
		Average ratio	**1.61**

On average, the 2013 reference sites Aroclor 1254 contamination was **61%** higher than the 2007 reference sites.

Comparison of 2007 and 2013 reference site data for the sum of the 16 PAH compounds analyzed in both years

2007 Evaluation		2013 Evaluation		
Site	Total of 16 PAHs (ppl	Sample	Total of 16 PAHs (ppb)	
CL-1	30	CLA1-1	8095	
CL-2	151	CLA1-2	2095	
CL-3	98	CLA1-3	5687	
CL-4	693	CLA1-4	3746	
Average	**243**	CLA1 Comp	1537	
		CLA1 Average	**4232**	
		Ratio 2013 CLA1 to 2007	**17.4**	
		CLA4-1	1806	
		CLA4-2	1858	
		CLA4-3	33409 **(outlier)**	
		CLA4-4	1641	
		CLA4 Comp	1951	(Excluding outlier)
		CLA4 Average	**8133**	**1814**
		Ratio 2013 CLA4 to 2007	**33.5**	**7.5**
		Average ratio	**25.5**	**12.4**

On Average, the 2013 reference sites PAH contamination was **25.5** times as high as the 2007 reference sites.

Excluding the outlier, the 2013 reference site PAH contamination was still **12.4** times as high as the 2007 reference sites.

Appendix B: Ohio EPA fish tissue PCB data

Ohio EPA fish tissue PCB concentration data for Cleveland Harbor and nearby open lake

Contaminant	Year	Sample n	Location	Species	PCB 1242	PCB 1254	PCB 1260	Sum PCBs	units	Number o
PCBs	2009	449	Lake Erie - NNW of Cleveland Harbor	WHITE BASS	<49.9	165	267	**432**	ug/kg	2
PCBs	2009	450	Lake Erie - NNW of Cleveland Harbor	WHITE BASS	<49.6	113	173	**286**	ug/kg	2
PCBs	2009	451	Lake Erie - NNW of Cleveland Harbor	WHITE BASS	<50.0	137	217	**354**	ug/kg	2
PCBs	2009	452	Lake Erie - NNW of Cleveland Harbor	WHITE BASS	<49.6	233	361	**594**	ug/kg	2
PCBs	2009	455	Lake Erie - NNW of Cleveland Harbor	WALLEYE	<50.0	<50.0	<50.0	**0**	ug/kg	2
PCBs	2009	456	Lake Erie - NNW of Cleveland Harbor	WALLEYE	<49.7	<49.7	60	**60**	ug/kg	2
PCBs	2009	463	Lake Erie - NNW of Cleveland Harbor	LAKE WHITEFISH	<49.9	88.1	100	**188.1**	ug/kg	2
			Lat: 41.6614 Long: -81.7667							
PCBs	2005	256	Lake Erie West Harbor	COMMON CARP	<33	79	<33	**79**	ug/kg	3
PCBs	2005	257	Lake Erie West Harbor	BROWN BULLHEAD	<33	76	<33	**76**	ug/kg	3
PCBs	2005	258	Lake Erie West Harbor	FRESHWATER DRUM	<66	560	<66	**560**	ug/kg	3
PCBs	2005	259	Lake Erie West Harbor	LARGEMOUTH BASS	<33	41	<33	**41**	ug/kg	3
			Lat: 41.6733 Long: -81.81							
PCBs	2008	454	Lake Erie, Cleveland Harbor East	RAINBOW TROUT	<50	230	255	**485**	ug/kg	2
PCBs	2008	455	Lake Erie, Cleveland Harbor East	LARGEMOUTH BASS	<50	53	58	**111**	ug/kg	3
PCBs	2008	456	Lake Erie, Cleveland Harbor East	COMMON CARP	<50	280	350	**630**	ug/kg	3
PCBs	2008	457	Lake Erie, Cleveland Harbor East	SPOTTED SUCKER	<50	140	330	**470**	ug/kg	4
			Lat: 41.541 Long: -81.6393							
PCBs	2008	450	Lake Erie, Cleveland Harbor West	LARGEMOUTH BASS	<50	110	79	**189**	ug/kg	4
PCBs	2008	451	Lake Erie, Cleveland Harbor West	ROCK BASS	<50	74	220	**294**	ug/kg	3
PCBs	2008	452	Lake Erie, Cleveland Harbor West	COMMON CARP	130	745	505	**1380**	ug/kg	3
PCBs	2008	453	Lake Erie, Cleveland Harbor West	SPOTTED SUCKER	<50	75	<50	**75**	ug/kg	5
			Lat: 41.4945 Long: -81.7294							

Ohio EPA 303(d) human health criterion	**23** ppb	**open lake + nearshore samples**	
Ohio EPA fish consumption criterion (1/wk)	**50** ppb	weighted avg	**327** ppb
Great Lakes WQ Agreement criterion	**100** ppb	**open lake samples only**	
U.S. EPA wildlife criterion	**160** ppb	weighted avg	**234** ppb
		(treating non-detects as zero)	

Appendix C: Equilibrium Partitioning Sediment Benchmarks (PAHs)

Equilibrium partitioning sediment benchmark toxic units, derived from final chronic values ($\Sigma ESBTU_{FCV}$)
(Shaded values exceed the threshold of 1, indicating expected risk of chronic toxicity)

Reference sediment samples

Sample	Toxic Units
CLA1-1	1.35
CLA1-2	0.35
CLA1-3	0.98
CLA1-4	0.65
CLA1-comp	0.28
CLA4-1	0.30
CLA4-2	0.31
CLA4-3 (**outlier**)	5.85
CLA4-4	0.36
CLA4-comp	0.59

CLA-1 average
0.72 toxic units

Reference sites average
1.10 toxic units

Reference sites average, excluding outlier
0.57 toxic units

CLA-4 average
1.48 toxic units

CLA-4 average, excluding outlier
0.39 toxic units

Dredged material samples

Sample	Toxic Units
DMMU-1	
CH-1	0.83
CH-2	1.74
CH-3	3.99
CH-4	3.57
CH-5	4.54
DMMU1-comp	1.71
DMMU-2a	
CH-6	2.47
CH-7	3.69
CH-8	3.09
CH-9	3.00
CH-10	2.54
DMMU2a-comp	6.96
DMMU-2b	
CH-11	3.90
CH-12	2.00
CH-13	3.29
CH-14	3.45
CH-15	4.10
DMMU2b-comp	3.50

DMMU-1 average
2.73 toxic units

DMMU-2a average
3.62 toxic units

DMMU-2b average
3.37 toxic units

All DMMU average
3.24 toxic units

Ratio of dredged material to reference sediment toxic units
2.9 (Dredged material 2.9 times as contaminated as reference)

Ratio of dredged to sediment TUs, excluding outlier
5.7 (Dredged material 5.7 times as contaminated as reference)

Appendix D: Comparison of individual and total PAHs to TECs and PECs

Comparing average PAH concentrations for all Cleveland Harbor sediment samples to TECs and PECs given in MacDonald *et al.* (2000).

	Proportion of TEC	Proportion of PEC
Anthracene	2.17	0.15
Benz(a)anthracene	7.05	0.72
Benzo(a)pyrene	7.38	0.76
Chrysene	4.98	0.64
dibenz(a,h)anthracene	4.68	PEC not established
Fluoranthene	4.09	0.78
Fluorene	0.83	0.12
Naphthalene	0.34	0.11
Phenanthrene	3.57	0.62
Pyrene	4.29	0.55
Total PAHs	6.84	0.48

TEC: Threshold effect concentration
PEC: Probable effect concentration
TEC quotients above 1 indicate potential toxicity and require further evaluation
PEC quotients approaching 1 indicate high risk of toxicity

Appendix 2: An Assessment of U.S. Army Corps of Engineers' Report, Cleveland Harbor (Upper Cuyahoga River Channel) Dredged Material Evaluation – 2013

Ohio EPA

Division of Drinking and Ground Waters

October 3, 2013

Division of Drinking and Ground Waters Comments

Ohio EPA Division of Drinking in Ground Waters (DDAGW) has several concerns regarding the potential impacts of open lake disposal of dredge material from the Cuyahoga River and the Cleveland Harbor on the Cleveland Drinking Water System. Please see the comments below.

Comments:

1) The Cleveland drinking water intakes are located 3-5 miles out in the lake so as to be outside the influence of plumes from rivers, creeks, CSO's and near shore discharges. The proposed open lake disposal sites subject Cleveland's intakes to potential plumes they would not otherwise face. DDAGW recommends that alternatives to open lake disposal such as continued use of the confined disposal facilities (CDF) and/or upland disposal be utilized. It is noted that in 2012, the Cleveland-Cuyahoga County Port Authority determined that by mechanically unloading the sediment at the CDF's the expected life of the CDF's could be extended by 20 years.

   If alternatives to open lake disposal are not available, US ACE must demonstrate that the Cleveland drinking water intakes will not be negatively impacted by the open lake disposal of dredge material. This demonstration should also address the concerns identified in comments 2, 3, and 4 below.

2) Open lake disposal so close to Cleveland's intakes may have a negative impact on the City's source water protection status. Under the 1996 Safe Drinking Water Act Amendments, the source water protection program was extended to public water systems using surface water, including those with intakes on the Great Lakes. Source water protection program managers in all the Great Lakes states and Ontario worked together to develop two categories for Great Lakes systems: (1) near-shore systems, which are expected to develop a detailed source water protection plan similar to inland stream plans; and (2) off-shore systems, which are only expected to provide public information via their annual Consumer Confidence Report, and to have an up-to-date contingency plan that includes good contacts with the U.S. Coast Guard. Such minimal requirements for a source water protection plan are based on the offshore system's distance from the shore as well as the absence of any land-based contaminants in the raw water. Cleveland is currently categorized as an offshore system. However, the presence of open lake disposal-based contaminants in the raw water, as well as the increased turbidity, could lead to Cleveland being recategorized as an onshore system, subject to much more demanding requirements for an endorsable source water protection plan. Since systems seeking Ohio EPA low-interest loans for drinking water infrastructure receive higher priority if they have an endorsed source water protection plan, such a recategorization could have significant financial impacts for the City of Cleveland.

3) The material dredged from the Cuyahoga River and Cleveland Harbor contains PCB's and PAH's. The drinking water maximum contaminant level (MCL) for PCB's is 0.0005 mg/L. PAH's include a broad number of organic compounds some of which have drinking water MCL's as low as 0.002 mg/L. Ohio Administrative Code 3745-81-12 indicates that the best available technology for the removal of these constituents is granular activated carbon and packed-tower aeration. The Cleveland Water System has neither of these treatment technologies at any of their four water treatment plants and thereby would be unable to effectively remove these constituents from the raw water supply if the raw water contained elevated levels of PCB's and PAH's.

4) The Cleveland Drinking Water System consists of four Water Treatment Plants each with its own intake extending 3-5 miles out into Lake Erie. Only one of these intakes is provided with a superstructure that extends above the waterline. The remaining three are submerged, on the bottom, with no identifying feature on the surface (no superstructure, no buoys, etc.). Open Lake disposal presents a scenario in which the dredged material is accidently dumped directly on top of the intake thereby disabling one of the four WTP's. While the three remaining Water Treatment Plants would still be able to provide supply, service would be severely hampered especially if the eastern or western WTP's was the plant that was disabled (Crown or Nottingham WTP). This scenario could also materialize if the disposal occurred so close to the intake that the raw water quality degraded to the point that the WTP had to be shutdown.

OPERATIONS AND MAINTENANCE

OPEN-LAKE PLACEMENT OF MATERIAL DREDGED FROM CLEVELAND HARBOR FEDERAL NAVIGATION CHANNELS IN THE UPPER CUYAHOGA RIVER

CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

• USACE RESPONSE TO OEPA ASSESSMENT

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207-3199

December 20, 2013

SUBJECT: Cleveland Harbor, Cuyahoga County, Ohio—Open-lake Placement of Material Dredged from the Upper Cuyahoga River Channel

Mr. Scott J. Nally
Director, Ohio Environmental Protection Agency
ATTN: Mr. Kurt Princic
Northeast District Office Chief
P.O. Box 1049
Columbus, Ohio 43216-1049

Dear Mr. Nally:

We appreciate meeting with the Ohio Environmental Protection Agency (OEPA) on November 4, 2013 to discuss your October 4, 2013 comments entitled "An Assessment of U.S. Army Corps of Engineers (USACE) Report, Cleveland Harbor (Upper Cuyahoga River Channel) Dredged Material Evaluation—2013." This letter is our official response to those comments. It also supplements our earlier letter to your office dated October 23, 2013 and our November 26, 2013 application for water quality certification (WQC) pertaining to the placement of Cleveland Harbor dredged material into the open-lake and confined disposal facilities (CDFs).

I believe it is important to highlight that the 2013 evaluation of sediments in the upper Cuyahoga River Channel indicates a net improvement in quality since 2007. This positive change is certainly advantageous to the health of the river and can be used to support beneficial use impairment (BUI) delisting efforts for the Area of Concern (AOC). This point was the emphasis of a presentation we offered at the State of the River, Cuyahoga 2013 Symposium on September 19, 2013. Such a net improvement in sediment quality is to be expected over time and is consistent with the overall trend demonstrated at other major Lake Erie tributaries with Federal navigation projects and/or designated AOCs, including Huron, Lorain (Black River AOC), Toledo (Maumee AOC), Erie (Presque Isle Bay AOC) and Ashtabula (Ashtabula River AOC) Harbors.

It is also important to emphasize that USACE evaluations of proposed dredged material discharges pursuant to Clean Water Act Section 404(b)(1) Guidelines and associated formal Federal guidance emphasize a biological effects-based and sediment elutriate testing, versus an evaluation using bulk sediment chemistry. The rationale behind this is that field sediments characteristically contain mixtures of contaminants and other constituents, such as organic carbon, hard carbon, oxides and other adsorbents and reactants that can potentially interact and

SUBJECT: Cleveland Harbor, Cuyahoga County, Ohio—Open-lake Placement of Material Dredged from the Upper Cuyahoga River Channel

influence bioavailability and toxicity. Biological tests (including toxicity tests [bioassays] and bioaccumulation experiments) and exposure modeling provide the most biologically meaningful and relevant information to assess any potential adverse toxicological impacts of sediments, and characterize their associated risks to aquatic life and human health.

Our comprehensive responses to OEPA's comments presented in the October 4, 2013 letter and our November 4, 2013 meeting is included as Enclosure 1. We believe this response corroborates that the dredged material meets Federal contaminant determination guidelines for open-lake placement, and we are requesting OEPA to review these responses. Should there be remaining concerns, we would propose another meeting with OEPA in January 2014.

If you have any questions, please feel free to contact Mr. Scott W. Pickard of the Environmental Health Section at 716-879-4404, by e-mail at scott.w.pickard@usace.army.mil or by writing to the following address: U.S. Army Corps of Engineers, 1776 Niagara Street, Buffalo, New York 14207-3199.

Sincerely,

David Romano, PMP
Chief, Planning Branch

Enclosure

U.S. ARMY CORPS OF ENGINEERS (USACE) RESPONSE TO OHIO ENVIRONMENTAL PROTECTION AGENCY (OEPA) OCTOBER 4, 2013 COMMENTS ON "AN ASSESSMENT OF USACE REPORT, CLEVELAND HARBOR (UPPER CUYAHOGA RIVER CHANNEL) DREDGED MATERIAL—2013" AND COMMENTS AT NOVEMBER 4, 2013 INTRAGENCY MEETING

I. Response to OEPA October 4, 2013 written comments on USACE dredged material evaluation

1. EXECUTIVE SUMMARY (Section 1)—Please see comments throughout this document.

2. SUMMARY OF THE 2013 CLEVELAND HARBOR EVALUATION (Section 2)—No comments.

3. 2013 CLEVELAND HARBOR METHODOLOGY (Section 3)

A. ***Use of contaminated reference sites*** *(Section 3.1)*—We disagree that surficial sediments at open-lake areas CLA-1 and CLA-4 are significantly more contaminated than other nearby open-lake reference areas. In addition, neither of these areas reflect contamination from past placement of contaminated dredged material. No placement of contaminated dredged material has occurred at CLA-4 or adjacent to CLA-4; the nearest placement of dredged material was more than two miles south of this area while dominant transport would occur in an east northeasterly direction. As discussed at our November 4 meeting, past dredged material placement occurred at CLA-1 over 50 years ago. CLA-1 is a non-dispersive area with fine-grained sediment, reflecting its depositional nature. In the past 50 years more than a foot of deposition would be expected to bury the placed dredged material such that the surficial sample taken at CLA-1 would be characteristic of background sediment instead of dredged material. The weight-of-the-evidence shows that bottom sediments at CLA-1 and CLA-4 are toxicologically comparable to sediments at the Cleveland Harbor open-lake reference area sampled in 2007 (CLA-R07), as well as at other open-lake reference areas sampled/analyzed in 2004, 2005, 2010, 2011 and 2013. It should also be noted that OEPA did not raise concerns with respect to the use of CLA-1 and CLA-4 as reference areas in their March 30, 2012 comments on the SAP.

The following paragraphs provide a review of the evidence indicating that the low levels of contaminants observed at CLA-4 do not affect the suitability of using CLA-4 as an open-lake reference area.

(1) Single discrete bulk sediment total polycylic aromatic hydrocarbon (PAH) concentration of 33.4 mg/kg at CLA4-3. OEPA expressed concern regarding the elevated concentration of PAHs measured in discrete sample CLA4-3. Elevated PAH concentrations observed at this site (33.4 mg/kg) are an anomaly and may be an artifact due to the presence of one or more fragments of charcoal, partially combusted coal (cenosphere), coal tar pitch or creosote-treated wood (Ghosh *et al.* 2003); these bulk PAH

measurement are very inconsistent with the other discrete samples open-lake area as well as the composite sample from CLA-4 (see USACE 2013). Nevertheless, the PAH concentrations measured are not indicative of highly contaminated or toxic sediment based on several lines of evidence:

(a) The lack of toxicity as measured in laboratory toxicity tests (bioassays). Benthic bioassay data on CLA-1 and CLA-4 sediments indicate insignificant sediment-associated toxicity (see Paragraph A[3][a]).

(b) The lack of toxicity predicted using the U.S. Environmental Protection Agency (USEPA) equilibrium partitioning (EqP) sediment benchmark (ESB) methodology based on the determination of dissolved PAHs in sediment porewater extracted from the CLA-4 composite sample. Target-lipid hydrocarbon narcosis and equilibrium partitioning models were employed to calculate EqP sediment benchmark toxic units (ESBTUs) using both the concentration of total extractable PAHs (16 parent PAH compounds) in bulk sediment sample CLA4-3 and the concentration of bioavailable dissolved PAHs (18 parent PAH and 16 groups of alkylated PAHs) in sediment porewater extracted from the composite sample CLA-4. Analysis of ESBTUs based on the Final Acute Values (FAV) for PAHs ($\sum ESBTU_{FAV}$) was conducted on the bulk sediment sample CLA4-3 (USEPA 2003). Freshwater sediments containing $\sum ESBTU_{FAV}$ <1.0 for a mixture of 34 or more PAH compounds are conservatively predicted to be acceptable for the protection of benthic organisms, and $\sum ESBTU_{FAV} \geq 1.0$ suggest that sensitive benthic organisms may be affected by the PAH mixture. This model employed $C_{OC,\ PAHi,\ FAVi}$ specific to the amphipod *Hyalella azteca* (Kreitinger, personal communication; USEPA 2003), which is one of two recommended freshwater test species used for standard acute bioassays in dredged material toxicity evaluations (USEPA/USACE 1998a). The test species *H. azteca* is more sensitive to PAHs than most other freshwater organisms, including the midge fly *Chironomus dilutus*. An uncertainty factor of 3.6 with a confidence level of 95% (Hawthorne *et al.* 2006a) was applied to the $\sum ESBTU_{FAV}$ calculations because the analyses covered only the 16 USEPA priority pollutant PAH compounds, and because the PAHs were assumed to be predominantly of pyrogenic origin based on phenanthrene (PhA)/anthracene (An), An/(PhA+An) and fluoranthene (FlA)/(FlA+pyrene [Py]) diagnostic ratios of 2.2, 0.31 and 0.47, respectively (e.g., Colombo *et al.* 1989, Iqbal *et al.* 2008, Li *et al.* 2006, Neff *et al.* 2005, Yunker *et al.* 2002, Zhang et al. 2004). Using the whole sediment data from USACE (2013), the calculated $\sum ESBTU_{FAV}$ for the PAH mixture at CLA4-3 was 0.99 and <1.0, suggesting that the PAHs present in this sample are not are not likely to result in acute toxicity to *H. azteca* (a discussion of the relationship between acute and chronic PAH toxicity to *H. azteca* is provided in Paragraph 3[C][2][b]). It is important to recognize that the $\sum ESBTU_{FCV}$ of 1.0 developed by USEPA is a screening value and should not be used for inferring toxicity during a specific laboratory test. This screening value provides good predictions that a sediment sample is not toxic; however, as with all conservative screening values, it is not a good predictor that a sediment sample will be toxic to aquatic life. Although $\sum ESBTU_{FAV}$ approached 1.0, this model is also conservative since it relies upon assumed partitioning between natural organic matter in sediment and sediment

porewater (K_{OC}), and does not take into consideration the anticipated low bioavailability of PAHs due to the presence of black carbon. Note that one could assume that EqP modeling based on CLA4-3 bulk sediment chemistry without additional information on PAH bioavailability suggests that the PAHs is near the threshold at which chronic toxicity could be possible because $\sum ESBTU_{FCV}$=0.99. However, this is not supported by the *C. dilutus* growth data for the CLA-4 composite sediment, which is a more sensitive endpoint and precursor of potential chronic toxicity.

(c) The lack of toxicity predicted using USEPA ESB methodology based on the determination of total extractable PAHs in the CLA-4 bulk composite sample. Measured concentrations of dissolved PAHs (18 parent PAH compounds and 16 groups of alkylated PAH compounds) in the porewater for the CLA-4 composite sediment (see Table 6 of USACE 2013) were very low (resulting in a $\sum ESBTU_{FCV}$ = 0.1) indicating that chronic toxicity is not expected due to sorption onto black carbon and the resulting low bioavailability of PAHs. The estimates of $\sum ESBTU_{FCV}$ =0.99 for the discrete sample CLA4-3 which are based on the concentration of total PAHs in bulk sediment are anticipated to overestimate the actual bioavailable concentration in the sample.

(2) Substantially higher bulk sediment PAH and polychlorinated biphenyl (PCB) concentrations at CLA-1 and CLA-4 relative to the open-lake reference area sampled in 2007

(a) PAHs. OEPA expressed concern regarding total bulk sediment concentrations of PAHs at CLA-1 (average 4.9 mg/kg) and CLA-4 (average 9.68 mg/kg) being several times that measured at CLA-R07 (average 0.24 mg/kg). However, when excluding the CLA4-3 outlier, the average PAH concentration for discrete samples (1.77 mg/kg CLA-4; 4.90 mg/kg CLA-1) are similar to the range of average concentrations measured at other nearby open-lake reference areas offshore of Rocky River (3.21 mg/kg [U.S. Army Engineer Research and Development Center {USAERDC} 2004]), Fairport (4.61 mg/kg [draft analytical report, 2013]) and Ashtabula (4.12 mg/kg [USACE 2011a]). The average total PAH concentration of 3.56 mg/kg for the combined data of CLA-1 and CLA-4 is quite comparable to the average of 4.02 mg/kg across Rocky River/Fairport/Ashtabula open-lake reference areas. On an organic carbon (OC)-normalized basis, the average for CLA-1/CLA-4 is 143 mg/kg-OC, which is less than the average of 199 mg/kg-OC for the Rocky River/Fairport/Ashtabula open-lake reference areas. These data indicate that the Cleveland open-lake areas are somewhat less contaminated with respect to PAHs than the other open-lake reference sites in Lake Erie. The average total PAH concentration at CLA-R07 is 0.24 mg/kg and the inclusion of this value with the other Cleveland open-lake area values would make this difference greater. The concentration of total PAHs at CLA-R07 are unusual in sediments near Lake Erie urban harbors; higher concentrations of PAHs in fine-grained sediments offshore of Lake Erie urban areas are more typical. The bulk concentration of total PAHs in samples at CLA-1 and CLA-4 are not of toxicological concern because they did not exhibit significant toxicity during the standard *H. azteca* and *C. dilutus* bioassays. Sediment porewater PAH data (Table 6 of USACE [2013]) on sample CLA-4 predicts that a lack of

chronic toxicity should be expected as evidenced by a calculated porewater $\sum ESBTU_{FCV}$ <0.1.

Porewater data on CLA-1 sediments demonstrate a potential for chronic toxicity as evidenced by the presence of alkylated PAHs and a calculated $\sum ESBTU_{FCV}$ of 2.8; however, laboratory bioassays provided no evidence that sediments at this location are toxic to benthic macroinvertebrates. Sediment porewater PAH concentrations on the order of those predicted for CLA-1 are not expected to exhibit chronic toxicity to *H. azteca* or *C. dilutus*. The 1 $\sum ESBTU_{FCV}$ screening value (USEPA 2003) is not specific to *H. azteca* or *C. dilutus*, and should not be used for predicting sediment toxicity to these organisms when laboratory bioassay data are available. In addition, the critical body residue developed by USEPA and used by OEPA for predicting that chronic effects are unlikely and determining 1 $\sum ESBTU_{FCV}$ (i.e., 2.24 μmol/g lipid) is based on the 90th percentile of a wide array of acute bioassay data conducted on both marine and freshwater organisms, which is then adjusted by an acute to chronic ratio (ACR). The predicted PAH internal critical body burden for sample CLA-1 (using the ESB methodology) is 6.1 μmol/g lipid, a level that does not exceed the whole body concentration at which chronic effects are expected for these freshwater macroinvertebrates (i.e. *H. azteca* 13.9 μmol/g lipid [see Paragraph 4{B}{1}{a}] and *C. dilutus* 10-16 μmol/g lipid for *Chironomus* spp. FCV [see USEPA 2003 for *Chironomus* spp.-specific GMAV values and the ACR of 4.16 for PAHs]).

(b) PCBs. The OEPA expressed concern regarding the concentration of Aroclor 1254 being, on average, about 60% higher at CLA-1 and CLA-4 when compared to CLA-R07. Bulk concentrations of total PCBs in Lake Erie bottom sediments vary spatially and temporally, and are related to sediment grain size and OC content. Bulk total PCB concentrations across CLA-1 and CLA-4 (average of Aroclor 1248 and 1254 sum of 126 μg/kg) are within the range of those measured at other open-lake areas offshore of Rocky River (average Aroclor 1260 concentration of 29.4 μg/kg [USACE 2004]), Fairport (average non-detectable Aroclor concentration of 18.5 μg/kg [draft analytical report, 2013]) and Ashtabula (composite congener sums of 43 μg/kg [USACE 2010a], and 111 μg/kg and 143 μg/kg [USACE 2011a]). The average total PCB concentration of 126 μg/kg across CLA-1/CLA-4 is greater than the average of 69.0 μg/kg across the Rocky River/Fairport/Ashtabula open-lake reference areas. Nevertheless, on an OC-normalized basis, the average PCB concentration of 5161 μg/kg-OC for CLA-1/CLA-4 is comparable to the average of 4682 μg/kg-OC for the four open-lake reference areas. The average OC-normalized PCB concentration for CLA-1/CLA-4 is also somewhat lower when compared to the average of 5541μg/kg-OC for the Rocky River and Ashtabula open-lake reference areas (i.e., when excluding the Fairport open-lake reference area located offshore of a comparably less urban/industrialized area). Note that the inclusion of CLA-R07 in the Cleveland open-lake area values would make these differences greater. Finally, average bulk (or composite) and OC-normalized sediment concentrations at CLA-1/CLA-4 of 126 μg/kg (5161 μg/kg-OC) is within the general range of those measured offshore of Toledo Harbor (13 μg/kg [1354 μg/kg-OC] to 154

µg/kg [5082 µg/kg-OC]) (USACE 2010b). Sediment-associated PCBs offshore of Lake Erie urban areas are commonly found in the range observed at CLA-1 and CLA-4.

(3) Benthic bioassay and PCB bioaccumulation data on CLA-1 and CLA-4 sediments

(a) Solid phase benthic bioassays. These tests included the standard 10-day *H. azteca* bioassay with survival as the biological measurement endpoint, and the standard 10-day *C. dilutus* bioassay with survival and growth as the biological measurement endpoints (USEPA/USACE 1998a and b). The results of these bioassays were compared across CLA-1, CLA-4 and CLA-R07. Mean *H. azteca* survivals for CLA-1 and CLA-4 ranged from 84% to 92% (mean 88%) and were comparable to the mean survival of 88% for CLA-R07. The lower mean survival for CLA-1 was not considered to be biologically significant (for example, it was not greater than 10% less than the mean survival for CLA-R07). For *C. dilutus,* mean survivals for CLA-1 and CLA-4 ranged from 88% to 90% (mean 89%) and were comparable to the mean survival of 94% for CLA-R07. The lower mean survival for CLA-1 was not considered to be biologically significant because it was not greater than 10% less than the mean survival for CLA-R07. Moreover, control-corrected survival values across all three open-lake areas ranged from 93 to 102 and were well above a 75% control-corrected survival rate determined to be acceptable for *C. dilutus* (USEPA 2004). With respect to *C. dilutus* growth, the mean dry weights (MDW) for CLA-1 (1.70 mg) and CLA-4 (1.72 mg) exceeded that for CLA-R07 (1.01 mg). This was not biologically significant because all exceeded the 0.6 mg MDW criterion indicating acceptable growth for this test species (USEPA/USACE 1998a). These bioassay data indicate that the differences in survival for macroinvertebrate exposure to all three open-lake areas are insignificant.

(b) Bioaccumulation of total PCBs. The bioaccumulation of total PCBs from sediments at CLA-1 and CLA-4 was measured during standard 28-day *Lumbriculus variegatus* (an oligochaete worm) bioaccumulation experiments (USEPA/USACE1998a). Since this bioaccumulation test was not performed on the CLA-R07 sediments, total PCB oligochaete tissue residues were estimated based on the theoretical bioaccumulation potential (TBP) model, an equilibrium theory-based algorithm used to predict the bioaccumulation of neutral, organic compounds in sediments by benthic macroinvertebrates (McFarland 1984). The TBP model predictions employed an empirical Lake Erie mean total PCB biota-sediment accumulation factor (BSAF) of 1.09 (unpublished data). The tissue residues of total PCBs in oligochaetes at CLA-R07 was predicted to be 20.3 to 27.3 µg/kg, which was within the range of the measured mean tissue residues for samples CLA-4 and CLA-1 (19.3 and 48.2 µg/kg, respectively). Further, these measured and predicted PCB tissue concentrations are within the range of measured *L. variegatus* tissue residues exposed to other open-lake reference areas in the Central Basin of Lake Erie (range 19.3 µg/kg to 168 µg/kg; average 60.6 µg/kg) (see Table 17 of USACE 2013). Presentation of the residual tissue data for the three lake areas on a lipid-normalized basis (when assuming a 1% lipid content for the CLA-R07 tissue estimate) further supports that the bioaccumulation of PCBs from CLA-1 (3013

μg/kg-lipid) and CLA-4 (1425 μg/kg-lipid) should not be a concern in comparison to CLA-R07 (2032 to 2730 μg/kg-lipid). Therefore, it is concluded that the benthic bioaccumulation of total PCBs at CLA-1 and CLA-4 were similar to other reference areas and not of toxicological significance.

(4) Use of the 2013 open-lake areas as reference sites. The use of CLA-1 and CLA-4 to determine whether the dredged material meets Federal guidelines for open-lake placement is appropriate. Please note that Section 404 of the Clean Water Act requires that the dredged material meet Federal guidelines, which include promulgated Section 404(b)(1) Guidelines. These guidelines include the application of formal guidance published in the Federal Register as the Great Lakes Dredged Material Testing and Evaluation Manual (GLTM) (USACE 1998a) and Evaluation of Dredged Material Proposed For Discharge in Waters of the U.S.—Testing Manual (ITM) (USACE 1998b). With respect to State requirements relative to the Clean Water Act Section 404(b)(1) Guidelines, that includes compliance with promulgated State water quality standards (WQSs). If a comparison of the 2013 biological measurement endpoint data (solid phase bioassays, and PCB and dichlorodiphenyltrichloroethane [DDT]/dichlorodiphenyldichloroethylene [DDE] bioaccumulation) on DMMU-1, DMMU-2a and DMMU-2b sediments were made to just those on CLA-R07 (with modeled bioaccumulation), it would also lead to a determination that the dredged material meets Federal guidelines for open-lake placement.

We conclude that the sediments sampled from CLA-I and CLA-4 are toxicologically similar to bottom sediments in the Lake Erie environs unimpacted by dredged material discharges. In summary: (1) the low concentrations of PAHs and PCBs present in CLA-1 and CLA-4 sediments did not contribute to an underrepresentation of the toxicity of open-lake reference area sediments or affect the conclusions of USACE (2013); (2) standard bioassays across CLA-1, CLA-4 and the other open-lake reference area sediments subjected to the same biological testing, as well as EqP modeling, demonstrate an absence of benthic toxicity; and (3) bioaccumulation experiments and/or bioaccumulation modeling indicated that the benthic bioaccumulation of total PCBs from the sediments was similar and/or within the range of variation.

B. *Inconsistent selection and interpretation of Federal guidance* *(Section 3.2)*—
To evaluate suitability of the dredged material for open-lake placement, USACE used the tiered evaluation process according to existing ITM (USEPA/USACE 1998b) and GLTM (USEPA/USACE 1998a) guidance.

(1) Use of GLTM (USACE 1998a) and ITM (USACE 1998b). The use of formal Federal guidance in both manuals is appropriate and required. The purpose of regional dredged material testing manuals, such as the GLTM, are to address regionally specific elements (such as topography, biological tests, etc.), but the protocol on how to make a determination whether dredged material meets Federal guidelines for open-water placement are intended to be the same. The Tier 2 elutriate data and the Tier 3 water column bioassay toxicity data showed that the dredged material was suitable for open-

lake placement based on water column impacts after consideration of mixing. The Tier 3 benthic bioassay toxicity and growth data showed that the dredged material was suitable for open-lake placement based on comparisons to open-lake reference area data. The Tier 3 PCB and DDT/DDE laboratory benthic bioaccumulation data showed that the dredged material yielded statistically significant higher bioaccumulation in *L. variegatus* when compared open-lake reference area; therefore, Tier 3 biological test results were insufficient to show that the dredged material was suitable for open-lake placement without an evaluation of the ecological significance of these data (note that this analysis is comparable to the evaluation of water column mixing under Tier 2 and Tier 3). As discussed at our November 4 meeting, the evaluation of ecological significance or risk of the benthic and pelagic bioaccumulation of PCBs was performed using site-specific and regional information under Tier 3 of the ITM and/or Tier 4 of the GLTM. The general purpose of Tier 4 in the GLTM guidance is to address decisions that could not be made in previous tiers. We do not agree that the determination made with respect to the bioaccumulation of PCBs and DDT/DDE was contrary to the GLTM or ITM guidance (please see Paragraph 4[A][2]). Note that 40 CFR 230.10(c) implies that statistically significant effects indicated by laboratory test results do not necessarily mean that they will be significantly adverse in the field. Under ITM guidance as well as the Section 404(b)(1) Guidelines, further evaluation of the laboratory benthic bioaccumulation data is needed to evaluate potential impacts to the aquatic ecosystem and human health for determining the suitability of the dredged material for open-lake placement. The use of bioaccumulation exposure factor (BEF) modeling for high trophic level receptors (in this case, yellow perch and walleye) as well as comparisons with other regional PCB bioaccumulation information and open-lake reference areas was used to assess the ecological significance of bioaccumulation of PCBs from the dredged material in fish tissue.

(2) Use of other PCB bioaccumulation information. Please see Paragraph 4(A)(2), "Assessment of PCB contamination." Note that one point of emphasis in any dredged material determination is to compare the data to those from the "disposal site" (or "reference site") (as termed in USEPA/USACE 1998a and 1998b). The disposal site, which includes bottom sediment, water column and biota, is an area that is inherently subject to background sources of contamination. Section 4.3.2 of the GLTM acknowledges this by indicating that background contamination that reflects the conditions of large areas, particularly those near major tributaries, is not an appropriate rationale for dismissing a disposal site's sediment from use in a dredged material evaluation. It is expected that the environs of any dredged material disposal site in Lake Erie will offer conditions of contamination attributable to past, existing and ongoing sources. While we agree that that PCB contamination in Lake Erie has resulted in existing fish tissue residues that exceed various thresholds (e.g., strategies, fish consumption advisories [FCAs], goals, objectives, plans, etc.), we have also shown through the evaluation that open-lake placement of this dredged material would not significantly increase PCB residues in yellow perch and walleye tissues. Therefore, open-lake placement of dredged materials from DMMU-1, DMMU-2a and DMMU-2b would not affect recovery of the fishery with respect to PCB bioaccumulation. Likewise,

placement of the dredged material in a confined disposal facility (CDF) or outside the Lake Erie aquatic environs would not measurably enhance the rate of reducing PCB residues in these receptors.

C. *Insufficiently protective toxicological endpoints* *(Section 3.3)*—We disagree that chronic benthic toxicity is or should be the primary endpoint for a dredged material evaluation. The following information supports this position. In addition, it should be noted that OEPA did not raise this concern in their March 30, 2012 comments on the SAP.

(1) Federal guidance interpretation. The application of chronic tests is not required or recommended in existing ITM (USEPA/USACE 1998b) or GLTM (USEPA/USACE 1998a) guidance. Section 11.2.3 of the ITM indicates that chronic testing is not a part of Tier 3 and could be used under Tier 4 of the manual, but defers to regional guidance. The GLTM recommends the application of only acute solid phase bioassays to dredged material discharges (Section 5.3.2), but provides an option for chronic testing in Tier 4. Existing Federal dredged material testing guidance uses acute toxicity tests with the primary biological measurement endpoints of survival and growth.

(2) Chronic bioassays. While the application of chronic bioassays can have biologically meaningful merit, the interpretation of chronic bioassay data can also be problematic due to substantial increases in uncertainties (loss of precision) and corresponding loss of statistical power, as well as interpreting the results within the framework of dredged material placement activities.

When considering the bioavailability of sediment contaminants such as cationic metals and PAHs, weight-of-the-evidence indicates that the dredged material is not chronically toxic. For example, cationic metal acid volatile sulfide/simultaneously extracted metals (AVS/SEM), PAH sediment porewater and hydrocarbon toxicity potential (HTP) data on the dredged material consistently indicate that chronic toxicity of the dredged material should not be expected.

(a) Cationic metal toxicity. Please see Paragraph 3.2.1(b)(1)(a) of USACE (2013). The only metal concentration that suggested the potential for chronic toxicity was zinc. In composite samples, ΣSEM-AVS values ranged from -1.61 μmole/g (DMMU-2a) to -0.58 μmole/g (DMMU-1), all of which were less than 0. These results indicated a lack of chronic toxicity. With respect to discrete samples, only site CH-2 yielded an ΣSEM-AVS that exceeded 1.0 (1.60 μmole/g) and ΣSEM-AVS/f_{OC} that exceeded 147.6 μmole/g (160 μmole/g), suggesting low, insignificant or variable chronic toxicity may be possible (Burton *et al.* 2005). When ΣSEM-AVS)/f_{OC} for CH-2 was considered in tandem with the excess AVS at its flanking discrete sites (CH-1 ΣSEM-AVS = -3.88 μmole/g; and CH-3 ΣSEM-AVS = -3.89 μmole/g), material in DMMU-1 was assessed to lack significant toxicity attributable to metals.

(b) PAH toxicity. OEPA calculations regarding the prediction of chronic PAH toxicity does not take into account site-specific variations in sediment geochemistry, PAH bioavailability or PAH-sensitivity specific to freshwater aquatic life. The measurement of actual PAH pore water concentrations (see Table 6 of USACE [2013]), which provide information specific to the sample as compared to the generic and therefore uncertain model predictions developed by OEPA, indicate low PAH bioavailability and potential for toxicity. It is also important to recognize that when a $\Sigma ESBTU_{FCV} \geq 1.0$ is observed, an impact to the aquatic ecosystem has not been clearly demonstrated. The ESB benchmark is a screening value that is used to assess whether PAHs present in a sediment sample are expected to not result in toxicity (USEPA 2003; Hawthorne *et al.* 2007). Because $\Sigma ESBTU_{FCV} \geq 1.0$ is a screening value and does not accurately predict that a sample is toxic, comparing computed $\Sigma ESBTU_{FCV}$ ratios for the project samples and open-lake area sediments to assess the degree of toxicity is inappropriate. Finally, as indicated below, the test species employed in the bioassays are very sensitive. With respect to *H. azteca* and PAH chronic toxicity, the *H. azteca-specific* acute $ESBTU_{FAV}$ based on 13.9 μmol/g lipid (an internal genus mean acute value [GMAV] for *H. azteca*) *is* a value below which chronic toxicity is also not expected (please see Paragraph 4[B][1][a]). With respect to *C. dilutus*, even though the sublethal growth endpoint used in the bioassay was derived using a relatively short exposure, it also offers empirical evidence regarding potential chronic toxicity. In this case, the acceptable growth data yielded through the *C. dilutus* bioassay (1.70 to 1.72 mg) suggest that chronic toxicity is unlikely. In summary, none of these biological effects-related lines of evidence offer any reason-to-believe that the dredged material is chronically toxic.

4. 2013 CLEVELAND HARBOR CONTAMINANT DATA (Section 4)

A. *PCBs* *(Section 4.1)*—We disagree that contaminant concentrations in the dredged material exceed "tolerable limits" for open-lake placement. OEPA cites a number of contaminated fish tissue-related thresholds that are virtually impossible to attain given current background contamination in the sediment and water column in Ohio's urban watersheds. These concerns relate to PCB bioaccumulation and not water quality. The emphasis of the USACE evaluation of dredged material proposed for placement in the open-lake is on using background conditions including bottom sediment and the overlying water column at the disposal site as the point of comparison. Our evaluation carefully considers the current PCB contamination levels in Lake Erie and the status of PCBs as a critical pollutant in the Great Lakes. On a bulk sediment concentration basis, note in Table 9 of USACE (2013) that the estimated total PCB concentrations in the dredged material sediments ranged from 112 to 126 μg/kg, while concentrations in CLA-1 and CLA-4 sediments ranged from 123 to 124 μg/kg. The bioaccumulation evaluation concluded that the levels of PCBs present in the dredged material when placed at CLA-1 and CLA-4 is not predicted to have a significant impact on target fish PCB tissue concentrations in Lake Erie, nor is predicted to increase potential risk to human health.

The interpretation of the PCB bioaccumulation data and our conclusion of unlikelihood for undesirable impacts were made in accordance with Clean Water Act Section 404(b)(1) Guidelines. Note that based on the bioaccumulation data, the measured increase in PCBs in *L. variegatus* is trivial when compared to the potential for increased PCB bioaccumulation in higher trophic level fish and wildlife potentially impacted by the placement of dredged material at the open-lake placement areas. Federal guidelines prohibit discharges if they will have "significantly" adverse effects on aquatic resources. In this context, "significant" means more than "trivial;" that is, significant in a conceptual rather than a statistical sense (USEPA/USACE 1998b). Not all effects which are statistically significant in the laboratory are significantly adverse in the field.

A conservative evaluation using the spatially explicit screening level exposure comparison (SESLEC) approach and BEF model was conducted in USACE (2013) (Paragraph 3.2.3[b][3]) with respect to bioaccumulation of sediment-associated PCBs using CLA-4 as an open-lake reference area. CLA-4 yields a total PCB benthic bioaccumulation of 19.3 µg/kg that is quite similar to predicted values for CLA-R07 (20.3 µg/kg to 27.3 µg/kg) (please see Paragraph 3[A][3][b]). If it is realistically assumed that average total PCB concentrations in lake bottom sediments east, offshore and west of Cleveland are on the order of 73.8 µg/kg (using a mean across data on Rocky River, Cleveland CLA-4 and CLA-R07, Fairport and Ashtabula open-lake reference areas) with a corresponding average TOC content of 2.2%, that yields an average reference total PCB benthic bioaccumulation of 36.6 µg/kg via the TBP model. Relative to this as a more representative reference area value, magnitudes of difference (MODs) of 1.97, 1.38 and 1.42 are yielded for the DMMU-1, DMMU-2a and DMMU-2b material, respectively, all of which are less than 2 (a value greater than 2 would mean that the difference is real as evidenced by it being greater than differences that could occur solely by sources of errors such as sampling, heterogeneity, testing conditions and analytical measurements). Further, the use of 36.6 µg/kg in the BEF model (in lieu of the measured benthic bioaccumulation for of 19.3 µg/kg CLA-4), while still failing to acknowledge that sediments at CLA-1 (32.2 µg/kg in *L. variegatus*) also contribute to background contamination, yields BEFs ranging from 1.01 (walleye for the DMMU-2a and DMMU-2b material) to 1.07 (yellow perch for the DMMU-1 material). The average BEF is 1.03, which is approximately equal to 1.0. A BEF of 1.0 implies no impacts to the receptor. A BEF of 1.03 indicates that the bioaccumulation pathway for PCBs is not expected to increase in a meaningful way and significant adverse impacts to the aquatic ecosystem and human health are not expected. It appears evident that the transfer of PCBs from this dredged material to fish should not be an issue if it is placed in the open-lake.

(1) 2013 PCB results (Section 4.1.1). While the evaluation points out that there may be statistically significant increases in PCB bioaccumulation in oligochaetes from the dredged material at the open-lake placement area, it concludes that it would not necessarily be biologically significant based on either the specified American Society of Testing and Materials (ASTM) consideration of biologically meaningful bioaccumulation when establishing comparison to a reference sediment (ASTM 2010) (please see Paragraph 4[A][1][c] for a very conservative application of the BEF model to receptor

species). OEPA's review does not take this interpretation of the bioaccumulation data into consideration. The determination does consider current PCB concentrations in Lake Erie through the measurement of bulk concentration in sediment and associated benthic bioaccumulation, and concentrations in the water column. The interpretation of the PCB data and associated determination is consistent with Tier 4 of the GLTM and/or Tier 3 of the ITM. The increase in bioaccumulation of PCBs in yellow perch and walleye in Lake Erie following placement of dredged material as predicted by the BEF model (please see Paragraph 4[A][1][c]) are much smaller than described by OEPA based on the laboratory bioaccumulation test data.

(a) Concentrations of PCBs in the dredged material.

•Bulk concentrations of total PCBs (congener total) in the three DMMUs range from 112 to 126 µg/kg (composite samples), and were comparable to CLA-1 (124 µg/kg) and CLA-4 (123 µg/kg) sediments (composite samples). However, the bioaccumulation of total PCBs from the dredged material in the laboratory tests was often statistically greater than that associated with the CLA-1 and CLA-4 sediments. Lower TOC content in the dredged material (composite sample average 1.23%) relative to CLA-1 and CLA-4 (2.4 to 2.5%) was a significant factor in the difference in PCB bioavailability and bioaccumulation.

•Average OC-normalized total PCB concentrations in the DMMU material across 2007, 2010 and 2013 Cleveland Harbor sampling events show that the concentrations of 4675 to 7350 µg/kg-OC are similar to those at CLA-1 and CLA-4 (5204 and 5118 µg/kg-OC, respectively).

(b) Benthic bioaccumulation of PCBs. USACE agrees that the standard 28-day *L. variegatus* bioaccumulation tests conducted under laboratory conditions showed that PCB residues in *L. variegatus* exposed to DMMU-1, DMMU-2a and DMMU-2b sediments were often statistically higher when compared to those exposed to sediments from CLA-1 and CLA-4. These results were then assessed with respect to the ASTM (2010) bioaccumulation criterion relative to reference sediments, and then further evaluated with respect to receptors that have direct and indirect food web links to benthos, including yellow perch and walleye. USACE does not identify unacceptable ecological impacts with respect to PCB food web bioaccumulation above the background condition for Lake Erie from the placement of dredged material at either CLA-1 or CLA-4 (please see Paragraph 4[A][1][c]).

Please note that recent evaluations regarding whether dredged material from other Great Lakes harbors met Federal guidelines for open-lake placement have included standard *L. variegatus* bioaccumulation experiments and concluded that the observed benthic bioaccumulation of total PCBs was acceptable, and therefore did not result in unacceptable adverse impacts.

•On a lipid-normalized basis, bioaccumulation of total PCBs from the DMMU material (4345 to 5920 μg/kg-lipid) was often statistically greater than that measured for CLA-1 and CLA-4 sediments. However, it is within the range of that predicted and/or measured from open-lake reference area sediments offshore of Toledo (2000 to 7620 μg/kg-lipid) and Ashtabula (1726 to 16800 μg/kg-lipid) between 2004 and 2011. It was also within the range of that predicted and/or measured from open-lake reference area sediments offshore of Rocky River, Fairport and Ashtabula (1391 to 16800 μg/kg-lipid) between 2004 and 2013.

•For the open-lake placement of Ashtabula Harbor maintenance-dredged material, material that bioaccumulates up to 63.8 μg/kg has been determined to meet Federal guidelines for open-lake placement based on statistical comparisons of the bioaccumulation data to open-lake placement/reference area sediments (USACE 2010a). OEPA granted Section 401 water quality certification (WQC) for open-lake discharge of the associated dredged material.

•For the open-lake placement of Ashtabula Harbor Great Lakes Restoration Initiative (GLRI) dredged material, material that bioaccumulated up to 87 μg/kg has been determined to meet Federal guidelines for open-lake placement based on a comparison of TBP predictions (using an empirical site-specific mean total PCB biota-sediment accumulation factor [BSAF] of 2.18) to open-lake placement/reference areas (USACE 2011a). OEPA granted Section 401 WQC for open-lake discharge of the associated dredged material.

•For the open-lake placement of Toledo Harbor maintenance-dredged material, material that bioaccumulated up to 100 μg/kg has been determined to meet Federal guidelines for open-lake placement based on a comparison of TBP predictions (using an empirical Lake Erie mean total PCB BSAF of 1.48) to open-lake placement/reference areas (USACE 2011b). OEPA granted Section 401 WQC for open-lake discharge of the associated dredged material.

The average oligochaete tissue residue of 83.6 μg/kg across the three Ashtabula and Toledo Harbor examples above (range 63.8 μg/kg to 100 μg/kg) exceeds the average of 58.2 μg/kg across the DMMU-1, DMMU-2a and DMMU-2b dredged material (range 52 μg/kg to 72 μg/kg) with which OEPA has currently expressed lake-wide concerns with respect to PCB bioaccumulation. On a more biologically meaningful lipid-normalized basis, the range of 6288 to 10000 μg PCBs/kg-lipid in oligochaete tissue across the other harbor's dredged material exceeds the 4345 to 5930 μg PCBs/kg-lipid tissue residue range across material dredged from DMMU-1, DMMU-2a and DMMU-2b.

(c) Bioaccumulation of PCBs in upper-trophic level receptors.
Statistically significant differences in the concentration of PCBs in oligochaetes is trivial when considered in an ecological context of potential for bioaccumulation in yellow perch and walleye, and ultimately, exposure to pisciverous wildlife and humans. A statistical analysis of variance for the predicted pre- and post-dredged material placement

exposure estimates of the BEFs to yellow perch and walleye demonstrate how small statistically significant increases in worm tissue concentrations measured in laboratory tests often does not translate into a significant impact through bioaccumulation in predatory fish at the placement area. The calculated BEFs provided in our evaluation are based on *L. variegatus* tissue concentrations that, when conservative, worst-case assumptions are used, yield a BEF of 1.27. The BEF is based on the mean PCB concentrations measured in oligochaetes exposed to CLA-1, CLA-4 and DMMU-1 sediments, which were 32.2±4.7 µg/kg, 12.9±1.2 µg/kg and 55.6±4.3 µg/kg, respectively. When the variance for the post-placement exposure is calculated, (i.e., C_0, the area-weighted average tissue concentration; see Equation 5 in USACE [2013]), a direct statistical comparison to the reference tissue PCB concentration can be performed using a Student's T or Fisher's Least Significant Difference (LSD) test. Given the variance associated in the PCB tissue concentration measured in oligochaetes exposed to CLA-1, CLA-4 and DMMU-1 sediments, an LSD[1] of 5.3 µg/kg (α=0.1, degrees of freedom [df]=19) can be calculated for comparison to the reference condition. The difference between the reference condition (CLA-4=12.9 µg/kg) and the exposure condition following dredged material placement (C_0=16.3 µg/kg) is 3.4 µg/kg. Since this difference is less than the LSD, USACE concludes that there is no basis for assuming that concentrations of PCBs in yellow perch or walleye will significantly increase through the placement of the dredged material at CLA-1 or CLA-4. In this way, a significant increase in risk to aquatic resources or human health cannot be predicted.

• According to ASTM (2010), the lack of consensus concerning what constitutes an acceptable minimum difference supports adopting a bioaccumulation testing protocol to detect a two-fold difference between tissue residues in a dredged material test and the reference or background sediment test. A two-fold difference is considered sufficient to determine the potential for ecological and human health concerns. Differences in contaminant bioaccumulation from the dredged material less than two times the reference sediment (i.e., <100% increase) are not biologically significant because they reflect the inherent variability in bioaccumulation.

• It is important to recognize that the BEFs calculated and used in the modeling were extremely conservative. These conservative measures were intended to further accentuate the insignificant risk posed by the dredged material placement at CLA-1 and CLA-4. For example, the BEF model for yellow perch is based on a home range of 18 square miles, which is believed to underestimate the home range in the field. The actual home range for this species in Lake Erie is likely to be significantly larger (up to 70 square miles) based on the work of Glover *et al.* (2008). Further, additional conservatism has been built into the BEF models by including the cumulative contribution of PCB exposure from both the historic dredged material placement at CLA-1 plus planned

[1] The estimated variance for the area-weighted mean tissue concentration (C_0) and development of an LSD statistic are based on the mean square error (MSE) and degrees of freedom developed from the ANOVA used to compare tissue concentrations among laboratory treatment means. Details of the statistical analysis can be provided.

placement of dredged material at CLA-4. An even lower BEF is calculated if consideration of only placement of dredged material at CLA-1 or CLA-4 is used for comparison to the baseline exposure.

•Note that Equation 7 in USACE (2013) contains a minor error; several parentheses are misplaced in the equation. The numerator, C_o, represents an area-weighted average concentration where the cumulative increase in exposure to fish is calculated based on benthos exposed to both two proposed open-lake placement areas as well as background PCBs present in Lake Erie sediments; it is the estimated PCB tissue residue in oligochaete populations across the fish species' home range. C_o should be represented by the equation ([PA/HR] x C_{dm}) + ([FPA/HR] x C_{dmfpa}])+([{HR – PA-FPA}/HR] x C_r) where the fractional concentration for fish exposure to background PCBs is [{HR – PA-FPA}/HR] x C_r. Despite this error in the text, the BEFs calculated in Table 20 are correct.

•The BEF model considers biouptake from sediments via benthic macroinvertebrates the sole source of bioaccumulation while it is known that bioaccumulation of PCBs in fish also occurs via other exposure pathways. The current, primary source of PCBs to Great Lakes fish are direct atmospheric deposition to the lake, resuspension and erosion of tributary sediments, combined sewer overflow (CSO) discharges and flow from urban watersheds (Offenberg et al. 2005). All of these sources influence uptake directly from the water column and via the pelagic food web. Given the lesser importance of uptake resulting from lake bottom sediments, the open-lake placement of this dredged material would not be expected to cause any measurable increase in PCB concentrations in fish tissue in Lake Erie within the Cleveland area or exacerbate current fish tissue residues of PCBs in Lake Erie fish, which often exceed various thresholds (please see Paragraph 4[A][2][a]).

(2) Assessment of PCB contamination (Section 4.1.2). Since the determination is consistent with Tier 4 of the GLTM and/or Tier 3 of the ITM, ITM guidance was not used in lieu of the GLTM. Note that neither guidance is intended to be comparatively more or less restrictive in terms of a dredged material determination. With respect to Tier 3 in the ITM, please note that benthic bioaccumulation should be interpreted in regard to the significance of the magnitude of the difference in comparison to the reference area, background conditions, and impacts via trophic transfer and a component of biomagnifications. Please see Paragraph 3(A)(2) showing why bottom sediments at CLA-1 and CLA-4 are within the range of lake background contamination and were adequately representative as open-lake reference/placement areas. We disagree that PCB bioaccumulation from the dredged material would have been evaluated to be considerably higher or biologically significant if other areas were used (in reference to the use of CLA-R07, please see Paragraph 4[A]).

(a) <u>Consideration of fish tissue PCB thresholds</u>. USACE acknowledges that PCBs in Lake Erie fish tissue often exceed various fish tissue thresholds, including 23 µg/kg (OEPA Clean Water Act 303[d] human health beneficial use impairment [BUI]

threshold for the Lake Erie Basin), 50 µg/kg (OEPA fish consumption advisory [FCA] threshold for "eat no more than one meal per week" advisories), 100 µg/kg (Great Lakes Water Quality Agreement [GLWQA] threshold for the protection of avian and wildlife consumers of fish) and 160 µg/kg (USEPA wildlife protection value). However, when considering measured ambient total PCB concentrations in Lake Erie water alone (average 0.22 ng/L) (USACE 2010a, 2011a) and under an assumption that the fish tissue derivation equation for trophic level 3 and 4 fish is reasonably predictive (OEPA 2012), application of the equation yields trophic level 3 and 4 fish tissue concentrations of 115 µg/kg and 412 µg/kg, respectively. This suggests that the PCB fish tissue thresholds of 23 µg/kg, 50 µg/kg and 100 µg/kg are currently unachievable due to existing Lake Erie background concentrations of total PCBs in the water column alone. Also note that measured total PCB concentrations in Lake Erie water (USACE 2010a, 2011a) exceed existing OEPA chronic water quality standards which are protective of fish tissue (0.12 ng/L for the protection of wildlife; 0.026 ng/L for the protection of human health). Clearly, most or all of these fish tissue thresholds and water quality standards are well below background conditions, and the equation indicates that they cannot be achieved until background water column concentrations of PCBs are reduced by between about 50% to 88%. As noted previously, Offenberg *et al.* (2005) found that urban influenced air-water exchange fluxes dominate PCB lake water budgets. This is another line of evidence that the negligible increase in PCB bioaccumulation from the dredged material in fish receptors, as conservatively predicted in USACE (2013), is insignificant compared to other sources (such as air deposition) that dominate the existing PCB budget in Lake Erie. Therefore, bioaccumulation associated with the water column and pelagic food web appears to be a major driver to the existing PCB impairments in Lake Erie.

USACE acknowledges that an explicit comparison of the *L. variegatus* PCB bioaccumulation data to the fish tissue benchmarks, including FCAs, was not documented in USACE (2013). First, note that such comparison is a Tier 2 rather than a Tier 3 consideration in the GLTM. In the ITM, it is a Tier 3 consideration and not a requirement; it would be performed only in the absence of bioaccumulation testing. While PCB tissue residues in *L. variegatus* exposed to all of the DMMU sediments (range 50.6 µg/kg to 72 µg/kg) exceed both OEPA as well as the GLWQI fish tissue thresholds, these thresholds appear to be unachievable due to background PCB concentrations and exposure within the pelagic environment alone. PCB tissue residues in *L. variegatus* exposed to the DMMU material are below the USEPA wildlife protection threshold value.

(b) Application of the BEF model to yellow perch and walleye. We disagree with the conclusion by OEPA that the biologically insignificant increases in PCB bioaccumulation concluded by USACE, which result in a determination that the dredged material meets Federal guidelines for open-lake placement, is contrary to the current weight-of-the-evidence.

•The bottom sediments at CLA-1 and CLA-4 are not significantly more contaminated with respect to total PCBs (please see Paragraph 3[A][2][b]). The potential 10%

increased bioaccumulation estimate for walleye and 27% increased bioaccumulation for yellow perch calculated through the BEFs are not significant given the variability in the underlying *L. variegatus* tissue data. A less than 100% increase in tissue bioaccumulation relative to reference sediment is not biologically significant (ASTM 2010) based on the inherent variability of laboratory test results, which is expected to be less than that observed when comparing organisms inhabiting actual sites in the environment. As discussed earlier, existing PCB residues in fish exceed fish tissue thresholds which appear to be unachievable due to background conditions in the lake.

•OEPA's suggestion that an increase in fish bioaccumulation in the Cleveland area from 10 (current estimate) to 20 times the OEPA fish tissue threshold of 23 μg/kg (i.e., from 230 μg/kg to 460 μg/kg) appears to be a misinterpretation of the BEF model and its results. If it is assumed that all yellow perch and walleye in the Cleveland area include both CLA-1 and CLA-4 within their home range and the dredged material placement footprint is directly proportional to their other benthic-linked dietary components outside CLA-1 and CLA-4 (these are additional, conservative assumptions, because PCB bioaccumulation in fish is likely driven primarily through the pelagic food web), the increase in PCB bioaccumulation could be a maximum of 10% to 20%, or from 230 μg/kg, to 253 μg/kg to 276 μg/kg. This very conservatively predicted increase falls within the general range of analytical variability.

•It is unclear how the predicted increase in PCB bioaccumulation of 330% was derived, but it appears to be a comparison of the *L. variegatus* tissue residue data for DMMU-1 dredged material vs. CLA-4 sediments. ASTM (2010) indicates that a 100% difference in bioaccumulation as compared to bioaccumulation from reference sediments is considered biologically significant. For the DMMU-1 material, benthic PCB bioaccumulation (72 μg/kg) would be 3.7 times that of CLA-1 (19.3 μg/kg), which is an increase of about 270% or 170% above the reference value. Although greater than 100%, as indicated above, the resulting BEF estimate is not predicted to be biologically meaningful given the home range of yellow perch and walleye and observed tissue concentrations in Lake Erie near Cleveland, and the variability in the PCB tissue concentrations observed in laboratory tests.

•USACE (2013) shows that the negligible increase in predicted PCB bioaccumulation in receptors would not be biologically significant. Please note that the GLTM (USEPA/USACE 1998a) does not restrict increases in PCB bioaccumulation, per se, but is intended to ensure that open-lake placement of dredged material does not result in statistically and biologically significant increases in bioaccumulative compounds.

(c) Consideration of PCB bioaccumulation within the context of State WQC. Based on application of a standard elutriate test (SET), the release of total PCBs from the dredged material to the water column would be non-detectable during placement in the open-lake. Such a discharge is a discontinuous event of short duration and constitutes an acute exposure; the bioaccumulation of PCBs from the water column

typically takes a matter of several days to weeks to occur. There would be no significant lowering of water quality associated with the discharge of this dredged material (please see Paragraph 4(A)(2)(d)). Additionally, it should be noted that OEPA did not raise these concerns in their March 30, 2012 comments on the SAP.

(d) Risk of violating Ohio WQSs. We disagree that compliance of the dredged material discharge with respect to PCB WQSs has not been addressed based on the SET and application of the short-term (ST)-FATE model for consideration of mixing of a plume from an instantaneous discharge to compare with WQSs for acute aquatic toxicity. This same approach is presented in both the ITM and GLTM and has been applied at other Lake Erie dredging projects for which OEPA granted WQC. This same approach was used to evaluate compliance of the Ashtabula Harbor GLRI project effluent with respect to Ohio WQSs for PCBs. We disagree that further evaluation is warranted in this case to demonstrate compliance with the Ohio's human health PCB WQS. Additionally, it should be noted that OEPA did not raise these concerns in their March 30, 2012 comments on the SAP.

Compliance of the dredged material discharge with respect to applicable Ohio WQSs was addressed as follows:

•PCB WQSs for the protection of wildlife and human health are not applicable in this case because they are chronic and intended to apply to fixed and continuous discharges, such as from the discharge of process wastewaters from point sources. Exposures of PCBs in the water column resulting from the open-lake placement of dredged material are acute (a exposure duration of only 15 to 20 minutes for fixed receptors, less than 15 minutes for organism passing through the plume, and a matter of hours for organisms passively transported with the plume), intermittent, and spatially distributed over three quarters of a square mile. Both of these WQSs are based on biouptake and bioaccumulation through continuous exposures that cannot occur from these dredged material discharges to the water column.

•PCBs (as Aroclors) in the sediment elutriates were all non-detected at maximum detection limits of 0.04 μg/L, which are below Ohio's practical quantitation limit (PQL) of 0.5 μg/L. If PCB concentrations in the elutriate were below detection limits, conservative estimates of the elutriate concentration could be estimated using conservative EqP relationships or the detection limit could be used to evaluate compliance after mixing.

•An average of measured, conservative total PCB concentrations in Lake Erie water (i.e., representing background water quality concentrations) of 0.22 ng/L (USACE 2010a and 2011a) is almost double the highest WQS of 0.12 ng/L for the protection of wildlife, and exceeds the human health WQS of 23 pg/L by almost 10-fold. Therefore, these WQS are currently impossible to achieve in Lake Erie.

B. ***PAHs*** *(Section 4.2)*—We disagree that the concentrations of PAHs in the DMMU-1, DMMU-2a and DMMU-2b material present a significant risk to aquatic life despite bulk sediment PAH concentrations being observed to be higher than sediments at CLA-1 and CLA-4. Note that the concentration of total extractable PAHs measured in sediment samples are poor predictors of the potential for toxicity because this analytical approach fails to measure the interaction of these compounds with sediment organic matter and their bioavailability, which drives toxicity. The solid phase bioassays performed by USACE provide a direct estimate of the potential for toxicity of the sediments to aquatic life. In addition, additional analysis of sediment porewater for dissolved PAHs provides a direct analysis of the geochemical interactions between PAHs and the sediment, thus providing an explanation for why the dredged material is not expected to result in chronic toxicity. Together, these bioassays and porewater data provide clear evidence that the PAHs within these sediments have low bioavailability and are present at concentrations that does not result in acute or chronic toxicity. Please see Paragraph 3(C)(2)(b) for additional information concerning chronic toxicity of the dredged material. USACE has concluded that the material to be dredged from DMMU-1, DMMU-2a and DMMU-2b meets Federal guidelines for open-lake placement.

(1) 2013 PAH results and EqP sediment benchmarks (Section 4.2.1)

(a) Assessment of acute and chronic toxicity. The application of solid phase bioassays per USEPA/USACE (1998a, 1998b) was conducted and did not show significant acute toxicity using the standard 10-day *H. azteca* survival, and 10-day *C. dilutus* survival/growth measurement endpoints. While these bioassays are acute, their results also indicate that no potential for PAH-associated chronic toxicity is likely. *H. azteca* is used for toxicity testing in part because it is considered to be the most sensitive freshwater sediment macroinvertebrate to PAH contaminants (USEPA 2003). The acute and chronic dose response of *H. azteca* to PAH mixtures has been studied in detail by others (see USEPA 2003, Figures 5-7 to 5-9). Chronic toxicity (e.g., negative effects on survival and growth over 28 days) for *H. azteca* does not occur until PAH sediment concentrations exceed the predicted GMAV concentration of 13.9 μmol/g lipid (USEPA 2003; Kreitinger *et al.* 2007). In addition, effects on *H. azteca* reproduction (42-day tests) has been reported to be at the same concentration affecting survival during a 10-day exposure to PAHs (USEPA 2003). USACE has concluded that, based on the results from the 10-day *H. azteca* bioassay, chronic toxicity to *H. azteca* due to the sediment PAHs in unlikely, and that the toxicity data generated through the acute test are adequate for evaluating the potential for PAH-associated toxicity to benthic macroinvertebrates.

(b) Application of USEPA ESBTU model.

•USACE has correctly applied the USEPA (2003) model for calculating ∑ESBTU values for PAHs. USEPA (2003) relies on literature derived aqueous-OC partitioning coefficients (K_{OC}) to predict the dissolved concentration and chemical activity of PAHs in sediment porewater. The K_{OC} values provided in USEPA (2003), however, are based on the partitioning of PAHs from natural organic matter into water and do not reflect the

actual geochemistry of sediments often present in urban environments (Hawthorne *et al.* 2006b). The ESBTU risk model applies these generic K_{OC} values and assumes that they are appropriate when no other site-specific data are available. USEPA (2003) anticipated that PAHs may have lower partitioning to interstitial water (i.e., higher K_{OC} values) when sediments contain soot particles, coal fines or similar materials when compared to sediments containing only natural organic matter, and cautions that this type of partitioning results in the calculation of benchmarks that are overprotective.

•USACE has used newly developed USEPA 8272/ASTM D7363 standard analytical methods to directly measure dissolved PAHs in sediment porewater to assess sample-specific bioavailability including the influence of coal fines and soot particles on K_{OC} values and predicted EqP benchmark screening values in Cuyahoga River Channel sediment. Using these methods, dissolved PAHs were rarely detected in sediment porewater, resulting in the calculation of K_{OC} values that are higher than default assumptions used by USEPA or OEPA in the EqP model. The DMMU-1, DMMU-2a and DMMU-2b samples were determined to have measured K_{OC} values that range from 1.8 to over 10 times generic K_{OC} values based on natural organic matter. In urban sediments, measured PAH K_{OC} values are often 5 to 100 times greater than literature obtained values derived using natural organic matter (Hawthorne *et al.* 2006b).

•As noted earlier, $\sum ESBTU_{FCV} \geq 1.0$ (whether specific for *H. azteca* or a generic $\sum ESBTU_{FCV}$ for all freshwater and marine aquatic organisms) do not indicate that the given sediment is toxic. Rather, the $\sum ESBTU_{FCV}$ is a screening value that, when used appropriately, provides information that could be used to determine whether the direct determination of sediment toxicity using Tier 3 testing is warranted.

•OEPA has correctly pointed out that the measurement of 34 PAHs (i.e., 18 parent PAH compounds and 16 groups of alkylated PAH compounds) in sediment is recommended over the measurement of the standard 16 USEPA priority pollutants as a more precise screening approach. USACE agrees that the toxicity of PAH mixtures results from a much larger number of PAH compounds than the 16 USEPA priority pollutant or the 13 PAH compounds recommended for determination of threshold effect concentration (TEC) and probable effect concentration (PEC) screening values (MacDonald *et al.* 2000). USACE conducted an analysis of the dissolved 34 PAHs in sediment porewater. These data provide a better understanding for the lack of toxicity of observed in the laboratory bioassays. As described above, analysis of the dissolved PAHs in sediment porewater demonstrated that the literature derived K_{OC} values applied by OEPA overestimated the actual PAH bioavailability in DMMU-1, DMMU-2a and DMMU-2b sediments and their potential to result in exposure and toxicity to aquatic life. The maximum concentration of PAHs present in the sediment porewater samples (found in DMMU-1) was at a concentration that represented one-tenth of the $\sum ESBTU_{FCV}$ (the $\sum ESBTU$ yielded by the FCV of 2.24 µg/mol lipid as a predictor of potential for chronic toxicity) (USEPA 2003). Sediment with porewater having $\sum ESBTU_{FCV} \leq 1.0$ is considered to be protective of both marine and freshwater benthic macroinvertebrates and

unlikely to result in chronic toxicity from PAHs. In summary, the calculation of ∑ESBTU using the measurement of 16 PAHs in bulk sediment and an uncertainty factor for PAH mixtures (Hawthorne *et al.* 2007) found in urban and industrial sediments (typical of northeastern US and Canada) was conducted to assess whether PAHs may be toxic. Subsequent direct testing of sediment toxicity using solid phase bioassays and the analysis of 34 PAHs in sediment porewater makes OEPA's concern regarding the use of this uncertainty factor and guidance by Burgess (2009) a moot point.

(2) Consensus-based PAH thresholds (Section 4.2.2). It is USACE policy to use sediment quality guidelines (SQGs), such as those in MacDonald *et al.* (2000), as an initial screen for determining if higher biological effects-based evaluation is required in subsequent tiers (USACE 1998a, 1998b). The application of MacDonald *et al.* (2000) consensus-based TEC and PEC values for toxicological risk management decision-making is inappropriate in this case. The USACE does not apply OEPA (2010) guidance for dredged material evaluations; we previously commented on the development of this guidance while it was in draft form. While the application of OEPA (2010) guidance may be OEPA's preference, it has inconsistencies with formal Clean Water Act Federal guidance, goes beyond compliance with applicable State WQSs and does not address USACE requirements toward the determination of an equitable Federal standard for dredged material management among Federal harbors across the Great Lake states.

(a) Appropriate use of SQGs. The rationale for not using SQGs for dredged material management decision-making is that they do not incorporate site-specific data related to the interaction between sediment contaminants and geochemistry. This interaction can have a profound impact on continuant bioavailability, the potential for exposure and toxicity to aquatic life. Although the PAHs present in the DMMU samples are higher in concentration in comparison to CLA-1 and CLA-4, they have low bioavailability as demonstrated by the analysis of sediment porewater and do not exhibit toxicity to benthic macoinvertebrates as determined through the application of laboratory bioassays. Such results are not unique to Cleveland Harbor sediments. Research conducted by Hawthorne *et al.* (2007) on 150 urban sediment samples has shown that the PEC screening value for total PAHs (22.8 mg/kg) correctly classifies a sample as nontoxic at a high rate (sensitivity =0.96); however, the PEC value provides only poor predictions of which samples are toxic (specificity=0.32). The resulting overall efficiency of the PAH PEC to correctly predict both toxic and non-toxic samples was found to be only 48%. This suggests that this PEC value is often not predictive of PAH toxicity in urban sediments dominated by pyrogenic sources of PAH contamination. Regarding individual PAH compounds, comparisons to compound PECs and TECs is not recommended due to the additive toxicity from exposure to multiple individual PAH compounds of potential for toxic effects (MacDonald *et al.* 2000). Total PAHs is the preferred measurement for comparison to the total PAH TEC and PEC screening values based on the sum of 13 individual priority pollutant PAH compounds.

(b) Benzo(a)pyrene toxicity. USEPA (2003) reviewed studies evaluating the teratogenic and carcinogenic effects of benzo(a)pyrene (as opposed to narcotic

toxicity) to freshwater and saltwater fishes (USEPA 2003). Although metabolism of PAHs is known to occur in invertebrates such as polychaetes, mollusks and crustaceans (McElroy *et al.* 2000), data on the potential carcinogenic effects of the metabolites to macroinvertebrates is largely unknown. For freshwater fishes, a minimum effects concentration for benzo(a)pyrene of 0.21 µg/L was identified based on observed teratogenic effects to rainbow trout eggs (Hannah *et al.* 1982, Hose *et al.* 1984). The concentration of benzo(a)pyrene in DMMU-1, DMMU-2a and DMMU-2b sediment porewater samples was determined to be <0.024 µg/L, which is an order of magnitude lower than the concentrations observed to result in teratogenic and carcinogenic effects to marine and freshwater fishes (please see Table 6-4 of USEPA 2003). USEPA (2003) evaluated 539 sediments and concluded the $\sum ESBTU_{FCV}$ for PAHs (based on literature derived K_{OC} values) is expected to be protective as a screening value for teratogenic and carcinogenic effects from benzo(a)pyrene and anthracene. Based on the direct measurement of benzo(a)pyrene in sediment porewater, USACE concludes that the PAHs present in the DMMU-1, DMMU-2a and DMMU-2b material are not expected to result in any teratogenic or carcinogenic effects in fishes.

C. *DDT and DDE* *(Section 4.3)*—We disagree that DDT/DDE in the dredged material would result in unacceptable adverse impacts when open-lake placed at CLA-1 and CLA-4.

(1) Appropriate use of SQGs. Bulk concentrations of DDT/DDE in the dredged material exceed the MacDonald *et al.* (2000) TEC. However, SQGs are intended to be used for screening purposes rather than on a "pass/fail" basis, or for decision-making. These criteria do not relate to WQSs. With respect to all contaminants in the dredged material, the two standard solid phase bioassays performed on the dredged material show that open-lake placement would not result in unacceptable toxicity when placed at CLA-1 and CLA-4. These data take precedence over judgments based on SQGs.

(2) Benthic bioaccumulation. The increase in the benthic bioaccumulation of DDT/DDE from the DMMU-1 and DMMU-2b material (i.e., more than twice that associated with CLA-4 sediments) is discussed in Paragraph 3.2.4(b) of USACE (2013) and addressed via the BEF model using yellow perch and walleye as receptors.

(3) Fish tissue concentrations of ΣDDT. Please note that the BEF model does not predict fish tissue concentrations. The BEF is a screening model that addresses the spatially weighted average exposure of receptors to bioaccumulative contaminants in benthic invertebrate prey. We disagree that bottom sediments at CLA-1 and CLA-4 are significantly more contaminated than nearby open-lake reference area sediments. For example, the minimum average bulk sediment concentration of ΣDDT of 8.1 µg/kg at CLA-R07 (including just DDD) is comparable to the minimum average of 7.3 µg/kg across CLA-1/CLA-4 (including just DDE and DDD). Further, a comparison of the average bulk sediment concentration of DDD at CLA-R07 alone shows that it is comparable to the average of 7.84 µg/kg across CLA-1/CLA-4.

5. CONCLUSIONS (Section 5)—We disagree with OEPA's assessment of the data, and associated conclusions, based on an array of technical and regulatory rationale. Please see comments throughout this document.

6. POTENTIAL IMPACT OF OPEN-LAKE PLACEMENT OF DREDGED MAERIAL ON THE QUALITY OF WATER AT POTABLE WATER INTAKES (PWIs) (Section 6)—OEPA Division of Drinking in Ground Waters (DDAGW) raised several concerns regarding the potential impacts of open-lake placement disposal of dredge material from the Cuyahoga River and Cleveland Harbor on the Cleveland Drinking Water System.

A. ***OEPA requested that the USACE demonstrate the potable water intakes will not be negatively impacted by dredged material placement operations in Lake Erie*** *(Section 6.1)*—Hydrodynamic (ADCIRC), particle tracking (PT) and erosion (LTFATE) modeling was completed in 2013 to address the potential transport of total suspended solids (TSS) to the Crown, Morgan, Baldwin and Nottingham PWI structures following the placement of Cleveland Harbor dredged material at open-lake areas #1 and #4. Solids losses resulting from dredged material placement at these two areas are not expected to have any significant impact on water column TSS concentrations at these PWIs. No transport of TSS to any of the four PWIs is predicted to occur from placement operations at CLA-1. Under the modeled worst-case scenario, TSS contributions of up to 1 mg/L from dredged material placement operations at CLA-4 is predicted to occur less than 1% of the time at the Morgan PWI; no TSS contributions are predicted to occur the rest of the time or at the other PWIs. Currents at CLA-4 typically head in an east northeasterly direction causing the disposal plume to pass at least 3000 to 5000 ft north of the Morgan and Baldwin PWIs. Under the conditions where transport of TSS from CLA-4 to Morgan PWI occurs, water column TSS at Morgan PWI would increase less than 15% from about 8 mg/L (background) to 9 mg/L. The median background TSS concentration at Morgan PWI is about 3.5 mg/L; ambient TSS concentrations at Morgan PWI ranged from about 0.5 to 200 mg/L in 2012 and from about 1.3 to 36 mg/L in May 2012 (May is the typical month for placement operations). Erosion modeling of the partially consolidated dredged material deposit predicted no erosion. This result is reasonable in light of the ambient conditions; the area is at least four miles offshore in water depths of 55 to 60 ft, and has a fine-grain sediment bed. Therefore, the modeling demonstrates that placement operations are not predicted to negatively impact the PWIs.

B. ***Open lake disposal so close to Cleveland's intakes may have a negative impact on the City's source water protection status*** *(Section 6.2)*—The modeling results described in Paragraph 6(A) showed no meaningful impact on the water source. The proposed dredged material placement operations are protective because of the limited connectivity between the placement areas and PWIs. Placement operations are intermittent; under the worst-case condition, exposure to a plume would occur for up to 20 minutes four times per day on five per year. Exposure to a plume would occur only at the Morgan PWI, but only after hours of settling and dilution such that TSS concentrations would increase by only 15% above background. Additionally, no impacts are predicted from erosion of the

dredged material bed formed by the placement operations. The placement open-lake areas are predicted to be non-dispersive. The effects on contaminant concentrations at the PWIs would also be inconsequential as discussed below in Paragraph 6(C).

C. ***The material dredged from the Cuyahoga River and Cleveland Harbor contains PCB's and PAH's*** *(Section 6.3)*—Additional modeling based conservatively on EqP was employed to predict contaminant contributions at the PWIs from fine-grained materials and organic matter attributable to the open-lake placement of dredged material. A worst-case analysis was performed to calculate the maximum potential increase in contaminant concentrations (both dissolved and total) at Morgan PWI from dredged material placement at nearest point in CLA-4 (the only condition for exposures of interest). The analysis used the maximum predicted TSS contribution from the placement operations and the highest bulk sediment contaminant concentrations normalized to the organic matter/carbon and clay content from any of the three DMMU composites and subsamples, which assumes that all of the contaminants in the dredged material is associated with the organic matter/carbon and clay content. In addition, the analysis assumed that the TSS contribution from the placement operations was composed of only organic matter and clays, which provides the worst-case contaminant contributions at a PWI. All contaminants, except benzo(a)pyrene, were predicted to contribute total and dissolved contaminant concentrations less than 5% of the drinking water criteria. The worst-case predicted increase in total benzo(a)pyrene concentration was 58% of the drinking water criteria while the predicted increase in dissolved benzo(a)pyrene concentration was 29.5% of the drinking water criteria. Considering the conservative nature of this worst-case analysis and the limited exposure duration, the modeling indicates that no meaningful contribution of contaminants from dredged material placement operations at CLA-1 or CLA-4 would be expected at any PWI.

D. ***Open lake disposal presents a scenario in which the dredged material is accidently dumped directly on top of the intake thereby disabling one of the four WTP's*** *(Section 6.4)*—Shipping lanes to the CLA-1 and CLA-4 do not pass within 5000 ft of any of the PWIs. All transport vessels operate with GPS to ensure the proper course is maintained. The vessels also operate with Silent Inspector to track that the vessel path and dump location to ensure compliance with the operating plan. If an accidental discharge were to occur, the dredged material from a single discharge would spread radially to a diameter of about 600 ft and mound to a maximum height of about 12 inches in the center and taper to a thickness of less than one inch at 300 ft from the center. The accumulation would not hamper operation of the PWI because their intakes are at least 7 ft above the sediment bed.

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II. Response to OEPA comments at November 4, 2013 meeting

1. **RECENT NET IMPROVMENTS IN UPPER CUYAHOGA RIVER CHANNEL SEDIMENT QUALITY**. At the November 4 meeting, Mr. Kurt Princic inquired as to the change in the quality of these sediments between 2007 and 2012. This topic is specifically addressed as "Sediment Quality Assessment with Trends over Time" in Section 3.3 of the dredged material evaluation. Note that trend assessment did not specifically address total PAH contamination because total PAHs were not identified as a sediment contaminant of concern (COC) due to no evidence of acute or sublethal toxicity as gauged via the standard bioassays (please see discussion on the technical rationale for biological testing below). For indicator metals, the only increase between 2007 and 2012 on an averaged basis was for OC-normalized lead concentrations, but this increase was not of toxicological significance. On average, a decline or overall uniformity in sediment-associated OC-normalized PCB and DDT concentrations was evidenced between 2007 and 2012. For PAHs on average, an increase in sediment-associated OC-normalized concentrations occurred between 2007 (181 mg/kg-OC) and 2012 (765 mg/kg-OC); however, this increase was not toxicologically significant. With respect to the three biological measurement endpoints (i.e., *H. azteca* survival, and *C. dilutus* survival and growth), the bioassay data show that the toxicity of the sediments has either declined or shown no biologically meaningful increase between 2007 and 2012, and/or 2010 and 2012. This positive change is certainly advantageous to the health of the river and can be used to support beneficial use impairment (BUI) delisting efforts for the Area of Concern (AOC).

2. **DIFFERENCE AMONG 2007 AND 2012 SEDIMENT SAMPLING/TESTING EFFORTS AND DATA INTERPRETATION**. Mr. Princic also inquired at the November 4 meeting as to why the dredge*d* material did not meet Federal guidelines for open-lake placement using the 2007 data, but now meets Federal guidelines using the 2013 data. There are several reasons for that. In 2007, material DMMU-1 in the upper Cuyahoga River Channel showed statistically significant reduced survivals relative to open-lake reference area sediments using standard *H. azteca* and *C.dilutus* bioassays; in 2013, these same bioassays yielded survivals that were not statistically different relative to the open-lake reference area sediments. Note that the survivals of these test species for sediments across all open-lake reference and placement areas used in the 2007 and 2013 sampling events were quite comparable. In 2007, total PCBs and ΣDDT were identified as sediment COCs at Tier 2 of the GLTM) and no bioaccumulation testing was employed at Tier 3; total PCB and ΣDDT bioaccumulation testing was applied in 2013. Just two biological tests were used in 2007 and these were only applied to the DMMU-1 material. In 2013, there were more biological tests applied, the suite of tests was more advanced and this more rigorous testing was expanded to include DMMU-2a and DMMU-2b, as well as DMMU-1. In summary, in comparison to the 2007 testing program, the 2013 effort was much more advanced and was applied to material from additional reaches of the upper Cuyahoga River Channel.

OPERATIONS AND MAINTENANCE

OPEN-LAKE PLACEMENT OF MATERIAL DREDGED FROM CLEVELAND HARBOR FEDERAL NAVIGATION CHANNELS IN THE UPPER CUYAHOGA RIVER

CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

APPENDIX C: COASTAL MANAGEMENT PROGRAM FEDERAL CONSISTENCY DETERMINATION

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207-3199

January 27, 2014

REPLY TO
ATTENTION OF:

Environmental Analysis Section

SUBJECT: Cleveland Harbor, Cuyahoga County, Ohio - Request for Coastal Management Program Federal Consistency Determination Concurrence for 2014 Maintenance Dredging Project

Mr. James Zehringer
Director, Ohio Department of Natural Resources
ATTN: Mr. Karl Gebhardt
Deputy Director
2045 Morse Road
Columbus, OH 43229

Dear Mr. Zehringer:

Enclosed for your review is a request for Coastal Management Program Federal Consistency Determination for our scheduled 2014 maintenance dredging operations at Cleveland Harbor, Ohio. This project involves maintenance dredging an estimated 225,000 cubic yards of sediments from the harbor, with placement of the associated dredged material at either of two new open lake areas and the existing confined disposal facilities (CDFs). An Environmental Assessment pursuant the National Environmental Policy Act (NEPA) will be forthcoming in February 2014 and will be released for public review and comment. The enclosed and previously released Public Notice has been prepared in conformance with U.S. Army Corps of Engineers (USACE) regulation, "Practice and Procedure: Final Rule for Operation and Maintenance of Army Corps of Engineers Civil Works Projects involving the Discharge of Dredged Materials into Waters of the United States or Ocean Waters," 33 Code of Federal Regulations (CFR) 337.1.

The USACE has already requested Water Quality Certification for the subject project from the Ohio Environmental Protection Agency (OEPA), or waiver thereof, under Section 401 of the Clean Water Act.

In accordance with Coastal Zone Management Regulations 15 CFR 930.34(a), the USACE has determined that the proposed maintenance dredging and dredged material placement operations required to maintain the Cleveland Harbor federal navigation channels would be undertaken in a manner which is consistent to the maximum extent practicable with the State of Ohio Coastal Resources Management Program and the Federal Consistency Determination

SUBJECT: Cleveland Harbor, Cuyahoga County, Ohio - Request for Coastal Management Program Federal Consistency Determination Concurrence for 2014 Maintenance Dredging Project

documents this determination. Please advise us regarding your concurrence with this determination by March 20, 2014, if possible.

We have forwarded a copy of this letter to Mr. John Kessler, Division of Real Estate & Land Management, and Mr. Steve Holland, Federal Consistency Coordinator.

If you have any questions pertaining to this matter please contact Mr. Scott Pickard of our Environmental Health Section at (716) 879-4404, by writing to the following address: U.S. Army Corps of Engineers, 1776 Niagara Street, Buffalo, New York 14207-3199, or by e-mail at Scott.W.Pickard@usace.army.mil.

Sincerely,

Martin P. Wargo, PWS
Supervisory Biologist
Environmental Analysis Section

Enclosures

STATE OF OHIO COASTAL MANAGEMENT PROGRAM
FEDERAL CONSISTENCY DETERMINATION

PROJECT NAME: Cleveland Harbor
TYPE OF PROJECT: Operations & Maintenance (Dredging and Dredged Material Placement)
COUNTY: Cuyahoga

1. PROJECT DESCRIPTION

1.1 Cleveland Harbor is located on the south shore of Lake Erie at the mouth of the Cuyahoga River in Cuyahoga County, Ohio within the central basin of Lake Erie. The deep-draft federal navigation channels are maintained by the U.S. Army Corps of Engineers (USACE) in support of commercial and recreational navigation.

1.2 The proposed project will entail the maintenance dredging of sediments from the authorized federal navigation channels of Cleveland Harbor, Cuyahoga County, Ohio. The channels will be dredged to the authorized depth (See Figures 1a and 1b in the Public Notice). To ensure that the minimum depth in the Harbor is maintained throughout the navigation season, an additional four feet of shoal may be removed including one foot of overdepth and three feet of advance maintenance dredging. Approximately 225,000 cubic yards of sediments will be dredged from the harbor in 2014 (minimum degradation alternative). Dredged material placement will occur in the open lake and confined disposal facilities (CDFs) (See Figures 3 and 4 in the Public Notice). In the Spring of 2012, a comprehensive sediment testing effort was conducted on sediments sampled from the upper reach of the Cuyahoga River Channel, between Stations 799+00 (upstream Federal navigation channel limit) and 736+00 (Turning Basin), to evaluate suitability of the dredged material for open-lake placement. This reach of the upper Cuyahoga River Channel was subdivided into dredged material management units (DMMUs) DMMU-1, DMMU-2a and DMMU-2b (see Figure 2 in the Public Notice). The sediments analyzed represent approximately 80 percent of the material dredged from Cleveland Harbor on an annual basis. The subsequent evaluation completed in 2013 was conducted in accordance with the protocols and guidelines contained in the U.S. Environmental Protection Agency (USEPA)/USACE Great Lakes Dredged Material Testing and Evaluation Manual (1998) and Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.—Testing Manual (1998). The evaluation concludes that discharge of the material in the open lake would not culminate in contaminant-related, unacceptable adverse impacts to the aquatic ecosystem. Therefore, it has been determined that this dredged material meets federal "contaminant determination" guidelines (40 CFR 210.11[d]) for open-lake placement. Placement of the suitable dredged material is proposed at open lake areas #1 and #4 (see Figure 3 in the Public Notice). The remaining material to be dredged from the harbor has not yet been determined to meet federal guidelines for open-lake placement, and will therefore be placed in either confined disposal facility (CDF) No. 9 or 10B, both of which are located in the Cleveland Outer Harbor (Figure 4 in the Public Notice). The dredging is scheduled to occur between 1 May

and 30 December 2014. The project will be accomplished by a contractor of the federal government.

2. EVALUATION

2.1 The USACE - Buffalo District has analyzed the proposed action with respect to the 41 management policies presented in Chapter 5 of the April 2007 State of Ohio Coastal Management Program and Final Environmental Impact Statement. The following policy statements have been determined to be applicable to the proposed action:

2.1.1 **Policy 6—Water Quality** *[It is the policy of the State of Ohio to maintain and improve the quality of the State's coastal waters for the purpose of protecting the public health and welfare and to enable the use of such waters for public water supply, industrial and agricultural needs, and propagation of fish, aquatic life and wildlife by:*

I. Assuring attainment of State water quality standards and other water quality related requirements (O.A.C. 3745-1) through:

Enclosure 2

a. controlling discharges into waters of the State by requiring permits to construct facilities and by establishing and enforcing effluent limitations under the National Pollutant Discharge Elimination System (NPDES, §402 CWA, O.R.C. §6111.03);

b. administering a permit system to control injection well drilling in compliance with the SDWA and CWA (O.R.C. §6111.043 and 6111.044);

c. regulating discharge of dredged or fill material into surface waters including wetlands in accordance with Section 401 of the CWA (O.R.C. §6111.03);

d. establishing uniform regulations regarding solid waste disposal sites and facilities (O.R.C. §3734.02 and 3734.05);

e. prohibiting the sale or distribution for sale of phosphorous containing household laundry detergents in the Lake Erie Basin (O.R.C. §6111.10);

f. preparing a State water quality management plan to assess technical needs for pollution control and institutional mechanisms to enforce controls (O.R.C. §6111.41 and 6111.42); and

g. administering a State revolving loan fund program to provide financial assistance for publicly owned wastewater treatment facilities (O.R.C. §6111.02 and 6111.03).

II. Coordinating, through the Lake Erie Commission, State and local policies and programs pertaining to Lake Erie water quality; reviewing, and making recommendations concerning, the development and implementation of policies, programs and issues for long-term, comprehensive protection of Lake Erie water resources and water quality that are consistent with the Great lakes Water Quality Agreement and Great Lakes Toxic Substances Control Agreement (O.R.C. §1506.21).

III. Using the Lake Erie Protection Fund (LEPF) to establish a firm scientific base for implementing a basin-wide system of water quality management for Lake Erie and its tributaries; supporting research to improve the scientific knowledge on which Lake Erie aquatic resource protection policies are based (O.R.C. §1506.23).]

The material that would be dredged under this alternative consists of sediments that have been deposited in the federal navigation channels since the last maintenance dredging effort.
With respect to the placement of dredged material in the CDFs and associated return water, the sediments to be dredged are homogenous and residually contaminated with pollutants that are ubiquitous throughout the Great Lakes. As such, these sediments, although not virgin material with high levels of pollutants, contain levels of contaminants that may be elevated or are more bioavailable in relation to Lake Erie background contaminants, and should be confined from the aquatic environment after dredging. This alternative would result in a short-term, localized, and negligible lowering of ambient water quality. The main water quality impact would be negligible turbidity associated with CDF return water. Dredging and open-lake placement activities would result in excavation (dredging only), smothering, and mortality of benthic macroinvertebrates, and possibly the temporary avoidance of work areas during the dredging operation by some fish and wildlife species (i.e., mostly waterfowl). Following dredging and placement activities, benthic communities are expected to rapidly recolonize the impacted areas, and fish and wildlife would return. The dredging area is industrialized, so benthic, fish and wildlife use of the water resource is limited; therefore, impacts in this regard would be minor. No impacts to any listed Threatened or Endangered Species would occur from dredging or the placement of dredged material.

During the course of the dredging and dredged material placement operation, varying degrees of sediments would be re-suspended. The generation of turbidity and variation in dissolved oxygen levels in the water column would be the primary physical effects associated with these activities. These impacts should be minor, temporary and localized.

Section 401 Water Quality Certification (WQC) has been requested from the Ohio Environmental Protection Agency (OEPA) for the discharge of return water from the CDFs and the discharge of dredged material into the open-lake area.

2.1.2 **Policy 9 - Potable Water Supply** *[It is the policy of the State of Ohio to ensure that a safe supply of water is available for private, community, industrial, agricultural and commercial uses along Lake Erie by:*

a. administering the State Safe Drinking Water Act (O.R.C. Chapter 6109);

b. supervising the design, construction, and operation of public water supply treatment and distribution systems (O.R.C. 6109.07); and

c. regulating private water systems (O.R.C. §3701.344, O.A.C. 3701-28).]

Modeling was completed by the USAERDC in 2013 to address the potential transport of total suspended solids (TSS) and dissolved constituents from the dredged material to the Crown, Morgan, Baldwin and Nottingham PWIs. TSS and dissolved constituents are detrimental to water treatment, and can increase costs and impair finished drinking water quality. Dissolved organic constituents increase the required disinfectant dosages and the formation of harmful disinfection by-products. Modeling showed that solids and dissolved constituents losses resulting from dredged material placement at these two areas are not expected to have any significant impact on water column TSS concentrations at these PWIs. Under the worst-case scenario modeled for CLA-4, TSS contributions of up to 1 mg/L from dredged material placement would occur at the Morgan PWI only about 1% of the time during annual placement operations lasting up to eight weeks. During this time period, water column TSS would increase

less than 15% from 8 mg/L (background) to 9 mg/L. During these same time periods, TOC at the Morgan PWI is predicted to increase less than 5% and the dissolved organic content is predicted to increase less than 2%. No measurable TSS contributions are expected to occur at any of the other PWIs. Similarly, no measureable TSS contributions are expected to occur at any of the four PWIs from dredged material placement operations at CLA-1.

Note that the hydrodynamic data used for this modeling represents currents that could potentially occur in May. Stronger currents tend to occur in April and could occur in May as well. It is estimated that stronger currents typical in April might increase background concentrations by approximately 30 percent. Nevertheless, TSS contributions from dredged material placement would still be expected to be around 20 percent above background and would occur with similar frequency. Additional modeling was employed to ascertain dissolved contaminant contributions at the PWIs from fine-grained and organic matter attributable to the open-lake placement of this dredged material. As a worst-case scenario, this effort used the maximum increased water column TSS concentration that may occur at the Morgan PWI from placement of dredged material at CLA-4, along with the highest measured, normalized bulk contaminant concentrations associated with fine-grained and organic matter. All calculated dissolved phase contaminant concentrations were below National Primary Drinking Water Regulation Maximum Contaminant Levels (MCLs) and Drinking Water Standards for Ohio Public Water Systems. The very conservative approach used in these modeling efforts indicate that no meaningful contribution of suspended solids, dissolved constituents or contaminants from dredged material placement operations at CLA-1 and CLA-4 would be expected at any PWI.

2.1.3 **Policy 17—Dredging and Dredged Material Disposal** *[It is the policy of the State of Ohio to provide for the dredging of harbors, river channels and other waterways and to protect the water quality, public right to navigation, recreation and natural resources associated with these waters in the disposal of the dredged material by:*

> *a. regulating, through the Ohio Environmental Protection Agency water quality certification, the discharge or disposal of dredged material (O.R.C. §6111.03[p] and O.A.C. 3745-1);*
>
> *b. requiring a lease for State-administered submerged lands through the Department of Natural Resources before initiating the confined disposal of dredged material in the waters or on lands underlying the waters of Lake Erie (O.R.C. §1506.11);*
>
> *c. regulating commercial dredging of mineral resources (O.R.C. §1505.07 and O.R.C. §1505.99); and*
>
> *d. coordinating interdisciplinary reviews of dredging projects at Ohio's Lake Erie ports and providing technical and funding assistance to help select and implement environmentally sound dredging and dredged sediment management practices.]*

A 401 Water Quality Certification was submitted to Ohio EPA on November 27, 2013. Included with this application was a *Cleveland Harbor (Upper Cuyahoga River Channel) Dredged Material Evaluation – 2013* which evaluated the suitability of this sediment for unconfined open lake placement. Additional information with respect to this evaluation was provided to OEPA on December 20, 2013.

Mechanical equipment would be used to dredge and discharge the upper Cuyahoga River

Channel material at open-lake areas #1 and #4. The placement of material dredged from DMMU-2a and DMMU-2b would be spatially limited to a one-square mile area within open-lake areas #1 and #4. The placement of material dredged from DMMU-1 would be spatially limited to a one square mile area within open-lake area #1 and two-third square mile area within open-lake area #4. Dredging would not be performed during Lake Erie storm events. Care would be employed throughout the course of the dredging/placement operations to avoid the creation of unnecessary turbidity that may degrade water quality or adversely affect aquatic life outside the project area.

2.1.4 **Policy 19—Lake Erie Ports** *[It is the policy of the State of Ohio to promote and provide for maritime commerce and related economic development along the Lake Erie shore by:*

a. providing assistance to, and assisting in the procurement of Federal funds for port development activities for local governments and port authorities that have the powers to plan, improve, acquire, enlarge, operate, maintain and finance port activities and projects; and

b. encouraging the development of comprehensive port facility and expansion master plans and improvement projects through financial assistance from the Ohio Department of Transportation.]

The proposed maintenance dredging would be consistent with the promotion of maritime commerce and related economic development at Cleveland Harbor.

2.1.5 **Policy 23 - Recreational Boating** *[It is the policy of the State of Ohio to satisfy and serve the public interest for recreational boating opportunities and watercraft safety in the coastal area by:*

a. regulating safety of watercraft by enforcing watercraft laws (O.R.C. Chapter 1547);

b. conducting a watercraft safety and education program (O.R.C. 1547.52 and 1547.521);

c. developing and operating boat facilities at State-owned areas along Lake Erie;

d. assisting in the planning and development of local government operated marinas and boat launching areas under Ohio Department of Natural Resources' Community Watercraft Assistance and the Lake Erie Access Program; and

e. participating jointly with the U.S. Army Corps of Engineers and local coastal area governments in completing the Ohio Lake Erie refuge harbor system (O.R.C. 1547.71).]

The proposed dredging and sediment management activities may temporarily interfere with some recreational vessel traffic in/around Cleveland Harbor. The work would be accomplished by a contractor of the federal government who would be required to comply with all U.S. Coast Guard safety and navigation requirements. Accomplishment of the dredging operation would allow for the continued safe commercial navigation of Cleveland Harbor federal channels and facilitate its continued availability as a Ohio Lake Erie refuge harbor.

2.1.6 **Policy 26—Preservation of Cultural Resources** *[It is the policy of the State of Ohio to provide for the preservation of cultural resources to ensure that the knowledge of Ohio's history and pre-history is made available to the public and is not willfully or unnecessarily destroyed or lost, by:*

a. protection of cultural resources on or eligible for State and National registers of historic places (O.R.C. §149.51 through 149.55);

b. regulating recovery of submerged abandoned property through permits (O.R.C. §1506.32);

c. establishing and enforcing Lake Erie submerged lands preserves (O.R.C. §1506.31).]

There are no registered historic properties listed in or eligible for listing the National Register of Historic Places that will be affected by this project. Since the dredging and most of the dredged material management areas would be limited to those areas which have been historically impacted by these activities (except open lake area #4), the likelihood of encountering unknown cultural resources is low. In the event that unrecorded historic or archaeological remains are encountered during the course of the dredging operations, the State Historic Preservation Office (SHPO) will be duly notified and appropriate measures will be taken to preserve their integrity. National Environmental Policy Act scoping and a Clean Water Act Section 404 public notice have already been provided to the Ohio SHPO in August and December of 2013, respectively, and a Project Summary Form is being submitted. To date there has been no response from Ohio SHPO regarding this project.

2.1.7 **Policy 27—Fisheries Management** *[It is the policy of the State of Ohio to assure the continual enjoyment of the benefits received from the fisheries of lake Erie and to maintain and improve these fisheries by:*

a. regulating the taking of fish (O.R.C. §1531.08 and O.A.C. 1501.31);

b. prosecuting persons responsible for stream litter and for water pollution resulting in fish kills (O.R.C. §1531.29 and 1531.02);

c. protecting fish habitat through Ohio EPA's Section 401 water quality certification authority (O.R.C. §6111.03[o] and 6111.03[p] and O.A.C. 3745-1 and 3745-32);

d. considering the protection of fish habitat through the review of State and Federal permit applications;

e. establishing State wildlife areas for fish and wildlife habitat (O.R.C. §1531.06);

f. surveying fish populations and trends and conducting other fishery research studies;

g. providing access to the fishery; and

h. providing technical and general information about the Lake Erie fisheries.]

Dredging and dredged material placement activities would cause temporary and localized disturbance to local fish communities that would be unavoidable. Some fish may tend to avoid the area during the dredging and dredged material placement operations, but would return quickly after the activities cease. Some fish may also be attracted to the dredging-related activities for foraging reasons. Any adverse impacts would be temporary and localized. Major factors that may influence the response of fish to these activities would be turbidity, dissolved oxygen levels and benthic organisms suspended in the water column.

2.1.8 **Policy 29—Wildlife Management** *[It is the policy of the State of Ohio to provide for the management of wildlife in the coastal area to assure the continued enjoyment of benefits received from wildlife by:*

a. protecting all wildlife including nongame and endangered species (O.R.C. §1531.02, 1531.08 and

1531.25);

b. regulating the taking of wildlife (O.R.C. Chapter 1533 and O.A.C. 1501:31);

c. establishing State wildlife areas and providing recreation opportunities;

d. providing food, cover and habitat for wildlife; and

e. providing non-game wildlife research and education funding.]

There could be a short-term avoidance or attraction to the dredging operations by aquatic avifauna such as gulls, terns and waterfowl. There would be no measureable effect on populations of migratory birds.

Based on the review of available environmental data, we have determined that the proposed work will not affect any species proposed or listed by the U.S. Fish & Wildlife Service or ODNR as threatened or endangered, nor will it affect the designated critical habitat of any such species.

2.1.9 **Policy 33—Visual and Aesthetic Quality** *[It is the policy of the State of Ohio to protect the visual and aesthetic amenities of Lake Erie and its shoreline to enhance the recreational, economic, cultural and environmental values inherently associated with the coastal area by:*

a. prohibiting the dumping of litter and refuse into or along the waters of Lake Erie and its tributaries, and maintaining law enforcement activities to apprehend violators (O.R.C. §1531.29 and 3767.32);

b. enforcing State water quality standards (O.R.C. Chapter 6111, O.A.C. 3745-1-04);

c. preserving aesthetic resource areas of Statewide significance through the nature preserve, park development and historic preservation programs.]

The discharges of dredged material would comply with State WQSs. The presence of dredging equipment, impacts on water quality such as turbidity and reductions in water clarity, and air emissions may detract from the aesthetic quality of the project areas. Such impacts would be minor, localized and short-term. The aesthetic quality of the area would return to pre-project conditions shortly after completion of the dredging-related activities.

3. CONCLUSION

In accordance with Coastal Zone Management Regulations 15 CFR 930.34(a), the USACE has determined that the proposed maintenance dredging and placement operations required to maintain Cleveland Harbor Federal navigation channels would be undertaken in a manner which is consistent to the maximum extent practicable with the State of Ohio Coastal Management Program.

OPERATIONS AND MAINTENANCE

OPEN-LAKE PLACEMENT OF MATERIAL DREDGED FROM CLEVELAND HARBOR FEDERAL NAVIGATION CHANNELS IN THE UPPER CUYAHOGA RIVER

CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

APPENDIX D:

- **USACE SCOPING INFORMATION PACKET (SIP); AUGUST 14, 2013**
- **COMMENTS RECEIVED ON SIP**
- **USACE SECTION 404(A) PUBLIC NOTICE (PN); DECEMBER 2, 2013**
- **COMMENTS RECEIVED ON PN**

OPERATIONS AND MAINTENANCE

OPEN-LAKE PLACEMENT OF MATERIAL DREDGED FROM CLEVELAND HARBOR FEDERAL NAVIGATION CHANNELS IN THE UPPER CUYAHOGA RIVER

CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

• USACE SCOPING INFORMATION PACKET (SIP); AUGUST 14, 2013

US Army Corps of Engineers®
Buffalo District

SCOPING INFORMATION PACKET

Open Lake Placement of Dredged Material

Cleveland Harbor Operations & Maintenance Navigation Dredging

Cuyahoga County, Ohio

August 14, 2013
Comments accepted until September 14, 2013

U.S. Army Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, New York 14207-3199

CONTENTS

SECTION		PAGE
1.0	Introduction	1
2.0	Background	2
3.0	Need for Action and Study Overview	3
4.0	Proposed Alternatives	4
5.0	Environmental Impacts	4
6.0	Public Participation and Interagency Coordination	5
7.0	Compliance with Environmental Protection Statutes	5
8.0	Point of Contact	6
9.0	Federal Environmental Protection Laws, Executive Orders, Policies	7

FIGURES

Figure 1	Location of Cleveland, Ohio	2
Figure 2	Cleveland Harbor Map	9
Figure 3	Cleveland Harbor Upper River Sample locations and DMMU boundaries	10
Figure 4	Locations considered for open-lake placement	11

1. Introduction

Implementation of the National Environmental Policy Act (NEPA) requires that Federal agencies initiate "an early and open process for determining the scope of issues to be addressed and for identifying any significant issues related to the proposed action." The purpose of this scoping is to disseminate information regarding the U.S. Army Corps of Engineers (USACE) proposal to discharge suitable dredged sediment from the Cleveland Harbor Federal navigation channels into an unconfined, deep-water open lake placement area in Lake Erie, and to elicit comments from the general public and interested parties. This information has been prepared as part of the formal scoping process pursuant to NEPA and the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR Part 1500 et seq.).

Cleveland Harbor is located on Lake Erie at the mouth of the Cuyahoga River. The harbor is 191 miles southwest of Buffalo, New York and 110 miles east of Toledo, Ohio (Figure 1). The harbor is approximately 1,300 acres in size. It is five miles long and varies in width between 1,600 to 2,400 feet. The harbor is protected by a breakwater system: an east breakwater (20,970 feet long), a west breakwater (6,048 feet long), and the east and west arrowhead breakwaters (each measuring 1,250 feet) (Figure 2). Authorized depths for maintenance dredging in this area range from 25 to 28 feet below Low Water Datum (LWD). The east and west arrowhead breakwaters protect the Lake Approach Channel which has an authorized depth of 29 feet below LWD. The Entrance Channel varies in width from 220 to 750 feet and is maintained at an authorized depth of 28 feet below LWD to the mouth of the Cuyahoga River. The lower Cuyahoga River channel, from the lakeward side of the piers to immediately above the Old River confluence, is maintained to an authorized depth of 27 feet below LWD. The upper Cuyahoga River channel and turning basin are maintained to an authorized depth of 23 feet and 18 feet below LWD, respectively.

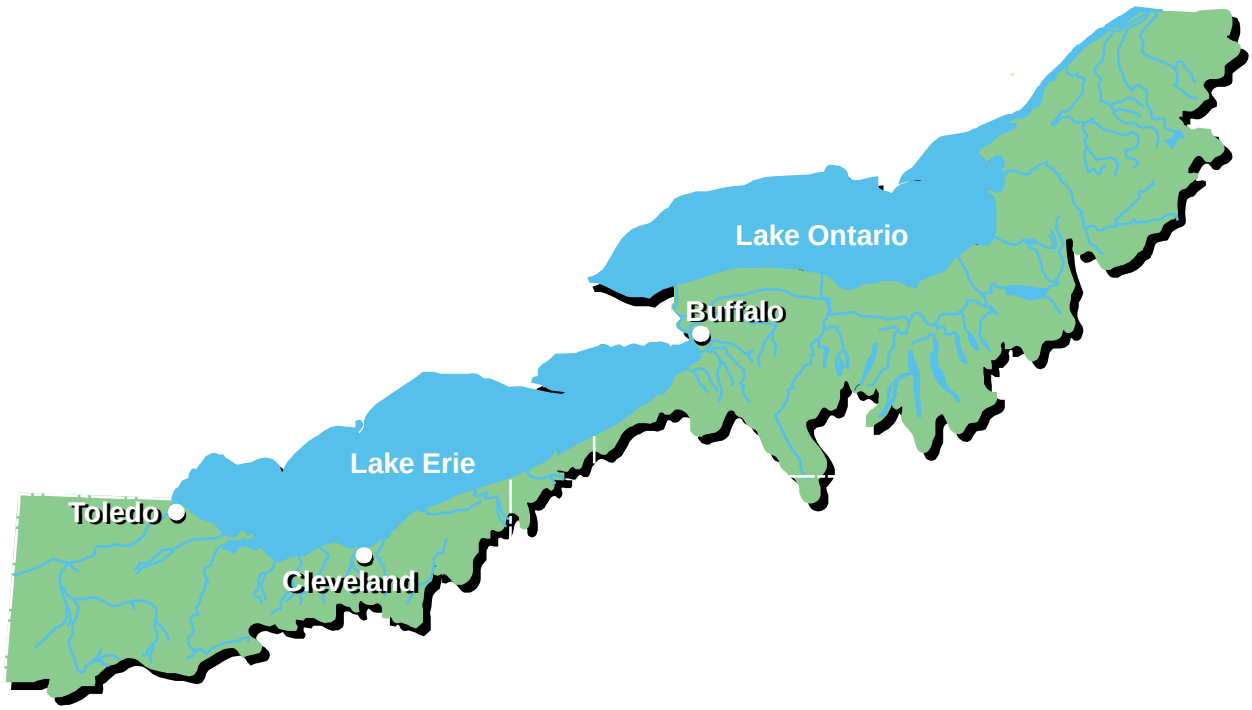

Figure 1: Location of Cleveland Harbor, Ohio

2. Background

Cleveland Harbor requires maintenance dredging on an annual basis to facilitate commercial, deep-draft navigation. Dredging of the harbor's Federal navigation channels is usually conducted twice per year – in the Spring and Fall. Since 2006, maintenance dredging of the harbor has been accomplished by removing less than 225,000 cubic yards (CY) annually from the Federal navigation channels. Approximately 80 percent of the sediment dredged each year is from the upper reach of the Cuyahoga River channel between the upstream limit and uppermost turning basin. The quantity of material annually dredged from this reach is approximately 180,000 CY. All dredged sediment from Cleveland Harbor Federal navigation channels is currently placed into a confined disposal facility (CDF). Since the 1960's, five CDFs have been constructed and utilized at Cleveland Harbor (i.e., 9, 10B, 12, 13, and 14). The design capacities for hydraulic placement in the currently used CDFs (9 and 10B) will effectively be reached after 2014 dredging.

Data on sediments within the upper Cuyahoga River channel are routinely sampled and analyzed at periodic intervals to assess the sediment conditions and suitability of dredged material management practices. The 2007 and 2010 sampling events evidenced an overall net improvement in quality. Notable improvements in sediment quality in Great Lakes tributaries is becoming common, and is largely the result of decades of point and non-point source water pollution regulation, and remediation of contaminant sources. Under a five-year routine periodic operation and maintenance sediment sampling and analysis regime, data generated from a 2012 sampling event were evaluated by the USACE to determine whether the sediment dredged from this reach of the harbor meets Federal guidelines for open-lake placement. Because of the earlier evidenced improvement in sediment quality, some more advanced testing/evaluation procedures

were applied in 2012 to enable a more comprehensive and accurate evaluation of the dredged material.

3. Need for Action and Study Overview

The USACE is responsible for determining the dredged sediment management plan which represents the least costly alternative, consistent with sound engineering practices and in compliance with Clean Water Act Section 404(b)(1) guidelines. The current re-assessment of the alternatives that are available is particularly critical at this time due to severely diminished CDF capacities and the significant cost of constructing additional space in existing or new facilities. To focus efforts on those harbor areas where most sedimentation occurs and where most maintenance dredging is needed, the upper 1.2 miles of Cuyahoga River channel was divided into three dredged material management units (DMMU) shown as DMMU-1, DMMU-2a and DMMU-2b (Figure 3). Sediments from these DMMUs and two deep-water potential open-lake areas for the placement of dredged material were sampled in 2012 and subjected to a suite of tests (Figure 4). Testing included bulk sediment physical and chemical analyses (e.g., metals, phosphorus and organic contaminants), elutriate testing, standard sediment and elutriate bioassays, and sediment bioaccumulation testing for PCBs, DDT and DDE. Data generated from this effort were used to evaluate whether the dredged sediment meets Federal guidelines for open-lake placement.

Aquatic habitats at the two potential open-lake placement areas are similar and consist primarily of warmwater, mud-bottom, benthic substrate with overlying water column. The bottom sediments are colonized by benthic invertebrate communities common throughout deeper-water Lake Erie. The water column at these areas is used by most fish, nekton and plankton on a transient basis as required for foraging and migration. Aquatic birds use the water surface and water column for resting and foraging.

To determine whether sediment dredged from DMMU-1, DMMU-2a and DMMU-2b meets Federal guidelines for open-lake placement with respect to contaminant-related impacts, relevant contaminant pathways were examined to evaluate fate, exposure and risks. Contaminant exposure pathways primarily include toxicity and uptake (including bioaccumulation) from sediments to benthic invertebrates and fish, and the release of contaminants from the sediments to the water column and associated uptake and toxicity to invertebrates and fish. Testing and evaluation showed that contamination and toxicity associated with the dredged material was either comparable to open-lake placement area sediments and/or placement in the open-lake would not represent any appreciable increased toxicological risk to the affected aquatic ecosystems. With respect to the potential influence of open-lake placement operations on water quality at the potable water intakes (PWIs) shown on Figure 4, preliminary modeling indicates either no or extremely minor short-term impacts at area #4.

Sediment from Cleveland Harbor Federal navigation channels would be mechanically dredged using a clamshell bucket, and would be placed into a scow for transport and discharge at a designated open-lake area(s). During discharge, dredged material is released from the scow and descends through the water column until it hits the bottom substrate, than collapses and spreads out before coming to rest on the lake bottom. Based on recent studies and site-specific modeling,

water column turbidity generated via dredged material discharge at the open lake areas would be both short-term and localized. In terms of movement, the placed dredged material would behave in a manner similar to the adjacent and surrounding lake bottom sediments; deeper depths of the open-lake placement areas would serve to allay the potential for sediment erosion, resuspension and movement. However, some of the dredged material could migrate from the areas under severe storm conditions.

4. Proposed Alternatives

Alternative 1 (No Action): Under this alternative, the Federal Government would not select an open-lake placement site in Lake Erie.

Alternative 2: Under this alternative, the Federal Government would place dredged material that meets Federal guidelines for open-lake placement at open-lake area #1 (Figure 4).

Alternative 3: Under this alternative, the Federal Government would place dredged material that meets Federal guidelines for open-lake placement at open-lake area #4, which is the preferred disposal location (Figure 4).

Open-lake area #4 is preferred over area #1 because it is closer to the harbor. This location will provide decreased transportation costs and reduce safety concerns associated with transporting barges through potentially rough lake waters during spring and late fall conditions when dredging occurs.

5. Environmental Impacts

Future conditions with the no-action alternative, as well as potential impacts associated with the proposed action and alternatives, will be assessed for several social, economic, and environmental categories including:

• Biological Resources	• Solid Waste Management
• Recreation	• Contaminated Materials
• Cultural Resources	• Air Quality
• Socioeconomics	• Noise
• Transportation	• Aesthetics
• Geology and Soils	• Health and Safety
• Water Resources	• Environmental Justice

6. Public Participation and Interagency Coordination

Throughout the scoping process, stakeholders and interested parties are invited to provide comment on the alternatives that will be considered in this Cleveland Harbor dredged material open lake placement evaluation. An Environmental Assessment will be completed which will evaluate the potential social, economic, and environmental effects that may be expected from each alternative.

7. Compliance with Environmental Protection Statutes

a. National Environmental Policy Act (NEPA). In accordance with CEQ "Regulations for Implementing the Procedural Provisions of the NEPA of 1969" (40 CFR 1500-1508) and "Procedures for Implementing NEPA" (Engineer Regulation 200-2-2), the USACE will assess the potential environmental effects of the project alternatives on the quality of the human environment. Using a systematic and interdisciplinary approach, an assessment will be made of the potential environmental impacts for each plan as determined by comparing the "with-project" and "without-project" conditions. The Environmental Assessment process will determine if an Environmental Impact Statement is required, or if an Environmental Assessment and Finding of No Significant Impact (FONSI) is appropriate.

b. Clean Water Act. The project will be evaluated in accordance with the guidelines promulgated by the Administrator of the U.S. Environmental Protection Agency in conjunction with the Secretary of the Army under the authority of Section 404(b)(1) of the Act. A Section 404(a) Public Notice will be issued and the general public and any party that may be significantly impacted by the project will be afforded the opportunity to request a public hearing. Under Section 401 of the Act, water quality certification will be requested from the Ohio Environmental Protection Agency to establish whether the proposed discharge of dredged material is complies with applicable Ohio water quality standards.

c. National Historic Preservation Act. Under Section 106 of this Act, this Scoping Information initiates USACE consultation with the National Park Service, the Ohio Historic Preservation Office, interested Indian Nations, historic preservation organizations, and others likely to have knowledge of, or concern with, historic properties that may be present within the area of potential effect. The Area of Potential Effect (APE) for this proposed project consists of the two, two-square mile potential dredged material open lake placement areas shown in Figure 4. Based on available information and a side-scan sonar that was completed at the preferred placement location, the USACE does not believe there to be any cultural or archaeological resources listed or eligible for listing on the National Register of Historic Places within the APE. A Section 106 Review Project Summary Form will be sent under separate cover and will additionally initiate consultation with the Ohio State Historic Preservation Office.

d. Coastal Zone Management Act. This Act requires that Federal actions reasonably likely to affect any land or water use or natural resource of the coastal zone, regardless of location, be consistent with approved state coastal management programs. A Federal consistency determination will be submitted to the Ohio Department of Natural Resources (ODNR), Office of Coastal Management for their concurrence.

e. Endangered Species Act. In accordance with Section 7 of this Act, the USACE is requesting information from the U.S. Fish and Wildlife Service (USFWS) on any listed or proposed species, or designated or proposed critical habitat that may be present in the project area. If this consultation with USFWS identifies any such species or critical habitat, then the USACE will conduct a biological assessment to determine the proposed project's effect on these species or critical habitat.

f. Fish and Wildlife Coordination Act. The USACE is coordinating this study with the Reynoldsburg Field Office of the USFWS. The USACE will collaborate with the USFWS to identify any fish and wildlife concerns, identify relevant information on the study area, obtain their views concerning the significance of fish and wildlife resources and anticipated project impacts, and identify those resources which need to be evaluated in the study. Full consideration will be given to their comments and recommendations resulting from this coordination.

g. Other Coordination Requirements. In addition to the aforementioned Federal statutes, the proposed project must also comply with any other applicable and relevant Federal laws from the comprehensive list below. Therefore, an additional intent of this scoping information packet is to disseminate pertinent project information to meet the applicable coordination/consultation requirements required under their provisions.

The purpose of this scoping process is to provide an opportunity for the public and governmental agencies to comment on and provide input to help identify issues related to the proposed project to be addressed in the Environmental Assessment. If, after this evaluation, it is concluded that the proposed project would have no significant environmental impacts and an Environmental Impact Statement is not required, the District Commander will sign a FONSI.

8. Point of Contact

Comments and input about the issues and studies for the proposed project will be accepted **30 days from the date of this scoping document** and should be sent to:

U.S. Army Corps of Engineers, Buffalo District
Environmental Analysis Team – Cleveland Open Lake
1776 Niagara Street
Buffalo, NY 14207-3199

Telephone No.: 800-833-6390 (option #3)
Fax No.: 716-879-4225
E-mail: ClevelandOpenLake@usace.army.mil

9. Federal Environmental Protection Laws, Executive Orders, and Policies.

1. PUBLIC LAWS

a. American Folklife Preservation Act, P.L. 94-201; 20 U.S.C. 2101, *et seq.*
b. American Indian Religious Freedom Act, P.L. 95-341, 42 U.S.C. 1996, *et seq.*
c. Anadromous Fish Conservation Act, P.L. 89-304; 16 U.S.C. 757, *et seq.*
d. Antiquities Act of 1906, P.L. 59-209; 16 U.S.C. 431, *et seq.*
e. Archaeological and Historic Preservation Act, P.L. 93-291; 16 U.S.C. 469, *et seq.* (Also known as the Reservoir Salvage Act of 1960, as amended; P.L. 93-291, as amended; the Moss-Bennett Act; and the Preservation of Historic and Archaeological Data Act of 1974.)
f. Archaeological Resources Protection Act, P.L. 96-95 as amended, 16 U.S.C. 470aa, *et seq*.
g. Bald Eagle Protection Act; 16 U.S.C. 668.
h. Clean Air Act, as amended; P.L. 91-604; 42 U.S.C. 1857h-7, *et seq*.
i. Clean Water Act, P.L. 92-500; 33 U.S.C. 1251, *et seq*. (Also known as the Federal Water Pollution Control Act; and P.L. 92-500, as amended.)
j. Coastal Zone Management Act of 1972, as amended, P.L. 92-583; 16 U.S.C. 1451, *et seq*.
k. Comprehensive Environmental Response, Compensation, and Liability Act, P.L. 96-510, 42 U.S.C. 9601, *et seq*.
l. Endangered Species Act of 1973, as amended, P.L. 93-205; 16 U.S.C. 1531, *et seq*.
m. Energy Independence and Security Act, P.L. 110-140, 42 **U.S.C**. 15821, *et seq*.
n. Energy Policy Act, P.L. 109-58, 42 **USC** 13201, *et seq*.
o. Estuary Protection Act, P.L. 90-454; 16 U.S.C. 1221, *et seq*.
p. Farmland Protection Policy Act, P.L. 97-98, 7 U.S.C. 4201, *et seq*.
q. Federal Environmental Pesticide Control Act, P.L. 92-516; 7 U.S.C. 136.
r. Federal Water Project Recreation Act, as amended, P.L. 89-72; 16 U.S.C. 460-1(12), *et seq*.
s. Fish and Wildlife Coordination Act of 1958, as amended, P.L. 85-624; 16 U.S.C. 661, *et seq*.
t. Historic Sites Act of 1935, as amended, P.L. 74-292; 16 U.S.C. 461, *et seq*.
u. Land and Water Conservation Fund Act, P.L. 88-578; 16 U.S.C. 460/-460/-11, *et seq*.
v. Migratory Bird Conservation Act of 1928; 16 U.S.C. 715.
w. Migratory Bird Treaty Act of 1918; 16 U.S.C. 703, *et seq*.
x. National Environmental Policy Act of 1969, as amended, P.L. 91-190; 42 U.S.C. 4321, *et seq*.
y. National Historic Preservation Act of 1966, as amended, P.L. 89-655; 16 U.S.C. 470a, *et seq*.
z. Native American Graves Protection and Repatriation Act, P.L. 101-601, 25 U.S.C. 3001, *et seq*.
aa. Native American Religious Freedom Act, P.L. 95-341; 42 U.S.C. 1996, *et seq*.
bb. Noise Control Act, P.L. 92-574, 42 U.S.C. 4901, *et seq*.
cc. Resource Conservation and Recovery Act of 1976, P.L. 94-580; 7 U.S.C. 1010, *et seq*.
dd. River and Harbor Act of 1899, 33 U.S.C. 403, *et seq.* (also known as the Refuse Act of 1899)
ee. Toxic Substances Control Act, P.L. 94-469; 15 U.S.C. 2601, *et seq.*
ff. Watershed Protection and Flood Prevention Act, as amended, P.L. 83-566; 16 U.S.C. 1001, *et seq.*
gg. Wild and Scenic Rivers Act, as amended, P.L. 90-542; 16 U.S.C. 1271, *et seq.*

2. EXECUTIVE ORDERS

a. Executive Order 11593, *Protection and Enhancement of the Cultural Environment*, May 13, 1979
b. Executive Order 11988, *Floodplain Management*, May 24, 1977
c. Executive Order 11990, *Protection of Wetlands*, May 24, 1977
d. Executive Order 11514, *Protection and Enhancement of Environmental Quality*, March 5, 1970, as amended by Executive Order 11991, May 24, 1977
e. Executive Order 12088, *Federal Compliance with Pollution Control Standards*, October 13, 1978
f. Executive Order 12372, *Intergovernmental Review of Federal Programs*, July 14, 1982
g. Executive Order 12580, *Superfund Implementation*, January 23, 1987
h. Executive Order 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements*, August 3, 1993
i. Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, February 11, 1994
j. Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, April 21, 1997
k. Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, January 10, 2001
l. Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, January 24, 2007

m. Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, October 5, 2009

3. OTHER FEDERAL POLICIES

a. Council on Environmental Quality Memorandum of August 11, 1980: Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act
b. Council on Environmental Quality Memorandum of August 10, 1980: Interagency Consultation to Avoid or Mitigate Adverse Effects on Rivers in the National Inventory Migratory Bird Treaties and other international agreements listed in the Endangered Species Act of 1973, as amended, Section 2(a)(4)

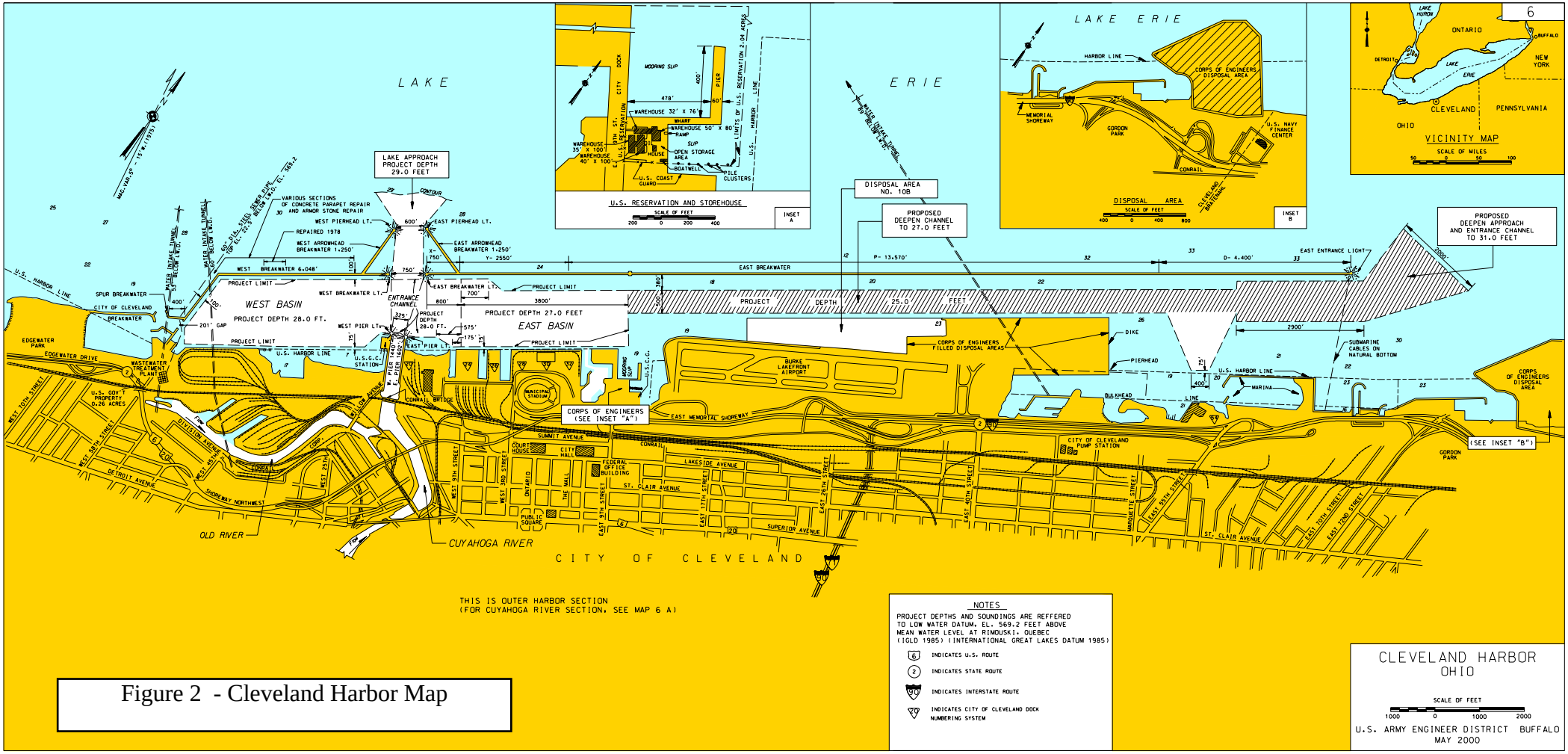

Figure 2 - Cleveland Harbor Map

Figure 3:Upper Cuyahoga River Sample Locations and DMMU Boundaries

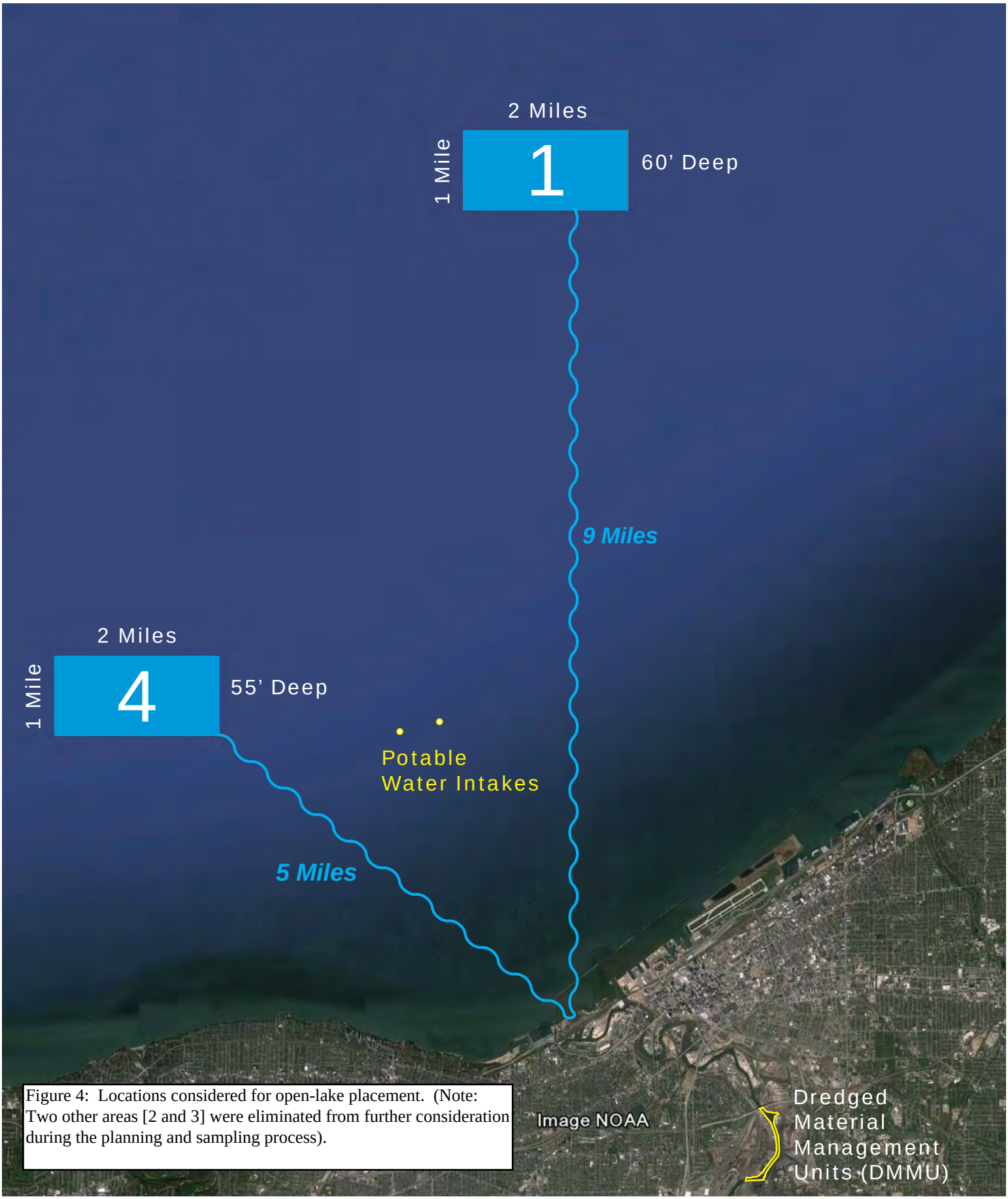

Figure 4: Locations considered for open-lake placement. (Note: Two other areas [2 and 3] were eliminated from further consideration during the planning and sampling process).

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OPERATIONS AND MAINTENANCE

OPEN-LAKE PLACEMENT OF MATERIAL DREDGED FROM CLEVELAND HARBOR FEDERAL NAVIGATION CHANNELS IN THE UPPER CUYAHOGA RIVER

CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

- **COMMENTS RECEIVED ON SIP**

From:	Robin Halperin
To:	Cleveland Open Lake
Cc:	"Rodgers, Maggie"
Subject:	[EXTERNAL] Cleveland Harbor Open-lake placement Scoping Information Packet available for review (UNCLASSIFIED) - Comments
Date:	Thursday, August 15, 2013 1:16:40 PM

The figure in your document only shows 2 of the 4 Cleveland Water intake structures. I am most concerned about the proximity of Area #4 to the location of the Crown WTP Intake and how it may affect drinking water. Please be sure to consider this intake in your evaluation. I am copying the Water Quality Manager at the Cleveland Division of Water on this email, in case you need additional information. Thanks, Robin

http://www.lrb.usace.army.mil/Missions/CivilWorks/PublicReviewDocuments.aspx

Robin Halperin
Manager of Regulatory Compliance
Northeast Ohio Regional Sewer District
(216) 881-6600 x 6465

From:	Andrea M. Salimbene
To:	Cardus, Christine M LRB; Krawczyk, Joseph W LRB
Cc:	"Tim Barber"; "Jen Lyndall"; David E. Nash
Subject:	[EXTERNAL] RE: Buffalo District Environmental Analysis Team is seeking information on the Project Icebreaker transmission cable alignment... (UNCLASSIFIED)
Date:	Thursday, August 15, 2013 3:47:33 PM

Thank you, Christine. We have reviewed and our site is several miles away from either of your sites so we should not have an issue. We appreciate you getting in touch so there are no surprises!

_____
Andrea M. Salimbene
Partner

McMahon DeGulis LLP | Direct: 614.678.5372
Cleveland | Columbus | Cincinnati

-----Original Message-----
From: Cardus, Christine M LRB [mailto:Christine.M.Cardus@usace.army.mil]
Sent: Wednesday, August 14, 2013 1:10 PM
To: Andrea M. Salimbene; Krawczyk, Joseph W LRB
Cc: 'Tim Barber'; 'Jen Lyndall'; David E. Nash
Subject: RE: Buffalo District Environmental Analysis Team is seeking information on the Project Icebreaker transmission cable alignment... (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Hi Andrea - Here is the link to our public review files - the Cleveland project is the third one in the list: http://www.lrb.usace.army.mil/Missions/CivilWorks/PublicReviewDocuments.aspx

I don't have the exact coordinates of the open-lake areas - but I can find out from someone who does.

Let me know if you have any questions about what is in our scoping document.

Christine

-----Original Message-----
From: Andrea M. Salimbene [mailto:asalimbene@mdllp.net]
Sent: Wednesday, August 14, 2013 9:01 AM
To: Cardus, Christine M LRB; Krawczyk, Joseph W LRB
Cc: 'Tim Barber'; 'Jen Lyndall'; David E. Nash
Subject: [EXTERNAL] RE: Buffalo District Environmental Analysis Team is seeking information on the Project Icebreaker transmission cable alignment... (UNCLASSIFIED)

Christine,
Thank you. I'm pleased our projects are not being planned in overlapping areas. How far north of the water intake crib is your project? Do you have longs and lats you can share? Please send me the link you mentioned once it is posted so we can review from our end. I will just plan to get in touch if we need to discuss further.

Thanks,
Andrea

_____
Andrea M. Salimbene

Partner

McMahon DeGulis LLP | Direct: 614.678.5372 Cleveland | Columbus | Cincinnati

-----Original Message-----
From: Cardus, Christine M LRB [mailto:Christine.M.Cardus@usace.army.mil]
Sent: Tuesday, August 13, 2013 3:32 PM
To: Andrea M. Salimbene; Krawczyk, Joseph W LRB
Cc: 'Tim Barber'; 'Jen Lyndall'; David E. Nash
Subject: RE: Buffalo District Environmental Analysis Team is seeking information on the Project Icebreaker transmission cable alignment... (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Looking at this map I don't think there will be any overlap of the two project areas- since our one site is to the west of the water intake and the other is well north of the intake.

The NEPA scoping document that explains the proposed Corps open-lake disposal project will be available for public review starting tomorrow afternoon - so I will forward that link once the document is posted.

Thursday afternoon works best for me if you want to discuss further.

Thanks,
Christine

Christine Cardus
Buffalo District, U.S. Army Corps of Engineers Biologist, Environmental Analysis Section
Christine.M.Cardus@usace.army.mil
716.879.4130

-----Original Message-----
From: Andrea M. Salimbene [mailto:asalimbene@mdllp.net]
Sent: Tuesday, August 13, 2013 3:10 PM
To: Krawczyk, Joseph W LRB
Cc: Cardus, Christine M LRB; 'Tim Barber'; 'Jen Lyndall'; David E. Nash
Subject: [EXTERNAL] RE: Buffalo District Environmental Analysis Team is seeking information on the Project Icebreaker transmission cable alignment... (UNCLASSIFIED)

Christine,
Hi - thank you for getting in touch. I have attached our current site plan with the anticipated cabling route. We are still investigating cabling route options so this is not yet set in stone, but it is our current best estimate. I would like to speak to you, though, to discuss your open lake placement site project.

I have wide availability on Thursday. Is there a time that day that works for you?

I would also like to include my teammate Jen Lyndall in the discussion if she is able.

Thanks,
Andrea

_____
Andrea M. Salimbene
Partner

-----Original Message-----
From: Krawczyk, Joseph W LRB [mailto:Joseph.W.Krawczyk@usace.army.mil]
Sent: Tuesday, August 13, 2013 2:24 PM
To: Andrea M. Salimbene
Cc: Cardus, Christine M LRB
Subject: Buffalo District Environmental Analysis Team is seeking information on the Project Icebreaker transmission cable alignment... (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Andrea,

Last week I had a conversation with Christine Cardus, who is copied on this message. Christine is a Biologist with the Buffalo District's Environmental Analysis (EA) Team. Christine told me that the location of a Corps open-lake placement site may coincide with the proposed alignment of the Project Icebreaker transmission cable. This came to EA's attention through recent communication with OEPA. Christine would like to open a line of communication with LEEDCO and is also requesting specific siting information for the cable route and turbines (see Christine's message below).

Similar to your communication with Bob Remmers (of our Operations and Technical Support Section), please keep me in the loop on any communications with our EA Team.

Thank you,

Joe

Joseph W. Krawczyk
Biologist
US Army Corps of Engineers
Buffalo District, Regulatory Branch

Phone: (716) 879-4186
Fax: (716) 879-4310
Email: joseph.w.krawczyk@usace.army.mil

-----Original Message-----
From: Cardus, Christine M LRB
Sent: Thursday, August 08, 2013 8:26 AM
To: Krawczyk, Joseph W LRB
Subject: Cleveland Windmill project (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Joe - I am looking for information about coordinates/locations of the proposed windmills and associated electrical lines. We want to coordinate our open-lake placement site project with them - so if you could put me in contact with someone or have them contact me at my information below I will make sure they have the necessary information about the Corps project.

Thanks,
Christine

Christine Cardus

Buffalo District, U.S. Army Corps of Engineers Biologist, Environmental Analysis Section
Christine.M.Cardus@usace.army.mil
716.879.4130

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Ohio EPA
40 years and moving forward
John R. Kasich, Governor
Mary Taylor, Lt. Governor
Scott J. Nally, Director

RECEIVED
SEP 05 2013
OHIO EPA NEDO

September 4, 2013

Lieutenant Coronel Owen J. Beaudoin
US Army Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, NY 14207

Dear Lieutenant Coronel Beaudoin:

On August 1, 2013 US ACE submitted the Cleveland Harbor (Upper Cuyahoga River Channel) Dredge Material Evaluation – 2013 document to Ohio EPA for review. On August 14, 2013, the Scoping Information Packet required by the NEPA process which compliments the above mentioned document was released as well. Both these documents support the Corps' position that open lake disposal is appropriate for much of the sediment which need to be removed annually from the Cleveland Harbor and Upper Cuyahoga navigation channel.

My staff is currently reviewing both these documents. We expect to complete review of the Cleveland Harbor (Upper Cuyahoga River Channel) Dredge Material Evaluation – 2013 document in early October and expect to provide comment on the Scoping Information Packet by September 14, 2013 as requested. Please know however, that Ohio EPA will likely be asking for additional information and\or have significant questions regarding your office's evaluation of the sediment. We will do your best to accommodate the time schedules, however, given the complexity of the review and significant change in the management approach to sediment disposal, I am concerned that this review will not be able to accommodate open lake disposal for 2014.

As you are aware, if open lake disposal is not approved for the 2014 dredge season and the sediments are disposed in the CDFs there will not be adequate CDF capacity for sediment disposal for 2015 and beyond. Fortunately, there are alternative management options contemplated by both the Cleveland Port Authority and USACE through the proposed 217 agreement and the interim dredge material management plan (IDMMP) respectively. Therefore, as I cannot yet commit to open lake disposal in 2014, I strongly encourage your office to continue to work closely with the Cleveland Port on either or both of these management alternatives. Implementation of one of these alternatives will ensure future CDF capacity which will be critical to the maintenance of the Cleveland Harbor and Cuyahoga River navigation channel.

50 West Town Street • Suite 700 • P.O. Box 1049 • Columbus, OH 43216-1049
www.epa.ohio.gov • (614) 644-3020 • (614) 644-3184 (fax)

It is important to note that even if open lake disposal does become an option for the some of the Cuyahoga sediments as proposed by US ACE, there will remain a need for CDF capacity for the foreseeable future for the material that does not meet the open lake standard. Therefore implementation of an alternative management option is necessary whether or not open lake disposal is approved.

Ohio EPA will be glad to provide any technical assistance as all parties work together to find a viable solution to this issue.

If you have any questions regarding this letter don't hesitate to contact Kurt Princic at Ohio EPA-NEDO at 330-963-1204.

Sincerely

Scott Nally
Director

Cc: Will Friedman, Cleveland Port Authority
Mayor Jackson, City of Cleveland
Kurt Princic, Ohio EPA NEDO
Dave Ramono, USACE-Buffalo
Ron Kozlowski, USACE-Buffalo

USDA

United States
Department of
Agriculture

Animal and
Plant Health
Inspection
Service

Wildlife Services

6100 Columbus Ave.
Sandusky, OH 44870

(419) 625-9093
Fax: (419) 625-8456

September 10, 2013

U.S. Army Corps of Engineers, Buffalo District
Environmental Analysis Team – Cleveland Open Lake
1776 Niagara Street
Buffalo, New York 14207-3199

To whom it may concern;

In order to further protect human health and safety related to aviation at Burke Lakefront Airport (BKL), USDA Wildlife Services (WS) would like to provide comments related to the Scoping Information Packet for Open Lake Placement of Dredged Material from Cleveland Harbor (August 2013). This is in regards to our current wildlife damage management at BKL and the USACE Confined Disposal Facilities (CDF) located there and per Federal Aviation Administration (FAA) safety guidelines for wildlife attractants near airports stated in Advisory Circular (AC) 150/5200-33B HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS dated 8/28/2007 (http://www.faa.gov/documentLibrary/media/advisory_circular/150-5200-33B/150_5200_33b.pdf).

FAA AC 150/5200-33B states that when considering proposed land uses, airport operators, local planners, and developers must take into account whether the proposed land uses, including new development projects, will increase wildlife hazards. Land-use practices that attract or sustain hazardous wildlife populations on or near airports can significantly increase the potential for wildlife strikes. The FAA recommends minimum separation criteria for land-use practices that attract hazardous wildlife to the vicinity of airports. AC 150/5200-33B states that for all airports, the FAA recommends a distance of 5 statute miles between the farthest edge of the airport's air operations area (AOA) and the hazardous wildlife attractant if the attractant could cause hazardous wildlife movement into or across the approach or departure airspace.

The proposed open lake placement sites are greater than 5 miles beyond BKL and the open lake placement method at the proposed sites is preferable to the CDF method. The concern for the open lake placement is the effect it will have on the management and focus on the existing CDFs 10B and 9 adjacent to BKL which are clearly within the 5

mile separation distance.

The USDA WS program has provided extensive assistance with wildlife-hazard management nationally to airports, communities, parks, corporations, government agencies, and private citizens. The USDA WS' National Wildlife Research Center is a world leader in wildlife damage management including the management of wildlife hazards to aircraft. Wildlife Services' expertise in the management of wildlife hazards to aviation on and near airports is acknowledged in a Memorandum of Understanding between the FAA and WS.

Through an interagency agreement with USACE, WS has been conducting wildlife management and wildlife surveys at CDF 10B since 2006 and extended these activities in Fiscal Year 2008 to CDF 12 and then CDF 9 as these CDFs were reactivated. This information provides a valuable reference of wildlife activity for future CDF management.

During discussions with the USACE, it was understood by WS that by 2013, CDF 10B would be filled to capacity and that the existing conditions attracting hazardous wildlife to the airport would be reduced or eliminated. Instead, the berms of CDF 10B were raised and material was removed to prolong the life of this CDF, in essence prolonging the existence of wetland conditions attractive to wildlife. Likewise, the berms of CDFs 9 and 12 were raised to facilitate reactivation and increased capacity for these CDFs as well creating additional, dangerous wildlife habitat immediately adjacent to BKL.

The construction and filling of CDFs 9, 10B and 12 on BKL produced protected bodies of water with nutrient-rich sediment and lush vegetation. Geese, ducks and gulls were previously attracted to temporary ponding water on BKL because it provided a feeding and loafing area that was protected during rough conditions on Lake Erie. However, the habitats created by the CDFs provide larger, more permanent protected bodies of water with much more substantial food sources. Notwithstanding the food resource, the large size of the CDFs and the surface area of the water are attracting an increased number of birds and bird species to the airport. All wildlife needs water and will seek it out where available.

In addition, the dense vegetation within the CDFs provides nesting habitat for red-winged blackbirds and other wetland-dependent birds. Insects (midges) emerging from pond sediment and swarming over the vegetation

attract swallows and other insectivorous species. The vegetation also harbors rodents and rabbits which attract predators such as coyotes and birds of prey. Lastly, the open mudflats within the CDFs provide foraging habitat for large flocks of shorebirds and loafing areas for large groups of waterfowl. All wildlife species, even very small species, are hazardous to aviation, especially if present in large numbers. According to FAA Advisory Circular No: 150/5200-33B, Table 1, some of the above referenced species groups are very hazardous to aviation safety with geese ranking third, ducks seventh, hawks eleventh, gulls twelfth, coyote seventeenth, shorebirds nineteenth, blackbirds twentieth and swallows twenty-third.

WS has communicated the need for enhanced habitat management and CDF reduction in the *U.S. Department of Agriculture, Animal Plant Health Inspection Service, Wildlife Services, Cleveland, Ohio 2012. Annual Report for Wildlife Management Activities in Confined Disposal Facility Dikes 10B and 12, October 1, 2010 through September 30, 2011.* The comments and recommendations in this report state that "Continued placement of material in the CDFs should eventually make the CDFs more manageable and less attractive to wildlife. As a CDF reaches capacity the surface material could be leveled and sloped to improve drainage and eliminate areas of standing water. Water management, ideally the complete elimination of standing water in the CDFs, should be the ultimate habitat management goal in the CDFs. A dry landscape would be accessible to standard machinery and vegetation management could be conducted.

As the CDFs are reaching capacity, WS recommends that dredge material deposition and the resulting ponding water and shallow mudflats are located on the northern sides of the CDFs. This modification will place the wildlife attractant as far from the BKL runways as possible. To accomplish this goal it may be necessary to move material from the northern side of the CDFs to the southern sides between active dredge cycles to provide a retaining basin for future dredge discharge. It is also recommended to pump as much water as possible from the CDFs between dredge cycles. It is the water that attracts the larger and more hazardous species such as waterfowl, gulls and herons."

With open lake placement, approximately 20% of dredge material will still require CDF placement. Wildlife Services is concerned that the filling of CDFs 10B and 9 will be prolonged and that the existing conditions attracting hazardous wildlife to BKL will remain unmanaged or will worsen. These CDFs are a threat to aviation safety and it is important to fill them to the extent that they become dry, solid ground such that the

vegetation can be managed with standard mowing equipment as soon as possible. With the reduced need for both CDF 10B and 9, it is recommended that focus is placed on filling at least one of these CDFs and managing the water and other habitats in the remaining CDF as recommended above. Although 80% of the dredge material may be placed directly into Lake Erie, the USACE may wish to consider placement of that material into one of the CDFs to expedite its filling and ultimate closure.

As long as active CDFs are adjacent to BKL, WS recommends using Integrated Wildlife Damage Management, which includes all legal and approved methods, to manage hazardous wildlife attracted to the CDFs adjacent to BKL. An effective Integrated Wildlife Damage Management program would include habitat management and modifications to dredge material management to reduce the attractiveness of the CDFs to wildlife. USDA Wildlife Services would be happy to provide further suggestions and expertise to that end and appreciates the opportunity to make these recommendations and to express our concerns for aviation safety at BKL.

In summary USDA Wildlife Services concerns with an open lake site for dredge material is its proximity to BKL and the potential attractiveness to wildlife that are hazardous to aviation. In the Scoping Information Packet found online both Open-Lake Area #1 and Open-Lake Area #4 appear to be beyond the FAA recommended distance of 5 statute miles between the farthest edge of the airport's AOA and the hazardous wildlife attractant. Wildlife hazards to aviation should still be taken into consideration during planning and placement of any open lake dredge site and the 5 statute mile separation distance should be strongly adhered to. Secondly, USDA Wildlife Services is concerned about the impacts open lake placement will have on the management of the active CDFs located next to BKL. Based on our experience with CDFs 9, 10B and 12 dredging activities and CDFs are hazardous wildlife attractants. Additionally any effects that delay the filling and closing CDF 10B and 9 should be avoided as these areas will be much less attractive to wildlife after they are filled and closed. These considerations are further substantiated by the Memorandum of Agreement between Federal agencies to Address Aircraft-Wildlife Strikes (http://www.faa.gov/airports/environmental/media/wildlife_hazard_mou_2003.pdf). This document includes the Federal Aviation Administration, the U.S. Army, and the U.S. Department of Agriculture among other agencies. Through this MOA, the agencies establish procedures necessary to coordinate their missions to more effectively address existing and future environmental conditions contributing to aircraft-wildlife strikes throughout the United States. These efforts are intended to minimize wildlife risks to aviation and human safety, while

protecting the Nation's valuable environmental resources.

Sincerely,

Jonathon D. Cepek
District Supervisor - Wildlife Biologist

From:	Rodgers, Maggie
To:	Cleveland Open Lake
Subject:	[EXTERNAL] Cleveland Open Lake Disposal - Cleveland Water Comments
Date:	Thursday, September 12, 2013 8:00:58 AM
Attachments:	Dredging_Locations_Intake_Overlay.pdf

Cleveland Water has reviewed the Scoping Information Packet for Open Lake Placement of Dredged Material of Cleveland Harbor Operations & Maintenance Navigation Dredging. We noted on page 3 that the USACE has completed some preliminary modeling that shows "either no or extremely minor short-term impacts at area #4" on potable water intakes. We also noted on page 4 that storm conditions could migrate the material from open lake disposal areas as shown by site specific modeling. We would like to review the sampling and modeling data, with sufficient time to analyze it, that led to these statements. We are opposed to the use of any open lake disposal sites that impact the quality of our raw water. Modeling should also include our Crown Plant intake, located South and West of area #4. The proximity of this intake is shown on the attached file. If any of the data shows that there may be an adverse impact on our water quality, we request a public hearing to voice our concerns.

Page 7 of the scoping document contains a list of Federal Environmental Laws, Executive Orders, and Policies. We were puzzled to not see the Safe Drinking Water Act on the list when proximity to Public Water System intakes in a concern.

We look forward to your response.

Maggie Rodgers
Water Quality Manager
Cleveland Water
maggie_rodgers@ClevelandWater.com
216-664-2444, ext. 5584

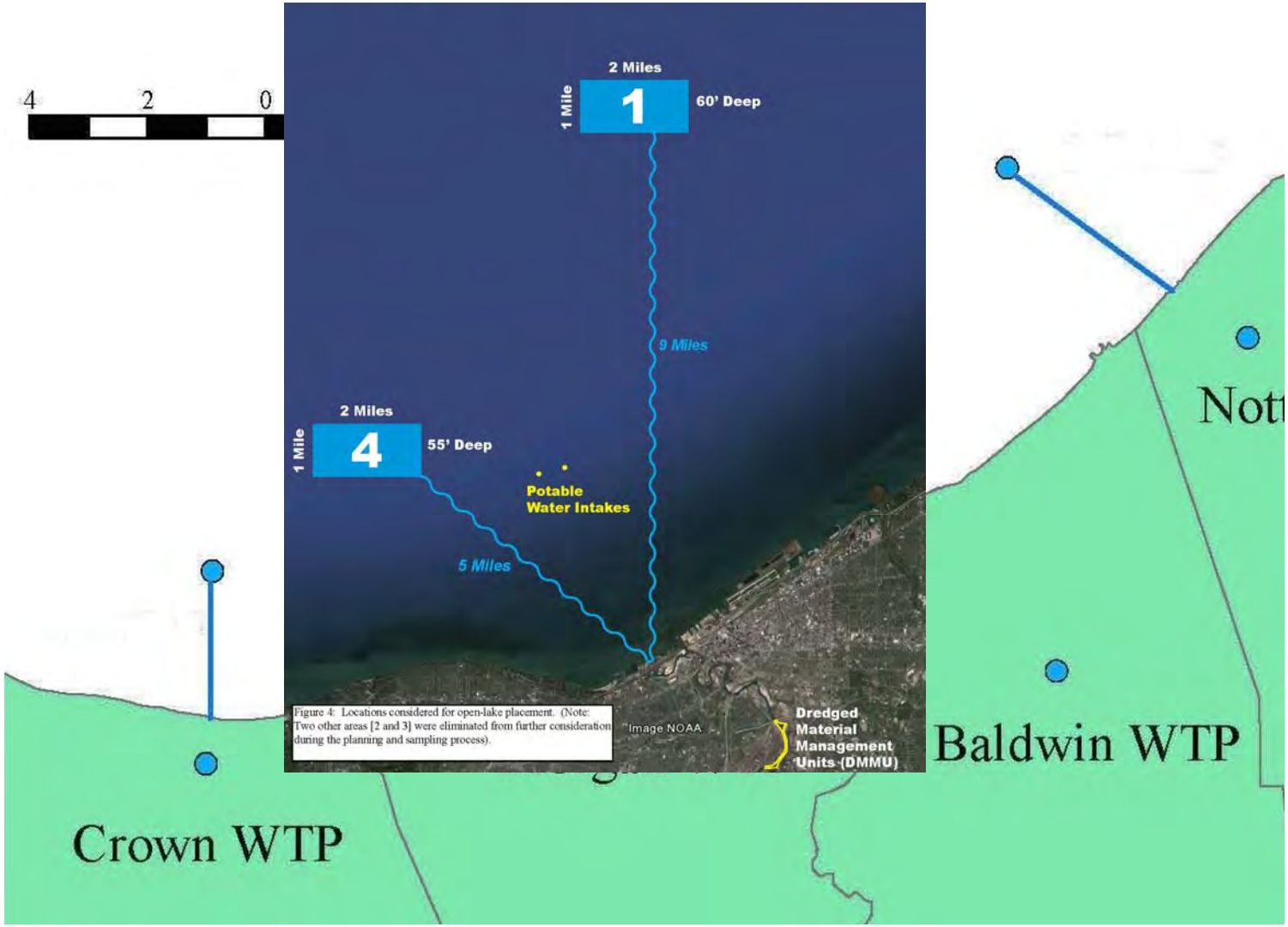


Figure 4: Locations considered for open-lake placement. (Note: Two other areas [2 and 3] were eliminated from further consideration during the planning and sampling process).

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
4625 Morse Road, Suite 104
Columbus, Ohio 43230
(614) 416-8993 / FAX (614) 416-8994

September 12, 2013

TAILS : 03E15000-2013-TA-1559

US Army Corps of Engineers, Buffalo District
Environmental Analysis Team—Cleveland Open Lake
1776 Niagara St.
Buffalo, NY 14207-3199

Dear Mr. Wargo:

This letter is in response your August 14, 2013 Scoping Information Packet for the Open Lake Placement of Dredged Material, Cleveland Harbor Operations and Maintenance Navigation Dredging, Cuyahoga County, Ohio.

The Scoping packet requests input on the U.S. Army Corps of Engineers (Corps) proposal to dredge Management Units 1, 2a, and 2b, of the Cuyahoga River channel, and to dispose of approximately 225,000 cubic yards of dredged material in one of two open-lake disposal sites in Lake Erie. Previously, this material had been placed in a Confined Disposal Facility, but sediment sampling events in recent years have indicated that the sediment is clean enough to be placed in the open lake. To satisfy the National Environmental Policy Act (NEPA), the Corps proposes to complete an Environmental Analysis (EA), considering how several alternatives will affect the human environment. The Scoping Packet identifies three alternatives: 1) No action—no open lake placement site would be selected; 2) Disposal of dredged material at open-lake area #1; and 3) Disposal of dredged material at open-lake area #4, which is the preferred disposal location.

The U.S. Fish and Wildlife Service (Service) provides the following comments for your consideration in drafting the EA:

The EA should consider a range of reasonable alternatives to the proposed action. We recommend that either within the No Action alternative or within a separate action alternative, the Corps fully evaluate an alternative that would place the dredged material somewhere besides in the lake. Alternate options for disposal locations (such as upland disposal, beneficial use, reclamation, etc.) should be fully evaluated in the EA.

The Service strongly supports efforts to reduce sediment from entering the watershed such as the use of riparian buffers, no-till farming practices, and wetland restoration upstream. Eliminating sediment inputs at the source could reduce the volume of annual dredging necessary for the navigation channel. In addition to reducing or eliminating sediment inputs at

the source, we also support the exploration and possible implementation of beneficial uses for dredged material.

In recent years, and particularly in the western basin of Lake Erie, the regulatory trend has been to try and reduce open-lake disposal of dredged material to minimize ecological impacts to the aquatic environment. This proposal, to begin a new open-lake disposal regime, appears to rebuff that trend. While the central basin of Lake Erie supports different habitat and ecosystem functions than the western basin, some of the same concerns raised about open-lake disposal would exist for both the western and central basins. In particular we are concerned about the impact of dredged material placement on the benthic habitat and species that inhabit it and the impact of sedimentation and sediment plumes on aquatic organisms in the open-lake disposal area.

The EA should thoroughly describe the habitat that currently exists within the proposed disposal areas, including any benthic, fish, or wildlife species that are known or expected to occur there. Short and long-term effects of open-lake disposal on these species and their habitats should be evaluated. Any avoidance or minimization measures implemented to protect these species should also be addressed. No in-water work should occur between April 15 and June 30 to protect fish spawning activities of interjurisdictional fish species.

The annual dredging regime should be fully described. This should include the quantity of sediment dredged on an annual, monthly, and daily basis, and how frequently material would be deposited in the open-lake site during the dredging period. For example, do dredging activities occur daily? Does open-lake disposal occur once per day, or more/less frequently during dredging operations? To fully understand the exposure of aquatic species to sedimentation and sediment plumes we must have a clear understanding of how frequently and to what extent they would be exposed. Chronic exposure to lower sediment loads may cause different effects than acute exposure to higher sediment loads.

ENDANGERED SPECIES COMMENTS: The proposed project lies within the range of the Indiana bat (*Myotis sodalis*), Kirtland's warbler (*Setophaga kirtlandii*), and piping plover (*Charadrius melodus*), federally listed endangered species. Due to the project type, size, and location, the project, as proposed, should not impact these species.

Should, during the term of this action, additional information on listed or proposed species or their critical habitat become available, or if new information reveals effects of the action that were not previously considered, consultation with the Service should be initiated to assess any potential impacts.

BALD EAGLE COMMENTS: The project lies within the range of the bald eagle (*Haliaeetus leucocephalus*), a species protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d) and the Migratory Bird Treaty Act (16 U.S.C. 703-712). Due to the project type, location, and onsite habitat, no impact to this species is expected. Relative to this species, this precludes the need for further action on this project as required by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.

Thank you for the opportunity to provide comments on this proposed project. Please contact biologist Megan Seymour at extension 16 in this office if I can be of further assistance.

Sincerely,

Mary Knapp

Mary Knapp, Ph.D.
Supervisor

Cc: Mr. John Kessler, ODNR, Columbus, OH
Mr. Steve Holland, ODNR Coastal Program, Sandusky, OH
Ohio EPA, 401 Section, Columbus, OH

Ohio EPA
40 years and moving forward
John R. Kasich, Governor
Mary Taylor, Lt. Governor
Scott J. Nally, Director

September 13, 2013

U.S. Army Corps of Engineers, Buffalo District
Environmental Analysis Team – Cleveland Open Lake
1776 Niagara Street
Buffalo, NY 14207-3199

RE: Ohio EPA Comments on the Scoping Information Packet, Open Lake Placement of Dredged Material, Cleveland Harbor Operations & Maintenance, Navigation Dredging, Cuyahoga County, Ohio

Dear Environmental Analysis Team – Cleveland Open Lake:

Thank you for allowing Ohio EPA the opportunity to provide comments on the above referenced document (Scoping Information Packet). The proposed activity to allow dredged material from the Cuyahoga River shipping channel to be placed in Lake Erie is a departure of the current practice of placing the dredged material into the confined disposal facilities (CDFs), which has been in place since 1970.

Part of the catalyst for this proposal is the fact that the existing CDFs are fast approaching their design capacity. Under current practices, the existing CDFs will reach their designed filled capacity if all of the dredged material from the 2014 dredging activities were to be taken to CDFs 9, 10b and 12. In the Scoping Information Packet, the U.S. Corps of Engineers (Corps) put forth three alternatives for placing the 2014 dredged material: placement at CLA-1 as the preferred alternative, placement at CLA-4 as the minimum degradation alternative and as the minimum degradation alternative, no open-lake placement would be selected. As stated in the September 4, 2013 letter from Director Nally to Lieutenant Colonial Beaudoin, the Corps should continue to plan for the non-degradation alternative and work with the Cleveland Port Authority on the proposed 217 agreement and interim dredge material management plan (IDMMP), respectively. As stated in that letter, "implementation of one of these alternatives will ensure future CDF capacity which will be critical to the maintenance of the Cleveland Harbor and Cuyahoga River navigation channel."

In the Scoping Information Packet, the Corps makes mention of the 2012 sampling event, which was the scheduled five-year "routine periodic operation and maintenance sediment sampling and analysis". From this sampling event, the Corps has generated a report entitled "Cleveland Harbor (Upper Cuyahoga River Channel) Dredged Material Evaluation 2013". Ohio EPA has not yet finished our review of this document but initial indications point to possible concerns over releasing PCBs and other pollutants at open lake sites. We expect to provide comments to US ACE on this document by early October.

You may also receive comments from the City of Cleveland, but it is our understanding that the Cleveland drinking water plant intakes were located 3-5 miles out into the lake. The intakes are located at this distance so as to be outside the influence of plumes from rivers, creeks, CSO's and near shore discharges. The proposed open lake disposal sites may subject Cleveland's intakes to potential plumes they would not otherwise face. Ohio EPA should be provided with the sampling and modeling data. The modeling should be based upon worst-case scenario for currents and winds including unusual current patterns.

Again, Ohio EPA appreciates the opportunity to comment on the above referenced document (Scoping Information Packet). We anticipate having a more detailed set of comments on the proposal regarding open-lake placement of dredged material from the Cuyahoga shipping channel to US ACE by early-October

If you have any questions, please do not hesitate to email me at Kurt.Princic@epa.Ohio.gov or call me at (330) 963-1204.

Sincerely,

Kurt Princic
District Chief
Northeast District Office

KP/cs

cc: Joe Loucek, Ohio EPA, DSW, NEDO
Will Friedman, Port of Cleveland

Cleveland-Cuyahoga
County Port Authority
One Cleveland Center
1375 E. Ninth St., Suite 2300
Cleveland, Ohio 44114-1790
216.241.8004 tel
216.241.8016 fax
www.portofcleveland.com

September 13, 2013

U.S. Army Corps of Engineers, Buffalo District
Environmental Analysis Team – Cleveland Open Lake
1776 Niagara Street
Buffalo, NY 14207-3199
E-mail: ClevelandOpenLake@usace.army.mil

To Whom It May Concern:

The Cleveland-Cuyahoga County Port Authority has reviewed the U.S. Army Corps of Engineers' National Environmental Policy Act ("NEPA") Scoping Information Packet for Open Lake Placement of Dredged Material in Cleveland Harbor.

Considering the continued need for CDF capacity, we remain committed to negotiating a Section 217 Tipping Fee agreement as previously detailed with USACE District, Division and Headquarters. Cleveland's harbor is an economic engine for the region and the Port remains committed to partnering with the Federal government, other agencies and all stakeholders to ensure that a cost-effective and environmentally sustainable alternative is implemented.

We also anticipate that beneficial use alternatives will continue to be a key component of the overall dredged material management approach. In 2013, the Port led specific beneficial use proof-of-concept projects and continues to refine the feasibility of dredged sediments being recycled for the benefit of the community.

Sincerely,

William D. Friedman
President & Chief Executive Officer

From:	Jan Rybka
To:	Cleveland Open Lake
Subject:	[EXTERNAL] Cuyahoga Soil and Water Conservation District comments
Date:	Friday, September 13, 2013 4:56:24 PM
Attachments:	Open Lake 0913.docx

Dear Environmental Analysis Team:

The attached comments regarding our concerns about open lake dumping of dredged sediments from the Cuyahoga River into Lake Erie are attached. We would much rather see soils beneficially reused for land applications than dumped into the lake. Furthermore, we are very concerned about the spread of harmful algae blooms in the Central Basin and hope that dredged sediments will not contribute to additional nutrient loadings.

Janine Rybka, District Administrator
Cuyahoga SWCD
6100 West Canal Road
Valley View, Ohio 44125
216-524-6580, ext. 13

Cuyahoga Soil and Water Conservation District

6100 West Canal Road
Valley View, Ohio 44125
216-524-6580 fax-216-524-6584
www.cuyahogaswcd.org

Letter by Email

September 13, 2013

US Army Corps of Engineers
Buffalo District
Environmental Analysis Team

Re: Open Lake Dumping, Cleveland

Dear Team Members:

We appreciate this opportunity to comment regarding the August 14, 2013 Scoping Information Packet on Open Lake Placement of Dredged Material for Cleveland Harbor Operations & Maintenance Navigation Dredging ("Packet"). The Packet indicates that sediment toxicity, uptake and bioaccumulation issues have been addressed through appropriate testing and that relevant Federal guidelines have been met. We are pleased with the conclusion therefrom that, "contamination and toxicity associated with the dredged material was either comparable to open-lake placement area sediments and/or placement in the open-lake would not represent any appreciable increased toxicological risk to the affected aquatic ecosystems."

However, we note that the Packet includes no indication that nutrient-related issues were addressed other than (presumably total) phosphorus being analyzed in sediment samples. Excessive nutrients, particularly phosphorus, now pose a major—and possibly the foremost—threat to the ecological health of Lake Erie. The interagency Ohio Lake Erie Phosphorus Task Force has identified increasing levels of dissolved reactive phosphorus ("DRP"), the most bioavailable form, as posing the greatest concern. As harmful algal blooms ("HABs") have been observed spreading to northeast Ohio shores in recent years', and as the lake's associated zone of hypoxia is located in the Central Basin, this threat is not limited geographically to the highly publicized situation in the lake's Western Basin. Just as in the Western Basin, both the Central Basin's aquatic ecosystem and local human health, through recreational contact with HAB-generated toxins, are jeopardized here.

We are concerned, in lieu of data supporting the contrary, that open-lake placement of the Cleveland Harbor sediments could potentially have adverse impacts on these issues. The proposed placement areas are in closer proximity to the location of the hypoxic zone than are the existing open-lake placement areas for the sediments dredged from Toledo Harbor. Also, while DRP loading in the Western Basin is dominated by input from the Maumee River, an

analogously dominant DRP source does not exist in the Central Basin, and open-lake placement here might have a greater relative impact than in the Western Basin.

As noted above, the Packet indicates that, "contamination … associated with the dredged material was … comparable to open-lake placement area sediments." However, it is not clear from the provided information that this is the case either for phosphorus in general or for DRP specifically. Our concerns could be alleviated, to at least some extent, by a demonstration of no major differences in total phosphorus and DRP concentrations measured in dredged sediments (and in their elutriates) when compared with their counterparts from the proposed placement areas. Such a showing would provide some assurance that the proposed actions will not result in significantly increased contribution of bioavailable phosphorus to areas having previously lower levels.

If significant differences do exist, though, the measured levels of total phosphorus and DRP should be compared with levels that have been associated with causing Lake Erie HABs and hypoxia. Furthermore, an evaluation of lake currents would then be warranted to determine how the currents' transport of increased phosphorus levels could potentially impact the zone of hypoxia and HABs along the shoreline.

We believe that our above recommendations constitute a minimum expectation for providing assurance that the proposed actions will not exacerbate nutrient-related ecological and human health threats in the Central Basin of Lake Erie.

Sincerely,

Janine Rybka
District Administrator

Keith Linn
Board of Supervisors

The Cuyahoga Board of Supervisors
Ruth Skuly, Chair

Fred Cash, Vice Chair

Patricia Carey, Secretary

Kevin Kubovcik, Fiscal Agent

Keith Linn, Lake Erie Central Basin Liaison

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

SEP 17 2013

REPLY TO THE ATTENTION OF:

U.S. Army Corps of Engineers
Buffalo District
Environmental Analysis Team – Cleveland Open Lake
1776 Niagara Street
Buffalo, New York 14207

Re: Comments on the Scoping Information Packet for an Environmental Assessment, Open Lake Placement of Dredged Material, Cleveland Harbor and Cuyahoga River Navigation Channel, Operations and Maintenance, Navigation Dredging, Cuyahoga County, Ohio

Dear Environmental Analysis Team:

The U.S. Environmental Protection Agency has received the request for scoping comments provided by the Corps of Engineers (Corps) dated August 14, 2013 for the development of an Environmental Assessment (EA) to evaluate proposed open lake placement of dredged material from Cleveland Harbor and the Cuyahoga River Navigation Channel. Our comments are provided pursuant to the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA implementing regulations (40 CFR 1500-1508), and Section 309 of the Clean Air Act.

In addition to evaluating a no-action alternative as required by NEPA, the Corps EA will evaluate two locations for open lake disposal in Lake Erie: Area 1 (a 2-square-mile area 9 miles north of downtown Cleveland in waters of 60-foot depth), and Area 4 (a 2-square-mile area 5 miles northwest of downtown Cleveland in waters of 55-foot depth). The Corps has preliminarily designated Area 4 as its preferred location, due to closer proximity to the harbor, with lower transportation costs and fewer weather-related transportation risks. The EA would inform a Corps decision whether open lake placement of these dredged materials would be the least cost environmentally acceptable alternative.

The Corps has indicated that, with current practices and annual sediment volumes, the existing confined disposal facility (CDF) would reach its capacity in 2014. The need for adequate capacity to manage dredged material in an environmentally-responsible and cost-effective way is critical to the ongoing navigation in Cleveland Harbor and the Cuyahoga River Navigation Channel. EPA understands the importance of dredging to the operation of the Port of Cleveland. We offer the following scoping comments for your consideration.

When the scoping information packet was released, the Corps' project timeline indicated the EA process would be completed by February 2014, in time to support implementation of a selected alternative during the 2014 spring and fall dredging seasons. We are aware of the letter that Ohio EPA (OEPA) Director Scott Nally sent to Buffalo District Commander Lieutenant Colonel Owen

Beaudoin on September 4, 2013. In that letter, OEPA advised the Corps that OEPA's complex process of reviewing sediment data and the proposal for open lake disposal may not be completed in time to accommodate open lake disposal in 2014. As you know, OEPA has authority under Section 401 of the Clean Water Act to grant or deny certification whether open lake disposal will or will not meet state water quality standards. USEPA encourages the Corps to work closely with OEPA to provide sufficient information to support the Section 401 process.

Because of the possibility that OEPA may either deny certification of open lake disposal, or not grant certification in time for the 2014 dredging season, OEPA recommended that the Corps work with the Cleveland Port Authority to evaluate interim sediment management options that could extend the useful life of the existing CDF. Based on a conversation between Corps project manager Frank O'Connor and myself on September 11, 2013, we understand that the Corps will be developing a feasibility study and decision document analyzing proposals from both the Corps and Port District for modifying practices at the CDF to extend its life. USEPA supports the evaluation of options that would optimize use of the remaining CDF capacity, reserving that capacity for those sediments too polluted to be managed in other ways. The pending EA should describe these options to provide context on sediment management for the next 5 years, and how these CDF optimization options may affect the timing of possible open lake disposal and volume of sediments targeted for open lake disposal.

USEPA has been an active participant and supporter of the ongoing Beneficial Reuse Task Force, an effort to consider opportunities to reuse cleaner sediments as an asset for commercial and/or public benefit. Beneficial reuse holds promise to reduce the volume of sediments needing disposal, while generating a product that could have value to the community. We recommend that the pending EA discuss efforts aimed at beneficial reuse and how those efforts relate to plans for open lake disposal. The proposed bed load interceptor project, which would mechanically recover cleaner sediments from the Cuyahoga River just downstream of Cuyahoga Valley National Park for beneficial reuse, should also be discussed in the EA, since it would affect the volume and quality of sediments entering the navigation channel and harbor. Likewise, ongoing efforts to remove three dams in the Cuyahoga River watershed should be evaluated in the EA for impacts to sediment volume and quality.

In 2010, EPA and Ohio EPA entered into a settlement with the Northeast Ohio Regional Sewer District (NEORSD) to address major violations of the Clean Water Act associated with combined sewer overflows into Lake Erie and area rivers. This settlement, which is being implemented over a 25-year period, calls for actions to capture and treat 98% of the wet weather flows entering the NEORSD system through construction of seven combined sewage storage tunnels, upgrades to other system components, and sewer separations. The settlement also includes the use of green infrastructure techniques to reduce wet weather loadings to the combined sewer system. As you know, urban runoff during storm events is a significant contributor of polyaromatic hydrocarbons and heavy metals affecting sediment composition in the Cuyahoga River navigation channel and Cleveland Harbor. The impacts of this CSO settlement on sediment volume and quality should also be analyzed in the EA.

As the Corps is aware, algal blooms and hypoxia have been chronic problems in areas of Lake Erie. The EA should summarize sediment characterization data for Cleveland Harbor and the

Cuyahoga River navigating channel for nutrients, such as phosphorus and nitrogen, and describe the anticipated impacts of open lake disposal on nutrient levels and the physical, chemical, and biological health of the lake in and around the proposed disposal areas.

Because Lake Erie serves as the main public water supply for metropolitan Cleveland, the EA should evaluate what impacts, if any, the proposed open lake disposal alternatives (locations and practices) would have on safe and reliable functioning of the public water supply intakes. Using modeling, this evaluation should consider the potential for placement activities to generate plumes under different weather conditions affecting winds and lake currents, including reasonably foreseeable worst-case scenarios.

Prior to the passage of the Clean Water Act in 1972, open lake disposal was a common practice in Cleveland. Sediment from that era was highly contaminated. The pending EA should evaluate whether the current proposals for open lake placement could disturb these historic sediments or affect any future remediation that might be contemplated.

USEPA had reviewed and commented on a Draft Environmental Impact Statement (EIS) for Cleveland Sediment Management in 2009. Mr. O'Connor informed me that the proposed creation of a new CDF, studied in that Draft EIS, is no longer under consideration for financial reasons. The pending EA should briefly summarize why work by the Corps on that EIS was dropped.

Thank you for the opportunity to comment on this EA scoping packet. If you have further questions, please contact me at 312-886-2910 and westlake.kenneth@epa.gov or Kathy Kowal of my staff at 312-353-5206 and kowal.kathleen@epa.gov. You may also wish to contact Brooke Furio, Director of USEPA's Cleveland office at 440-250-1705 and furio.brooke@epa.gov.

Sincerely,

Kenneth A. Westlake
Chief, NEPA Implementation Section
Office of Enforcement and Compliance Assurance

Cc: Will Friedman, Cleveland Port Authority
Kurt Princic, Ohio EPA, Northeast District Office Director

OPERATIONS AND MAINTENANCE

OPEN-LAKE PLACEMENT OF MATERIAL DREDGED FROM CLEVELAND HARBOR FEDERAL NAVIGATION CHANNELS IN THE UPPER CUYAHOGA RIVER

CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

• USACE SECTION 404(A) PUBLIC NOTICE (PN); DECEMBER 2, 2013

US Army Corps of Engineers

Public Notice

Issuing Office: CELRB-PM-EA **Published: 2 DEC 2013**
Notice No: CLEVELAND-14 **Expires: 2 JAN 2014**

OPERATION AND MAINTENANCE
DREDGING AND DREDGED MATERIAL PLACEMENT

CLEVELAND HARBOR

CUYAHOGA COUNTY, OHIO

This Public Notice has been prepared and distributed in conformance with U.S. Army Corps of Engineers (USACE) regulation, "Practice and Procedure: Final Rule for Operation and Maintenance of Army Corps of Engineers Civil Works Projects involving the Discharge of Dredged Materials into Waters of the United States or Ocean Waters," 33 Code of Federal Regulations (CFR) 337.1. Its purpose is to specify what dredged/fill materials would be discharged into waters of the United States by implementation of the proposed action, and advise all interested parties of the proposed project and provide an opportunity to submit comments or request a public hearing.

The USACE anticipates the need to dredge and place material excavated from the Federal navigation channels of the Cleveland Harbor, including the Cuyahoga River, Old River, Lake Approach Channel, and Outer Harbor Channel, in order to maintain sufficient depth for deep-draft commercial vessels. The attached maps (Figure 1a and 1b) show the authorized limits and depths of the Federal navigation channels. To insure that the minimum authorized depth in the Harbor is maintained throughout the navigation season, an additional four feet of shoal may be removed, including one foot of overdepth and three feet of advance maintenance dredging. Approximately 225,000 cubic yards of material will be dredged from Cleveland Harbor Federal navigation channels during the 2014 dredging operation.

The 2014 dredging operation at Cleveland Harbor is tentatively scheduled to be performed between April 1 and December 31.

Sediments will be removed from the channel bottom by mechanical dredge and placed aboard scows for transport to the placement areas. In previous years, clamshell and hopper dredges have been used to complete this dredging. A contractor of the Federal government will accomplish this work.

The material to be dredged from the Cleveland Harbor Federal navigation channels consists primarily of silts and clays, with some sands and gravels. In the Spring of 2012, a

comprehensive sediment testing effort was conducted on sediments sampled from the upper reach of the Cuyahoga River Channel, between Stations 799+00 (upstream Federal navigation channel limit) and 736+00 (Turning Basin), to evaluate suitability of the dredged material for open-lake placement (Figure 2). The subsequent evaluation of sediment sampling data completed in 2013 was conducted in accordance with the protocols and guidelines contained in the U.S. Environmental Protection Agency (USEPA)/USACE Great Lakes Dredged Material Testing and Evaluation Manual (1998) and Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.—Testing Manual (1998). The sediments analyzed represent approximately 80 percent of the material dredged from Cleveland Harbor on an annual basis. The evaluation concludes that discharge of this dredged material into the open-lake would not culminate in contaminant-related, unacceptable adverse impacts to the aquatic ecosystem. Therefore, it has been determined that it meets Federal "contaminant determination" guidelines (40 CFR 210.11[d]) for open-lake placement. Placement of this dredged material is proposed at open-lake areas 1 and 4 shown in Figure 3. The remaining material to be dredged from the harbor has not been determined to meet Federal guidelines for open-lake placement at this time and will therefore be placed in either confined disposal facility (CDF) No. 9 and/or 10B which are located in the Cleveland Outer Harbor (Figure 4).

In addition to showing that the dredged material met Federal guidelines for open-lake placement, the 2013 evaluation evidenced a significant net improvement in the overall quality of upper Cuyahoga River Channel sediments between 2007 and 2012. Further, the potential impacts from open-lake placement of this dredged material to the quality of water at the Crown, Morgan, Baldwin and Nottingham potable water intakes (PWIs) was investigated by the U.S. Army Engineer Research and Development Center (USAERDC). Conservative modeling showed that no meaningful contribution of any suspended solids or contaminants from dredged material placement operations at open-lake areas #1 or #4 would be expected at any of these PWIs.

Water Quality Certification (WQC) from the Ohio Environmental Protection Agency (OEPA) is required for this action, pursuant to Section 401 of the Clean Water Act. Therefore, a copy of this Public Notice has been provided to OEPA requesting WQC (or waiver thereof) for the associated discharge of dredged material at the open-lake placement areas and resultant overflow effluent from CDF Nos. 9 and/or 10B.

The environmental effects of the dredging operation are documented in the ***Final Environmental Impact Statement (FEIS), Operation and Maintenance, Cleveland Harbor, Ohio (1974); and FEIS, Harbor Maintenance and Confined Disposal Facility Site 10B, Cleveland Harbor, Ohio (1994).*** These documents, and supplemental documentation, have been submitted to USEPA and copies are available for examination at the Buffalo District office. An Environmental Assessment and Clean Water Act Section 404(b)(1) Evaluation for discharge of the dredged material at the proposed open-lake lake areas are forthcoming and will be available for public review and comment.

There are no listed historic properties or properties determined as being eligible for listing in the National Register of Historic Places that will be affected by this project. By this notice, the National Park Service is advised that currently unknown archaeological, scientific, prehistorical

or historical data may be lost or destroyed by the work to be accomplished.

The USACE has determined that the proposed project will have No Effect upon any species proposed or designated by the U.S. Department of the Interior as threatened or endangered, nor will the proposed work result in an Adverse Modification of designated critical habitat for any such species. Therefore, unless new information indicates otherwise, no further consultation pursuant to Section 7 of the Endangered Species Act Amendments of 1978 will be undertaken with the U.S. Fish and Wildlife Service.

This work will be undertaken in a manner consistent, to the maximum extent practicable, with the State of Ohio Coastal Management Program. A Coastal Management Program Federal Consistency Determination will be submitted to the Ohio Department of Natural Resources (ODNR) documenting this determination.

The decision whether to perform dredging has been based on an evaluation of the probable impact, including cumulative impacts of the proposed activity on the public interest. That decision reflects the national concern for both protection and utilization of important resources. The benefit which is reasonably expected to accrue from the proposal has been balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal have been considered including the cumulative factors thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership and, in general, the needs and welfare of the people.

This activity is being coordinated with the following agencies, as well as other appropriate Federal, State and local agencies and organizations:

Ohio Department of Natural Resources
Ohio Environmental Protection Agency
Ohio Historic Preservation Office
U.S. Coast Guard
U.S. Department of the Interior, Fish and Wildlife Service
U.S. Environmental Protection Agency

Any interested parties and/or agencies desiring to express their views concerning these proposed discharges of dredged material may do so by filing their comments, in writing, no later than 30 days from the date of this notice. Any person who has an interest which may be affected by the discharge of this dredged material may request a public hearing. The request must be submitted in writing to the undersigned within 30 days of the date of this Public Notice. The request must clearly set forth the interest which may be affected, and the manner in which the interest may be affected, by this activity.

Interested parties are encouraged to contact the USACE with their comments regarding the proposed discharge of this Cleveland Harbor dredged material. Please review this Public Notice and send your comments in writing within 30 days to the following e-mail address:

ClevelandOpenLake@usace.army.mil

or via mail to:

U.S. Army Corps of Engineers, Buffalo District
Environmental Analysis Team
1776 Niagara Street
Buffalo, NY 14207-3199
ATTN: Environmental Analysis – Cuyahoga River Dredging

This Public Notice is published in conformance with 33 CFR 337.1. All dredging and dredged material discharge will be performed in conformance with Sections 313 and 404 of the Clean Water Act (33 USC 1323 and 1344, respectively).

Martin P. Wargo, PWS
Supervisory Biologist
Environmental Analysis Team

Attachments

NOTICE TO THE POSTMASTER: It is requested that the above notice be conspicuously displayed for 30 days from the date of issuance.

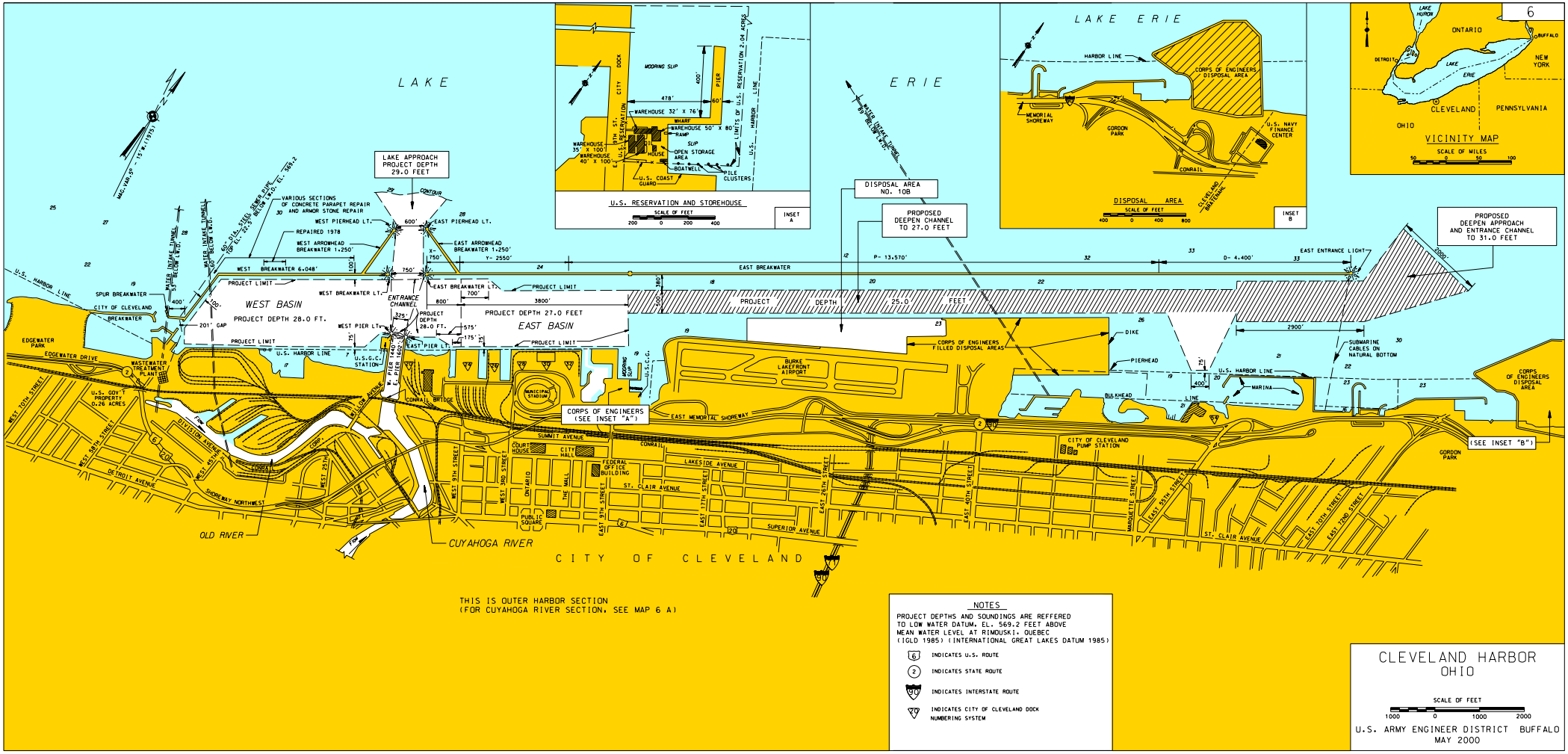


Figure 1a. Cleveland Harbor (Cuyahoga River), Cuyahoga County, Ohio (Outer Harbor)

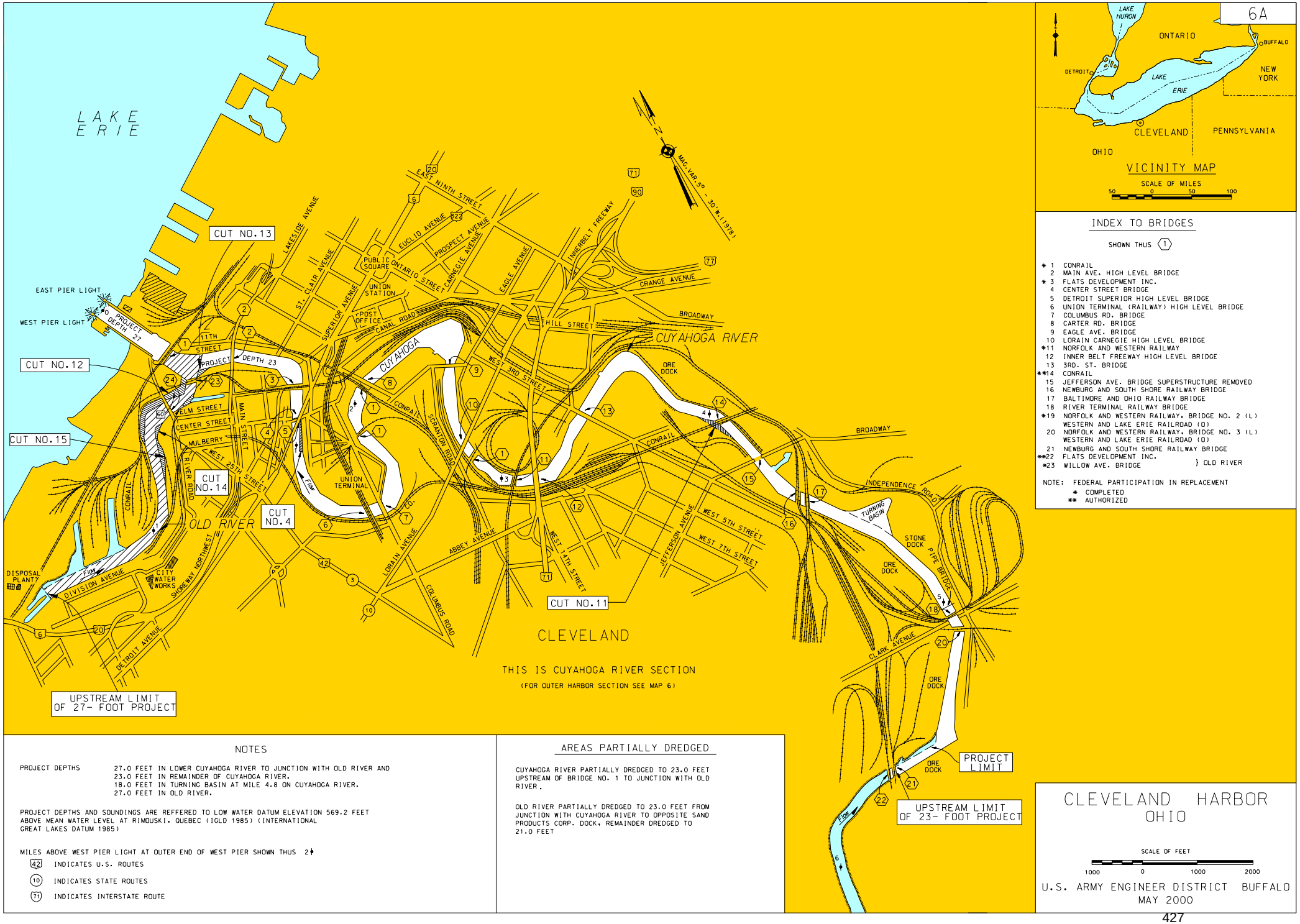
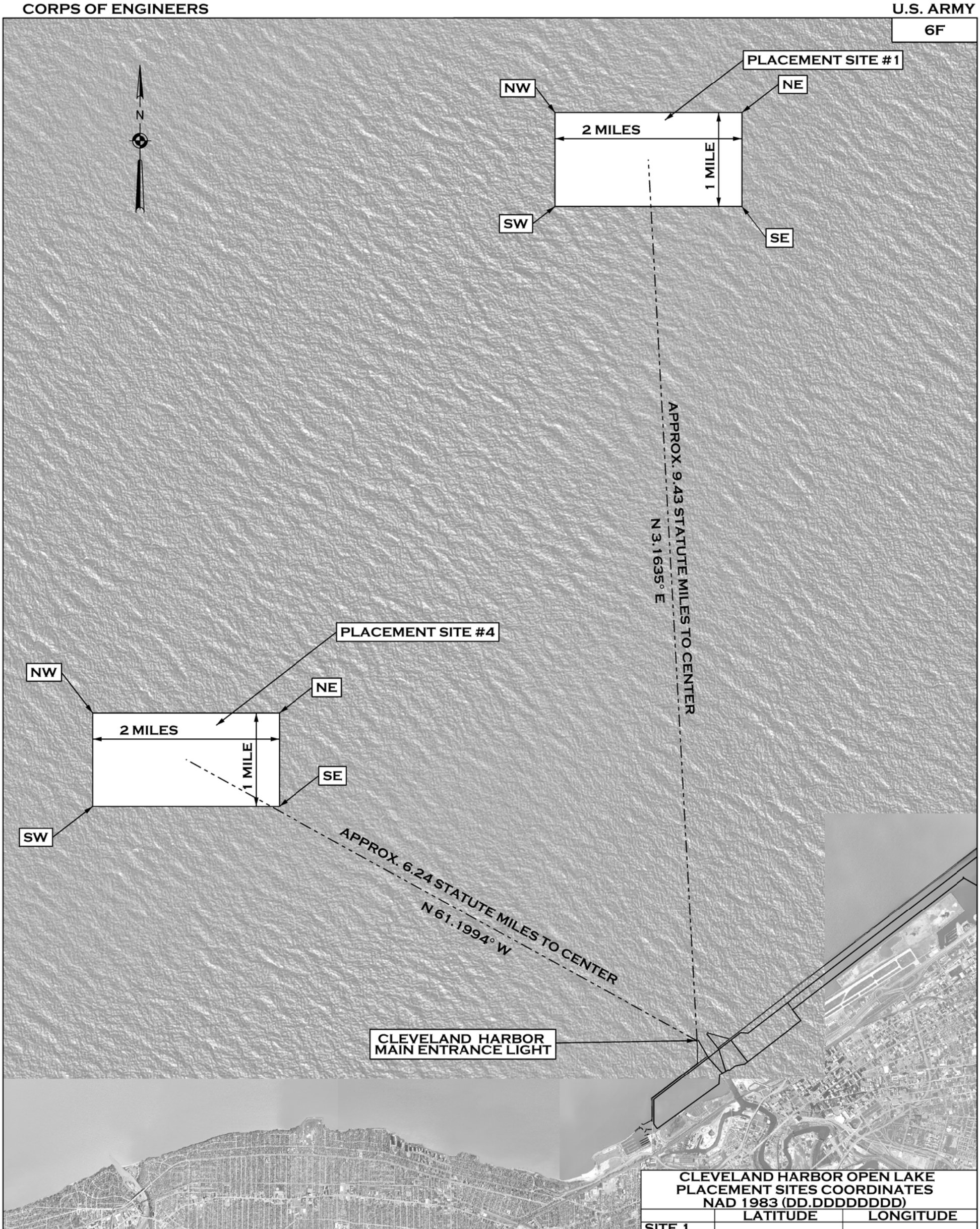


Figure 1b. Cleveland Harbor (Cuyahoga River), Cuyahoga County, Ohio (River)

Figure 2:Upper Cuyahoga River Sample Locations and DMMU Boundaries

Figure 3: Open Lake Placement Site Locations in Lake Erie, Cleveland, Ohio



CLEVELAND HARBOR OPEN LAKE PLACEMENT SITES COORDINATES NAD 1983 (DD.DDDDDDDD)		
	LATITUDE	LONGITUDE
SITE 1		
CENTER	41.645504988	81.726066535
NE	41.652619543	81.706661473
SE	41.638130041	81.706837175
SW	41.638387177	81.745467376
NW	41.652876734	81.745300230
SITE 4		
CENTER	41.553171131	81.822554593
NE	41.560302010	81.803187373
SE	41.545811921	81.803341480
SW	41.546037006	81.841917596
NW	41.560527144	81.841772022

LOCATION OF PLACEMENT AREAS WERE CALCULATED AS FOLLOWS:

1. THE LAT/LON COORDINATES WERE PROVDIED TO TD-DS IN A EMAIL FROM PM-EA ON 17 OCT. 2013.
2. THE COORDINATES WERE CONVERTED TO STATE PLANE COORDINATES USING CORPSCON AND PLOTTED IN A CADD FILE.
3. THE SOUTHWEST CORNER WAS HELD AS THE STARTING POINT WITH LINES DRAWN DUE EAST AT 2 MILES AND DUE NORTH AT 1 MILE, THEN COPIED PARALLEL TO FORM THE 2 MILE X 1 MILE SITE.
4. THE XY STATE PLANE COORDINATES OF THE CORNERS FROM THE DRAWN PLACEMENT SITE WERE THEN CONVERTED TO LAT/LON FOR INCLUSION ON THIS MAP.
5. THE BEARING AND DISTANCE TO THE CENTERS WAS CALCULATED BY DRAWING A LINE FROM THE CENTER OF THE PLACEMENT SITE TO THE LIGHTHOUSE SHOWN ON A GEOREFERENCED SID FILE OBTAINED FROM THE OHIO GRAPHICALLY REFERENCED INFORMATION PROGRAM.

CLEVELAND HARBOR
OHIO
OPEN LAKE PLACEMENT SITE LOCATION
SCALE OF MILES
1 ½ 0 1
U.S. ARMY ENGINEER DISTRICT BUFFALO
NOVEMBER 2013

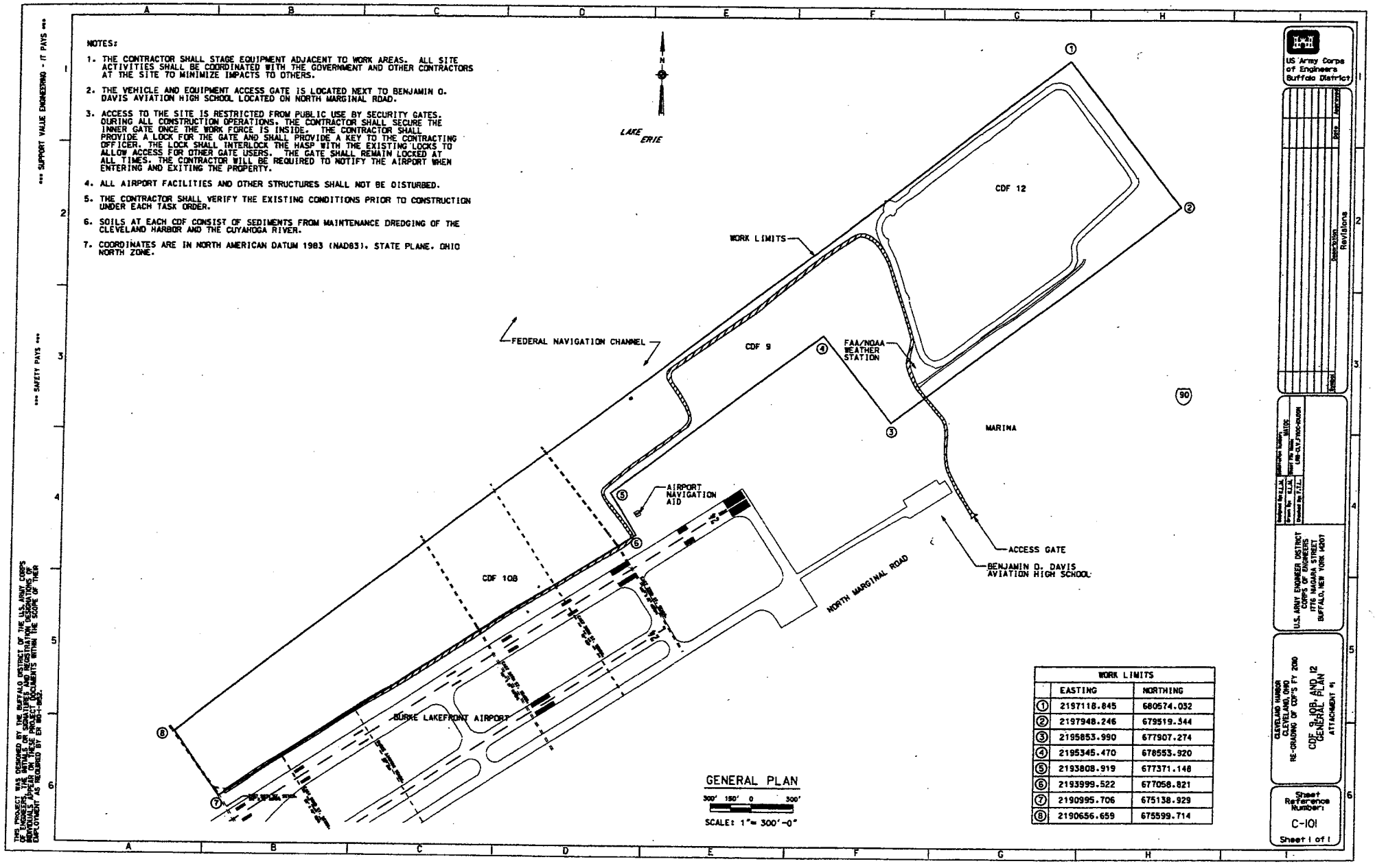


Figure 4 - Cleveland Harbor Confined Disposal Facility (CDF)

OPERATIONS AND MAINTENANCE

OPEN-LAKE PLACEMENT OF MATERIAL DREDGED FROM CLEVELAND HARBOR FEDERAL NAVIGATION CHANNELS IN THE UPPER CUYAHOGA RIVER

CLEVELAND HARBOR
CUYAHOGA COUNTY, OHIO

• COMMENTS RECEIVED ON PN

Miller, James M LRB

From: Cardus, Christine M LRB
Sent: Friday, December 20, 2013 3:00 PM
To: Pickard, Scott W LRB
Cc: Mckenna, Patrice M LRB; Wargo, Martin P LRB; Asquith, Michael LRB; O'Connor, Frank A LRB
Subject: FW: Cleveland Water Comments (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Public Notice comment from Cleveland Water

-----Original Message-----
From: Rodgers, Maggie [mailto:maggie_rodgers@ClevelandWater.com]
Sent: Friday, December 20, 2013 2:54 PM
To: Cleveland Open Lake
Cc: Margevicius, Alex; Porter, Rolfe; Haddad, Pierre; Tomasello, Shirley
Subject: [EXTERNAL] Cleveland Water Comments

Cleveland Water appreciates the opportunity to provide comment on the USACE's application for a significant portion of the 2014 Cuyahoga River dredged material to be placed in the open waters of Lake Erie.

The USACE has performed significant modeling to examine the fate of dredged material placed in the Lake and the potential impact on our potable water intakes. However, all modeling was based on 9 year old meteorological data. If only one year of data is used, then it should represent the worst case conditions. It is unknown how 2004 meteorological data compares to more recent conditions and worst case conditions. We appreciate the effort that the USACE has put into modeling, but are not convinced that there will be little or no impact on our source water quality by open Lake placement of Cuyahoga River dredged materials.

Cleveland Water remains opposed to any disposal options that could degrade our source water quality and increase our operating costs to continue delivering high quality water to our customers.

Maggie Rodgers

Water Quality Manager

Cleveland Water

maggie_rodgers@ClevelandWater.com <mailto:maggie_rodgers@ClevelandWater.com>

216-664-2444, ext. 5584

Miller, James M LRB

From: Nathan Johnson [njohnson@theoec.org]
Sent: Wednesday, January 01, 2014 5:41 PM
To: Cleveland Open Lake
Subject: [EXTERNAL] Request for Extension and Public Hearing
Attachments: OEC_Cleveland Harbor Request_1-1-2014.pdf; FOIA Request Form - OEC 12-19-13.pdf

ATTN: Environmental Analysis Team

Attached, please find the Ohio Environmental Council's request for extension of time to comment, request for public hearing, and comments relating to USACE's proposed Cleveland Harbor open-lake disposal project.

Sincerely,

Nathan G. Johnson, Esq.
Attorney
Ohio Environmental Council
1207 Grandview Avenue, Suite 201
Columbus, Ohio 43212
(614) 487-5841 (Direct)
(614) 487-7506 (T) ext. 141
(614) 487-7510 (F)
NJohnson@theOEC.org
www.theOEC.org

Ohio Environmental Council
[UNLEASHING THE POWER OF GREEN]
1207 Grandview Avenue, Suite 201
Columbus, Ohio 43212
(614) 487-7506
www.theOEC.org

January 1, 2014

U.S. Army Corps of Engineers, Buffalo District
Environmental Analysis Team
1776 Niagara Street
Buffalo, NY 14207-3199
ClevelandOpenLake@usace.army.mil

RE: Environmental Analysis – Cuyahoga River Dredging

Dear USACE Environmental Analysis Team,

The Ohio Environmental Council (OEC) respectfully requests a 30-day extension of time to submit public comments and request a hearing relating to the Corps' Cleveland Harbor open-lake disposal project, noticed December 2, 2013 and set to expire January 2, 2014.

I. Request for Extension to File Comments and Request Public Hearing.

Several factors favor our request for extension:

- Upon information and belief, open-lake disposal of Cleveland Harbor dredge material has not occurred for over four decades – thus making the proposal one of significant public interest;
- The Christmas and New Years holidays fall within the current 30-day comment period, thereby effectively shortening the public's opportunity to examine relevant documentation and formulate comments;
- In addition to making several telephone calls to USACE, OEC emailed a FOIA request to USACE, Buffalo District on December 19, 2013 requesting the operative documents listed in this project's public notice, including the 2013 Sediment Sampling Evaluation. (Copy Enclosed). As of the present date, OEC has not received the requested documentation from USACE; and
- Ohio EPA and experts commenting on behalf of the Cleveland-Cuyahoga County Port Authority have raised numerous questions about USACE's methodologies and findings relating to this project and the 2013 Sediment Sampling Evaluation that demand additional time for critical examination.

II. Request, in the Alternative, for Public Hearing.

In the alternative, should the Corps deny OEC's request for an extension of time to comment and request a hearing, OEC respectfully requests that the Corps grant a public hearing on this matter.

The mission of the Ohio Environmental Council is to secure healthy air, land, and water for all who call Ohio home. OEC has over 100 environmental and conservation member organizations and thousands of individual members throughout the state of Ohio, including nearly 400 members in the Greater-Cleveland area. OEC has a substantial interest in, inter alia:

- Preventing negative impacts to human and wildlife health;
- Preventing negative impacts to Lake Erie's aquatic ecosystems;
- Ensuring the safety of the City of Cleveland's drinking water; and
- Ensuring that state and federal water-related standards, guidelines, and regulations are met and complied with; and
- Healthy outdoor recreational fishing opportunities.

OEC has obtained comments submitted to USACE regarding this project from Ohio EPA and the Cleveland-Cuyahoga County Port Authority. Those comments indicate that USACE's Cleveland Harbor open-lake disposal project would negatively impact all of the OEC's substantial interests enumerated above. A concise overview of some of the concerns raised in those comments is provided below.

III. <u>Overview of Selected Findings from OEPA and Cleveland-Cuyahoga Port Authority.</u>

A. Contaminated Cleveland Harbor Sediments Would Cause Unacceptable Impacts.

Per OEPA's comments, the Cleveland Harbor sediments "do not meet state or federal guidelines for disposal in Lake Erie."[1] The sediment disposal would be contrary to national goals for the reduction or elimination of discharges of pollutants, including PCBs, benzo[a]pyrene, DDT, and DDE.[2]

In particular, OEPA states that the proposed sediment disposal "would cause unacceptable impacts to the aquatic ecosystem and to human and wildlife health, and would exacerbate existing impairment to the Lake Erie region's commercial and recreational fisheries and tourism industries."[3] Specifically, several classes of contaminants in the Cleveland Harbor sediments are "above thresholds of concern and are likely to cause toxicity to aquatic organisms and increase already existing risks to human, avian, and wildlife consumers of fish."[4] Per OEPA, the sediment disposal would "substantially increase fish tissue PCB contamination."[5]

B. USACE Methodology Is Seriously Flawed.

The OEPA and Port Authority reviews call USACE's chosen methodology into serious

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[1] October 4, 2013 Letter from OEPA Director Scott Nally to Dave Ramano of USACE (hereinafter "OEPA Letter"), Appendix 1, p. 2.
[2] OEPA Letter, Appendix 1, p. 27.
[3] OEPA Letter, Appendix 1, p. 26.
[4] OEPA Letter, Appendix 1, p. 11.
[5] OEPA Letter, Appendix 1, p. 27.

question, on numerous grounds. Per OEPA, the methodology used by USACE was "contrary to the best available science and guidance."[6] Specifically, OEPA identifies the following problems:[7]

- Selection of contaminated sediment reference sites;
- Omission of important ecological data, prevailing scientific consensus, and key guidance specific to the Great Lakes;
- Selection of under-protective toxicological endpoints which artificially reduced the apparent toxicity of the Cleveland Harbor sediments. Specifically, USACE omitted to evaluate chronic toxicity, evaluating only acute toxicity. OEPA found that the sediments in question "present a clear risk of chronic toxicity to the aquatic ecosystem."[8]

In addition, two sets of comments submitted on behalf of the Port Authority call USACE's methodology and findings into question. One set of comments notes a "major concern" with the sediment sampling method; specifically, the project proposes to dredge sediment in depths of feet, but sampling was only conducted to a depth of inches.[9] Another set of comments submitted on behalf of the Port Authority concludes that "USACE does not appear to have sufficient data or analyzed the current data correctly to make informed decisions on the quality of the sediment for open lake placement or the disposal location."[10] The same set of comments notes that samples were only collected from the center of the river channel and not from locations near channel edges; furthermore, that replicate sampling was not conducted.[11]

C. The Project Creates Unnecessary Risks for City of Cleveland's Drinking Water.

Both OEPA and Port Authority comments note that proposed open lake disposal sites present unnecessary risks to the City of Cleveland's water supply system. OEPA notes that risks relating to disposal and the unmarked status of city water intakes could ultimately result in the severe hampering of water service; that open lake disposal so close to Cleveland's water intakes may negatively impact the city's SDWA source water protection status, which could result in significant financial impacts to the city; and that none of Cleveland's four treatment plants currently have the technology required to remove PCBs and PAHs from the water supply.[12] OEPA recommends that alternatives to open-lake disposal be used, such as upland disposal or continued use of confined disposal facilities (CDFs).[13] OEPA also notes that the Port Authority determined in 2012 that mechanically unloading sediments could extend the expected life of CDFs by 20 years.[14]

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6 OEPA Letter, Appendix 1, p. 2.

7 OEPA Letter, Appendix 1, p. 6.

8 OEPA Letter, Appendix 1, pp. 10-11.

9 John Peck, Professor of Geosciences, University of Akron, "Review of Cleveland Harbor (Upper Cuyahoga River Channel) Dredged Material Evaluation – 2013."

10 September 9, 2013 Letter from Stephen E. Duirk, Assistant Professor, Department of Civil Engineering, University of Akron (hereinafter Duirk Letter).

11 Duirk Letter.

12 OEPA Letter, Appendix 2.

13 OEPA Letter, Appendix 2.

14 OEPA Letter, Appendix 2.

Port Authority comments state that increased ammonia could result in elevated concentrations of carcinogenic DBPs in drinking water or, alternatively, insufficient disinfection of water-borne pathogens.[15] Port Authority comments also note that wind driven currents could cause fine sediment particles to stay suspended in the water column and reach the drinking water plant intakes.[16] Per the same comments, this could "increase the City of Cleveland's coagulant usage and potentially expose residents to dredge material contaminants."[17] The comments recommend that CLA-4 not be considered as a disposal site due to its proximity to the drinking water treatment intakes.[18]

IV. Conclusion.

For the aforementioned reasons, OEC respectfully requests a 30-day extension of the comment period and opportunity to request public hearing (currently set to expire January 2, 2014). Alternatively, should OEC's request for extension be denied, OEC respectfully requests that a public hearing be held on the present matter.

Based upon the evidence currently before it, OEC opposes USACE's proposal to dispose of contaminated sediments in the Cleveland Harbor area.

Sincerely,

Nathan G. Johnson, Esq.
Attorney
Ohio Environmental Council
1207 Grandview Avenue, Suite 201
Columbus, Ohio 43212
(614) 487-5841 (Direct)
(614) 487-7506 (T) ext. 141
(614) 487-7510 (F)
NJohnson@theOEC.org
http://www.theoec.org/

[15] Duirk Letter.
[16] Duirk Letter.
[17] Duirk Letter.
[18] Duirk Letter.

BUFFALO DISTRICT FOIA REQUEST FORM

Complete, SAVE and Print this document.
Mail, FAX or E-Mail completed document to:

Agency is generally allowed 20 business days to respond to requests.

FOIA Officer/FOIA Coordinator
Office of Counsel
USACE, Buffalo District
1776 Niagara Street
Buffalo, NY 14207-3199
Email:Michele.e.papaj@usace.army.mil
Fax (716) 879-4292
Phone (716) 879-4184

Date of Request: 12/19/2013

Requester Name/Company: Ohio Environmental Council

Telephone: 614-949-6622

Address: 1207 Grandview Avenue, Suite 201

Columbus, Ohio 43212

Email Address: NJohnson@theOEC.org

1. Pursuant to the Freedom of Information Act, 5 USC 552, and Department of the Army Regulation 25-55, I request these records: (Use back of form or attach additional pages if more space needed. Include any information to locate records, such as file number, permit number address location information and/or parties involved).

I request electronic copies of the following records (all listed in USACE's 2014 Cleveland Harbor Notice):

1. 2013 Sediment Sampling Evaluation;
2. Final Environmental Impact Statement (FEIS), Operation and Maintenance, Cleveland Harbor, Ohio (1974);
3. FEIS, Harbor Maintenance and Confined Disposal Facility Site 10B, Cleveland Harbor, Ohio (1994);
4. and "supplemental documentation" referenced in the 2014 Cleveland Harbor public notice document as having been submitted to USEPA.

2. Requester understands that fees may be charged for search, review, and/or duplication of records requested above. Fees are $20 per hour for clerical level search and review and $44 per hour for professional level search and review. Copies are $.15 for each printed side of a duplicated copy and $.25 for each printed side of microfiche copy. (Please check one)

☐ Requester agrees to pay any statutory costs for providing these records.

☒ The Requester agrees to pay up to $___40.00___ (fill in dollar amount) for these records. Please notify if costs exceed this amount.

☐ Please notify Requester if there will be any charges before fulfilling this request.

3. Please check one:

☐ Call Requester to pick up material

☒ Mail records to Requester. ***<u>PLEASE EMAIL RECORDS TO REQUESTER</u>.***

, Attorney

Signature of Requester (and title if representative of organization)

Miller, James M LRB

From: barbaramartin2001@juno.com
Sent: Wednesday, January 01, 2014 4:40 PM
To: Cleveland Open Lake; gruberwl@aol.com
Subject: [EXTERNAL] Comments and Request for a Public Hearing from Dike 14 Nature Preserve Committee
Attachments: Dike 14 NPC, Comments to ACOE, January 1, 2014.pdf

DIKE 14 NATURE PRESERVE COMMITTEE

To: **ClevelandOpenLake@usace.army.mil**

ATTENTION: Environmental Analysis – Cuyahoga River Dredging

From: Barbara A. Martin, Chair, Dike 14 Nature Preserve Committee

William M. Ondrey Gruber, Vice Chair, Dike 14 Nature Preserve Committee

Date: January 1, 2014

RE: ***Comments and Request for a Public Hearing -***

OPERATION AND MAINTENANCE DREDGING & DREDGED MATERIAL PLACEMENT,

CLEVELAND HARBOR, CUYAHOGA COUNTY, OHIO

Please find **ATTACHED** the *Comments and Request for a Public Hearing from the Dike 14 Nature Preserve Committee.*

Thank you.

Barbara A. Martin, Chair
Dike 14 Nature Preserve Committee
63 East Grand Street

William M. Ondrey Gruber, Vice Chair
Dike 14 Nature Preserve Committee
2714 Leighton Road

Berea, OH 44017
(440) 243-9070
barbaramartin2001@juno.com

Shaker Heights, OH 44120
(216) 371-3570
GruberWL@aol.com

How to Sleep Like a Rock
Obey this one natural trick to fall asleep and stay asleep all night.
peaklife.com

DIKE 14 NATURE PRESERVE COMMITTEE
P.O. BOX 81031, CLEVELAND, OHIO 44181

January 1, 2014

ClevelandOpenLake@usace.army.mil
Environmental Analysis Team
U.S. Army Corps of Engineers, Buffalo District
1776 Niagara Street
Buffalo, NY 14207-3199
ATTENTION: Environmental Analysis – Cuyahoga River Dredging

RE: Comments and Request for a Public Hearing -
OPERATION AND MAINTENANCE DREDGING & DREDGED MATERIAL PLACEMENT, CLEVELAND HARBOR, CUYAHOGA COUNTY, OHIO

Pursuant to the Public Notice – CLEVELAND-14, issued by CELRB-PM-EA on December 2, 2013, the **Dike 14 Nature Preserve Committee** (the "Committee") is submitting the following comments and request for a public hearing concerning the declared intent of the Army Corps to discharge dredged material into the "open-lake" waters of Lake Erie during 2014.

We are concerned about the proposal of the Army Corps for open-lake disposal, and the lack of a comprehensive environmental assessment. We are also concerned that the public has not been fully informed or been given an adequate opportunity to consider and comment upon the Army Corps proposal. The issuance of the Public Notice between Thanksgiving and the Christmas/New Year's holidays, and requirement that comments and requests for a public hearing be submitted within 30 days, by January 2nd, is insufficient to allow the public to be informed and have a realistic chance to opine on this critical issue for the citizens of Northeast Ohio. Thus, we provide limited comments below, and urge the Army Corps to hold a public hearing.

The Dike 14 Nature Preserve Committee is a grassroots organization in Northeast Ohio that has advocated and organized since 2001 for the preservation and development of the former Confined Disposal Facility (CDF) previously known as Dike 14 as a nature preserve. Today Dike 14 is known as the Cleveland Lakefront Nature Preserve, which is free and open to the public, and serves as a natural area for a wide variety of wildlife.

The Committee continues to advocate for the appropriate use and maintenance of the habitats of the Nature Preserve, and for protection of the surrounding waters of the Lake and the adjacent upland park areas. For example, the Committee strenuously opposed the proposal several years ago by the Cleveland-Cuyahoga County Port Authority that the Army Corps construct an over-sized CDF at East 55th Street on the lakefront just west of the Nature Preserve for the ultimate purpose of creating a mega-port industrial facility. This massive facility would have had a severely negative impact on the Nature Preserve, on the wildlife that lives or visits there, on the human visitor experience, and on the surrounding waters of the Lake.

Also, the Committee for many years has closely followed and participated in the various meetings and processes under which the Army Corps and Port Authority have studied and considered the dredging needs of Cleveland Harbor and the Cuyahoga River, and how and where to dispose of the dredged material.

The Committee has a keen and ongoing interest in the issue of dredging and how the dredged material is disposed of, and in the protection of the waters of Lake Erie from further degradation and negative impacts on wildlife, especially migratory birds, and including waterfowl. Thus, the Committee has an interest in promoting and protecting healthy aquatic life in Lake Erie, particularly off of Northeast Ohio, and in both aesthetic and recreational values of and along Lake Erie. Aquatic life, including waterfowl, are endangered by algae growth, and the presence of toxic algae. This scourge also is detrimental to the aesthetic and recreational values we seek to protect.

The Committee has the following specific concerns:

1. The Ohio EPA, in its comments dated October 4, 2013, has raised significant issues and concerns that Army Corps should address and the Corps' response should be publicly available. Without this response it is difficult, if not impossible, to thoroughly understand and comment on the Corps' proposal.

2. No Environmental Assessment has yet been conducted for this proposed Project, yet we must submit comments without having such assessment to inform our comments.

3. The Corps, along with the Port Authority, Ohio EPA and other agencies have discussed and considered various beneficial uses of dredge material. This proposal for open-lake dumping of the material is in conflict with these efforts and appears to be premature, and certainly is not part of a published comprehensive dredge management plan.

Considering the gaps in the information available to the public, the Ohio EPA's concerns and critiques of the proposed Project, and lack of time and notice to allow for adequate public comment, the Committee strongly urges the Army Corps to hold a public hearing on the Project proposal.

Sincerely,

Barbara A. Martin

Barbara A. Martin, Chair
DIKE 14 NATURE PRESERVE COMMITTEE
63 East Grand Street
Berea, OH 44017
440-243-9070 (h) 440-476-3841 (c)
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Bill Gruber

William M. Ondrey Gruber, Vice Chair
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GruberWL@aol.com

Miller, James M LRB

From: Tebbe, Sarah [Sarah.Tebbe@dnr.state.oh.us]
Sent: Friday, January 17, 2014 9:09 AM
To: Cleveland Open Lake; Cardus, Christine M LRB
Cc: Kessler, John; Baldridge, Paul; Ware, Andrew; Gilbert, Shelby
Subject: [EXTERNAL] 13-612 USACE - Cleveland Harbor Dredging FY14 Comments
Attachments: 13-612 Cleveland Harbor Dredging FY14 Comments.pdf

Christine,

Please see the attached comments.

Thanks,

Sarah Tebbe
ODNR office of REALM
Phone: 614 265 6397

Office of Real Estate
Paul R. Baldridge, Chief
2045 Morse Road – Bldg. E-2
Columbus, OH 43229
Phone: (614) 265-6649
Fax: (614) 267-4764

January 17, 2014

Christine Cardus
U.S. Army Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

Re: 13-612; Cleveland Harbor Dredging – FY14

Project: The project involves the maintenance dredging of the Cleveland Harbor and open lake placement of the associated dredged material.

Location: The project is located in Lake Erie, at the mouth of the Cuyahoga River, in Cleveland, Cuyahoga County, Ohio.

The Ohio Department of Natural Resources (ODNR) has completed a review of the above referenced project. These comments were generated by an inter-disciplinary review within the Department. These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the National Environmental Policy Act, the Coastal Zone Management Act, Ohio Revised Code and other applicable laws and regulations. These comments are also based on ODNR's experience as the state natural resource management agency and do not supersede or replace the regulatory authority of any local, state or federal agency nor relieve the applicant of the obligation to comply with any local, state or federal laws or regulations.

Fish and Wildlife: The Division of Wildlife (DOW) has the following comments.

The proposed project, located in the Cuyahoga River and Cleveland Harbor, Cuyahoga County, Ohio, is in a location identified as eligible for Statewide In-Water Work Restrictions associated with Percids (ex. walleye *Sander vitreus*). The DOW recommends no in-water work from March 15 to June 30 to reduce impacts to indigenous aquatic species and their habitat. If specific Best Management Practices (BMPs) to reduce the impacts of sediment resuspension are incorporated into the proposed project, the project may qualify for a waiver of a portion or all of the In-Water Work Restrictions. Please contact DOW for information on specific BMPs that might be implemented.

The ODNR Natural Heritage Database has a record on the I-90 Bridge over the Cuyahoga River for a nesting Peregrine falcon *(Falco peregrinus*), a state threatened species and a federal species of concern. As well as being a state threatened species, Peregrine falcons are protected by the Migratory Bird Treaty Act (MBTA). Harassment or disturbance of nesting peregrine falcons that interferes with the survival of young, eggs, or adults is prohibited. The contractors in the area should also be aware that Peregrine falcons can be territorial. Should the contractor encounter a peregrine falcon during the dredging project, the contractor must immediately notify the project engineer. Within 24 hours, the project engineer must

notify Jennifer Norris (DOW State Peregrine Coordinator), at 614 301 2639 or419-602-3141 (cell phone). Due to the type of work proposed, the project is not likely to impact the species.

The project is within the range of the Indiana bat (*Myotis sodalis*), a state and federally endangered species. The following species of trees have relatively high value as potential Indiana bat roost trees: Shagbark hickory (*Carya ovata*), Shellbark hickory (*Carya laciniosa*), Bitternut hickory (*Carya cordiformis),* Black ash (*Fraxinus nigra*), Green ash (*Fraxinus pennsylvanica*), White ash (*Fraxinus americana*), Shingle oak (*Quercus imbricaria*), Northern red oak (*Quercus rubra*), Slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), Eastern cottonwood (*Populus deltoides*), Silver maple (*Acer saccharinum*), Sassafras (*Sassafras albidum*), Post oak (*Quercus stellata*), and White oak (*Quercus alba*). Indiana bat habitat consists of suitable trees that include dead and dying trees with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. If suitable trees occur within the project area, these trees should be conserved. If suitable habitat occurs on the project area and trees must be cut, cutting must occur between October 1 and March 31. If suitable trees must be cut during the summer months, a net survey must be conducted between June 15 and July 31, prior to cutting. Net surveys shall incorporate either two net sites per square kilometer of project area with each net site containing a minimum of two nets used for two consecutive nights, or one net site per kilometer of stream within the project limits with each net site containing a minimum of two nets used for two consecutive nights. If no tree removal is proposed, the project is not likely to impact this species.

The project is within the range of the piping plover (*Charadrius melodus*), a state and federally endangered bird species, and the Kirtland's warbler (*Setophaga kirtlandii*), a state and federally endangered species. These species do not nest in the state but only utilize stopover habitat as they migrate through the region. Due to the type of work planned, this project is not likely to impact these species.

The project is within the range of the Canada darner (*Aeshna canadensis*), a state endangered dragonfly. Due to the type of work planned, this project is not likely to impact this species.

The project is within the range of the black bear (*Ursus americanus*), a state endangered species. Due to the mobility of this species, the project is not likely to impact this species.

The project is within the range of the king rail (*Rallus elegans*), a state endangered bird. A statewide survey has not been completed for this species. A lack of records does not indicate the species is absent from the area. Nests for this species are deep bowls constructed out of grass and usually hidden very well in marsh vegetation. Therefore, if this type of habitat will be impacted, construction must be avoided in this habitat during the species' nesting period of May 1 to August 1. Due to the type of work planned, this project is not likely to impact this species

The ODNR Natural Heritage Database has no other records for rare or endangered species at this project site. We are unaware of any unique ecological sites, geologic features, animal assemblages, scenic rivers, state wildlife areas, nature preserves, parks or forests, national wildlife refuges or other protected natural areas within the project area. Our inventory program does not provide a complete survey of Ohio wildlife, and relies on information supplied by many individuals and organizations. Therefore, a lack of records for any particular area is not a statement that rare species or unique features are absent from that area.

Natural Areas: The Division of Natural Areas and Preserves has the following comments.

The state-threatened *Potamogeton richardsonii*, Richardson's Pondweed, has been documented to occur in Cleveland Harbor. According to information stored in the ODNR Division of Wildlife's Natural Heritage Database, *Potamogeton richardsonii* was last documented in 1991. Based on

data stored within the Natural Heritage Database, *Potamogeton richardsonii* mayno longer qualify for state-threatened status and could be de-listed to potentially threatened in 2014. If you encounter this plant during the project, please contact Tom Arbour of the Division at 614-265-6575.

Coastal Management: The Office of Coastal Management has the following comments.

Pursuant to the Coastal Zone Management Act of 1972, as amended, and its corresponding federal regulations, the project may not proceed until a Federal Consistency concurrence is issued by ODNR. As of December 24, 2013, a Federal Consistency Determination has not been received for this project. To ensure Consistency with the applicable enforceable policies of the Ohio Coastal Management Program, an Ohio Environmental Protection Agency *401 Water Quality Certification* must be obtained for this project.

ODNR appreciates the opportunity to provide these comments. Please contact John Kessler at (614) 265-6621 if you have questions about these comments or need additional information.

John Kessler
ODNR Office of Real Estate
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Columbus, Ohio 43229-6693
John.kessler@dnr.state.oh.us